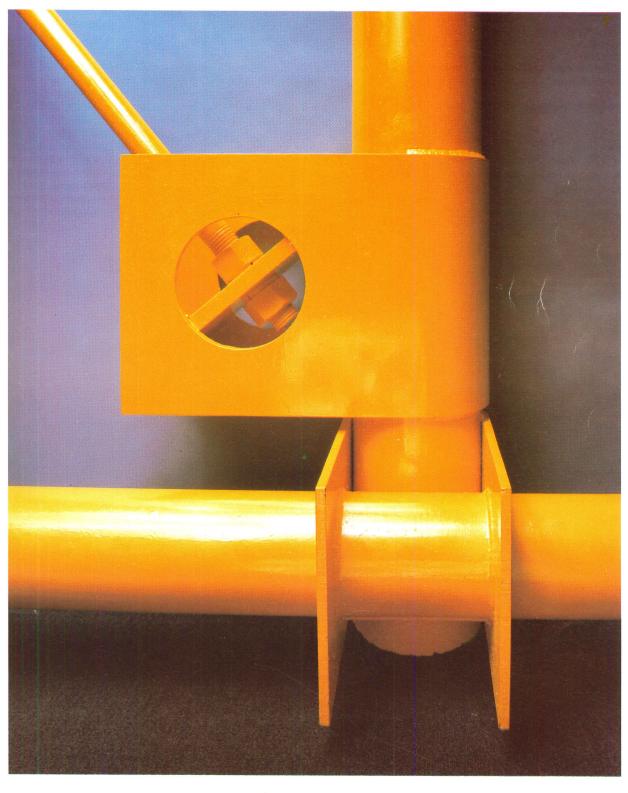
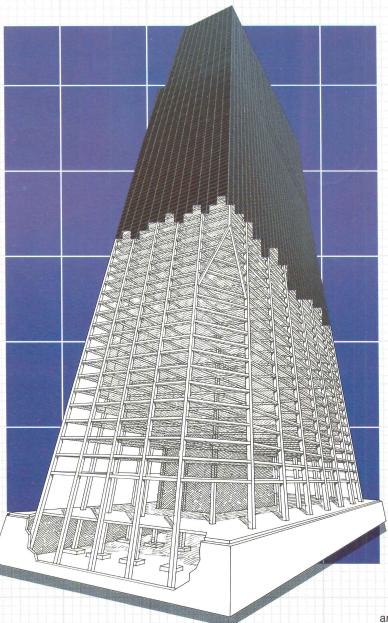
ARCHITECTURAL

# FALL 1984 THE AMERICAN INSTITUTE OF ARCHITECTS



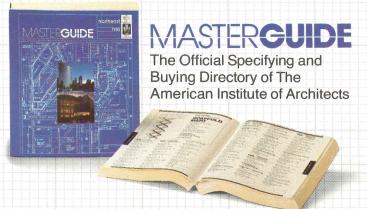
IKOY'S INDUSTRIALIZED BUILDINGS

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ARCHITECTURAL
THE AMERICAN INSTITUTE OF ARCHITECTS

DESIGN ♦ PRACTICE ♦ MANAGEMENT ♦ REVIEW ♦ REPORT

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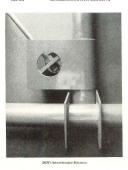
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#### TECHNOLOGY



sense of design and close attention to detail to produce exciting architecture from standard industrial parts. Our cover shows the bright yellow flange assembly that anchors wind braces in IKOY's Manitoba offices. Forrest Wilson's provocative introduction to IKOY is on page 6. IKOY principals Ronald Keenberg, James Yamashita and Donald Blakey explain their theories and techniques beginning on page 8.

IKOY Architects combines a keen

#### PERSPECTIVE

### USEFULNESS

ONTRIBUTORS MAKE MAGAZINES, SO LET'S TAKE A WALK through this issue and I'll make the introductions. Forrest Wilson's author's credit tells you he is director of the doctoral program in architecture at Catholic University, but Forrest is one of those people not easily defined by a title. He's best known for the illustrations in his books, which manage to convey serious issues like structural design through a series of powerful but witty graphics, but he is also an accomplished scholar, sculptor and writer. He has studied industrialization for many years, and edited a book on the subject by Richard Bender.

Armed with dozens of color photos of IKOY buildings, Forrest had no trouble convincing us that IKOY's approach to industrialized building design could be applied broadly and profitably by our readers. Forrest's former student Ron Keenberg and associates Jim Yamashita and Don Blakey came through with a clear and cogent explanation of their design theories. IKOY's buildings are eloquent testimony to the validity of the theories: clean and exciting design, expressed in working drawings so clear that bids come in within a 2 percent spread; constructed on time and often under budget, and ready for adaptive reuse.

IKOY's theory evolves from a multi-disciplinary, integrated approach to building design that involves owners, engineers, product manufacturers and contractors from the outset. The multi-disciplinary theme sounds again in the article by Bill Fisher and Sandy Shaw, which summarizes the "lessons learned" from DOE's Commercial Passive Solar Buildings Program. The U.S. Department of Energy discovered that the passive solar designs that work best are those that are produced with generous input from engineers, contractors, owners and occupants early in the design process. Fisher, who as a technical consultant to DOE has tracked the projects through the five-year program, and Shaw, who as a project manager for the AIA Foundation has responsibility for disseminating data from the DOE research, have done a superb job of translating the reams of program results into a short list of "Do's and Don'ts" for designers.

ARCHITECTURAL TECHNOLOGY brings readers ideas and techniques that they can apply immediately. That's why John Loss' article on the Architecture and Engineering Performance Information Center (AEPIC) includes forms for contributing to and requesting information from this important new data bank. John Loss, like Forrest Wilson, teaches and remains an active progressive force in the profession. He and Don Vannoy of the engineering school at the University of Maryland have worked with some of the leading thinkers in the design professions to establish an international repository for performance information on all types of structures. It's an ambitious effort that will succeed if building industry professionals support it.

AIA's Practice Department (particularly the codes and standards program) worked with Loss and Vannoy over the last two years as AEPIC evolved into an operational data bank. We think that the best way to continue support for AEPIC is to give our readers everything they need to start using it. The rest is up to you.

Ann Nydele's article in this issue on "The Architect as Employee" is the first in a series on "Power, Compensation and the Image of Architects." It marks a departure in business management coverage, in that it addresses issues of concern primarily to the staff architect, rather than the owner. Nydele, a market communications specialist who has worked for a number of design firms and magazines, points out that progressive firms work hard to establish good employee relations as a prerequisite for providing good service to the client, which in turn assures a stable niche in the marketplace.

"Affordable CAD" is Oliver Witte's latest dispatch from the frontiers of computer science, where the big news is that computer-aided design is within the financial grasp of every architect. Oliver and 14 AIA members from the Midwest spent more than six months reviewing six CAD programs that can be run on garden-variety microcomputer systems for a total investment of less than \$15,000, including hardware, software and peripherals.

Bruce Patty, FAIA, one of the founders of this magazine, considers computerization to be the future of this profession, and has announced that providing AIA members with the information they need to make the transition will be a major priority of his presidency in 1985. Oliver's article in this issue is the first of many we expect to carry to help guide our readers through the thickets of "computerese." The best guides are other practitioners, which is why Oliver organized your colleagues to try the programs and share their experience with you.

We like our articles about products to go beyond the usual descriptions to include market information, and good coverage of potential problems in detailing and installation. Stephanie Stubbs and Maureen Cunningham didn't find many problems with glass block, but they did uncover plenty that's new: the testing of a Japanese seismic detailing system for glass block in San Francisco's new DataMart building; use of energy-saving reflective glass block on the spectacular INTELSAT building under construction here in Washington; and the availability of exciting color and pattern choices from foreign manufacturers.

Usefulness is the most important criterion in selection of our editorial content. Please let us know how we can make this magazine more useful to you.

Karen Hass Smith



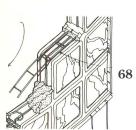




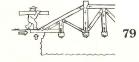
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- ART COMES FROM BEING RESPONSIBLE FOR WHAT YOU BUILD An introduction to IKOY Architects By Forrest Wilson
- Industrialized Buildings: Our theories and techniques BY RONALD KEENBERG, JAMES YAMASHITA AND DONALD BLAKEY AS TOLD TO FORREST WILSON Principals of a Canadian firm explain how they use standard industrial parts to produce clean and exciting designs; simplified and accurate working drawings;

rapid, low-cost construction; and flexibility for adaptive reuse.

- LESSONS LEARNED FROM DOE'S COMMERCIAL PASSIVE SOLAR BUILDINGS PROGRAM BY WILLIAM J. FISHER, AIA AND ALEXANDER SHAW Fourteen major design lessons learned from the U.S. Department of Energy's five year, \$3.2 million study of 21 non-residential passive solar buildings tracked from pre-design through occupancy.
- 28 FINALLY—A DATA BASE ON BUILDING PERFORMANCE DYSFUNCTIONS AND FAILURES BY JOHN LOSS, AIA Forms for contributing to and requesting information from the Architecture and Engineering Performance Information Center are included in this article explaining the organization and functions of the new data bank at the University of Maryland.

#### MANAGEMENT

- THE ARCHITECT AS EMPLOYEE . . . OR WHAT WE DO FOR LOVE BY ANN NYDELE Career management guidance for employees, and employee relations information for owners.
- 42 AFFORDABLE CAD BY OLIVER R. WITTE Six CAD systems costing less than \$15,000 are evaluated by 14 architects. Includes an introduction, write-ups on each program, a features comparison chart, advice about hardware and peripherals, cost comparisons with other CAD systems, and a glossary.

#### REVIEW

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## Letters to the Editor

#### Advice and dissent

As a full-time architect and part-time technologist I am heartened by your attempt to bring a sense and understanding of technology into the practice of architecture. . . . Any attempt to bring a more scientific and technological basis into the profession can only help increase the image of the profession in the eyes of the rest of the community and should therefore be applauded and promoted.

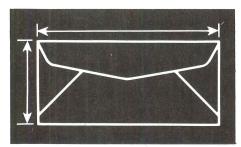
. . . It is for this reason that I was very disappointed in the article on photovoltaic systems in the Spring 1984 issue. I have to assume that the rationale for the article was to promote the use of photovoltaic systems by the profession. However, a brief analysis of the cost effectiveness of such systems seems to indicate that for any area east of the Mississippi river the return on investment for a residential structure even with some very favorable assumptions (i.e., a cost of \$200-\$300/sq. meter) is in the vicinity of 2 percent a year. This is not sufficient for any investment! I also queston the guideline 80 percent utilization factor. I assume a 50 percent utilization factor in view of the fact that the normal family will be home and utilizing the electrical output of the photovoltaic system for a maximum of 50 percent of the hours of the year when the sun is shining. In addition, I find the estimate of useful life 20–30 years to be extremely generous, especially in the northern climate with severe winters.

. . . why should the AIA waste valuable time, money and effort in the promotion of a concept which is really only financially feasible and applicable to the eastern mountain states which contain at best 10 percent of our total population? Why not spend more time investigating the efficiency of office buildings, factories, etc., places where people work and where a return on investment can be very substantial and beneficial to the community as a whole?

—Walter Ś. Lincoln, AIA Assistant Vice President Manager/Design Services Urban Investment and Development Co. Chicago, Ill.

First the roses. I am enjoying Technology and find most of the material interesting and stimulating. Keep up the good work.

Now for the bricks. In the article "Photovoltaics Design and Project Guide" by



George Royal, your illustration on page 39 omits a large piece of the United States. I happen to know that photovoltaic systems are in use in Alaska to provide power for remote locations. They power railroad crossings and relay stations. I'm sure there are many opportunities for their use in the Hawaiian Islands. . . . Those of us in Alaska and Hawaii are really offended by the continued omission of our states from maps showing the country. When this is done by some remote bureaucrat we usually pass it off and consider the source, but when our friends ignore us it is too much to let pass. . . .

R.N. Hesseltine CCS AIA/CSI Anchorage, Alaska

I have just finished reading Gary Hall's article "Wired for Change" (Spring 1984) and feel that I must make a comment from the client's viewpoint. When we completed construction on our new headquarters facility three years ago, the poke-through system had been installed to provide for power, task lighting, electronics and communication (PLEC). It had been proposed by the designers as the least expensive and most flexible system available. Both points are true, but the problem arises several years later following several departmental reorganizations that the floor slab begins to look like Swiss cheese. At this point we have lost most of our flexibility because unless we can utilize a previously abandoned poke-through we cannot drill another for fear of so weakening the structure to risk floor collapse. At which point we would have preferred that a system of cellular duct, underfloor duct, or access floor had been installed. The point of my letter is that the architect should look at not only the cost and ease of installation/ reinstallation, but also the long-range effect on the structure when making recommendations of PLEC systems.

—John C. Reese, AIA First National Bank Cincinnati, Ohio Your brief summarization of the research work conducted by William Murry and Kathleen Underwood ("Management by Textbook," Spring 1984) with respect to the efficacy of "management techniques" in design firms, does a disservice to the design profession. . . . I met with Mr. Murry and had the opportunity to review a considerable portion of the work he produced in conjunction with Ms. Underwood. . . . While I think the research project in question has assembled a considerable body of valuable information, the conclusions drawn by the researchers have produced an unfortunate and unnecessarily harsh view of the value of advanced management techniques within design firms. . . . My review of the researchers' summary data leaves me with the following viewpoints which are at odds with those of the researchers:

 As design firms increase in size, there is a greater tendency for advanced management techniques to be present. . . .

■ As these management techniques are implemented successfully in a growing firm, they assist that firm in maintaining desirable standards of performance under increasingly difficult circumstances. . . .

To suggest that "management techniques" are ineffective for firms of any size fails to recognize the very real differences that exist among firms of varying sizes. A firm of 10 may never reach (or remain) the size of 50 if certain internal mechanisms do not exist. And, that firm of 50 may never reach (or remain) the size of 100 if additional adjustments are not implemented at the appropriate point. . . . Every firm must carefully evaluate its own growth objectives and the degree of 'formal management' that is required at each stage along the way. . . . Unfortunately, the "typical" design professional would ordinarily seek to avoid "more management" in favor of "less." This article mistakenly gives the impression that "less" management is viable in most cases. And that is a very dangerous impression indeed-especially for firms that wish to grow larger.

—Robert P. Smith, AIA
President, The Robert P. Smith Company
Atlanta, Ga.

Having just completed some research on my own on computer-assisted scheduling software, I was interested in Mr. Krawczyk's article "Computer-Assisted Scheduling for Architects" in the Spring 1984 issue. While providing a reasonable review of several software packages, I suspect the "Project Scheduling Primer" on page 71 does not provide enough of the basics of network scheduling to enable the average architect to make anything out of the article. . . . I have used "CPM in Construction Management," by James J. O'Brien, P.E., as my basic reference, and have found that it provides an excellent history and basic knowledge of network scheduling.

—Don A. Walters, AIA
Staff Manager-Architectural
Administration
Southwestern Bell
St. Louis, Mo.

I would like to thank you for including PRO-JECT 6 in your review of project management systems (Spring 1984). I found the article fair and informative. However, I would like to point out a few inaccuracies in the features comparison chart. PRO-JECT 6 was shown as having a task capacity of 150 activities for \$199. In actuality, PRO-JECT 6 comes in three sizes with three separate costs. We have provided a 75 task version for \$99, a 150 task version for \$149, and a 250 task version for \$199. It was also indicated that PRO-JECT 6 cannot send reports to a disk file. PRO-JECT 6 is capable of sending printed reports to a disk file in ASCII format. This feature allows PROJECT 6 to interface with such popular programs as LOTUS's 1-2-3, MicroPro's WORDSTAR, FUNK Software's SIDEWAYS program and others.

—Mark A. Billitteri Vice President SoftCorp Clearwater, Fla.

Author's response: The system capacities, section C-1, only specify the task capacity of 150. I stand corrected in that the printer output can be routed to a disk file for further processing.

We appreciated the opportunity to have our product, MicroPERT O, reviewed by your publication. Although your reviewer found our package "not easy to use," our first three reviewers thought it was easy to use and I guess that three out of four isn't too bad.

Our own view was that MicroPERT O could be friendlier, and Version 3 of that product, which we are now shipping, has a number of changes that address that issue.

They include an online Help facility and a tutorial on project networking.

Apparently, the reviewer tried to review too many packages in too little time, because a number of factual errors about our product crept into the review. Some of the errors indicate confusion between our product and some of the others. MicroPERT O uses the "activity-on-arrow" networking method since it lends itself to the production of timescaled network diagrams (logic charts). Contrary to the review, we are the only product reviewed that displays this type of chart. All of the charts and reports produced by Micro-PERT O can be displayed on the screen or on a printer. The screen displays of both the charts and reports do use color on a color display, but only to isolate the activities on the critical path. Other than the time-scaled network diagram, MicroPERT O is not intended to have "advanced features," which I presume refers to cost and resource facilities. MicroPERT O is intended and is advertised as a "time-only" scheduling package. .

–Leland C. Sheppard Owner and Developer Sheppard Software Company Redding, Calif.

Author's response: MicroPERT O is the only package reviewed that has a time-scaled logic chart. Both Harvard Project Manager and PMS have logic charts that are not time-scaled. The review did not differentiate between the time-scaled and non-time-scaled charts.

The chart on page 72 was incorrect in stating that MicroPERT is a "time and resource" program; it covers "time only." The chart also failed to indicate MicroPERT's ability to allow multiple starts and finishes.

#### MUSIC TO OUR EARS

I have just taken the opportunity to read, from cover to cover, the Spring issue and was moved by its excellence to write this addition to your "Good Words for Good Works" file.

. . . those of us who often question where our AIA dues are going had some serious doubts about the value of this new publication. This issue certainly has convinced me that whatever that initial investment was, it was worth it. I think you and your staff deserve special praise for producing a magazine that is of such value to the prestige of the Institute, the enlightenment of the membership, and the state-of-the-art of the profession. . . .

-Frank Musica, associate member, AIA Washington, D.C.

. . . Unlike the Virginia gentleman who thought it too basic, I found many useful articles in your magazine. As a newly licensed sole proprietor of a small firm there are many things that I am unable to have contact with . . . day-to-day. . . . This journal helps to fill the gaps in my knowledge and education. . . .

-Mike D. McNally, AIA Mike D. McNally Architect Pacific Grove, Calif.

. . . Although I'm not an architect, but a structural engineer, I am very interested in architecture. I greatly enjoyed Frasca's article, "Don't Call it Post-Modern," as well as "Quake Codes" by Christopher Arnold. I'll encourage my architect-clients to read it. Perhaps the most valuable part of Technology is the Report section, with timely items which could get buried or missed by larger publications. . . . Keep up the good work!

–Ralph Kratz Interactive Resources Inc. Point Richmond, Calif.

. . . I wanted to express to you what a terrific publication I have found Technology to be. It puts light on subjects which are not covered in many other architecture and design magazines, and I find myself taking it apart and putting the articles into our resource file. . . .

-William F. Yarger, AIA Yarger Associates Inc. St. Louis, Mo.

... The Spring of '84 issue is jam-packed with the type of information that I have heard our members pleading for ever since I have been connected with AIA. Your no-nonsense and straight-forward approach to the graphics is right in line with what is needed for a periodical of this type. If you keep this up, we will have to save every issue of this publication as architects will be referring back to various articles for years to come. . . .

—George A. Allen, CAE Executive Vice President Florida Association/AIA Tallahassee, Fla.

## ART COMES FROM BEING RESPONSIBLE FOR WHAT YOU BUILD

BY FORREST WILSON

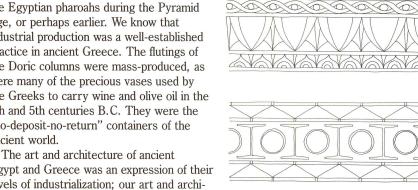
IKOY (eye-koy), a Canadian architectural firm with offices in Winnipeg and Regina, has developed a unique approach to industrialized building technology—an approach that results in outstanding design, relatively lowcost and high-speed construction, easier building maintenance, and extreme flexibility that readily accommodates changes in building use. The approach involves fundamental changes in the design and construction process, which, if broadly applied, could revolutionize the relationships among architects, engineers, contractors, product manufacturers, and building owners and users.

Since definitions of building industrialization are as diverse as those who define it, and almost as plentiful as definitions of technology, it is best that we start by defining terms.

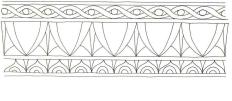
Industrialization as postulated here is the rationalization of production, in which complex tasks are reduced to simple ones, which, gathered together, produce complex products in large quantities.

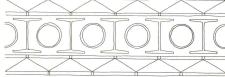
There is nothing new about this process. It probably began with the making of bricks. Gordon Childe tells us industrialization can be traced to the great funerary workshops of the Egyptian pharoahs during the Pyramid Age, or perhaps earlier. We know that industrial production was a well-established practice in ancient Greece. The flutings of the Doric columns were mass-produced, as were many of the precious vases used by the Greeks to carry wine and olive oil in the 6th and 5th centuries B.C. They were the "no-deposit-no-return" containers of the ancient world.

Egypt and Greece was an expression of their levels of industrialization; our art and architecture similarly reflects our level of industrialization.









IKOY's methods are not new, but their process is. These architects have gained undisputed control of technology by recognizing the precise state of industrialization in their time, and designing to take maximum advantage of industrialized processes without pushing them beyond their current limits. They have considered the peculiarities of modern industrial labor, and the factors affecting the availability, purchase and repair of its products. Their position is no longer that of "master builder"—if such a position ever existed; they are masters of assembly.

IKOY Principal Ron Keenberg says the cornerstone of this concept is visualization of the building as a building—not as a function. The building may be a bank today, a school tomorrow, an office complex the day after that, and end up as a home for homeless aardvarks-but it remains a building.

The peculiar attribute of buildings in our time is that they are activated by electrical and mechanical systems. IKOY considers recognition of this fact to be an unavoidable design imperative. But such recognition is not achieved in the preciousness of "high tech" design, or through wanton exposure of the building's private parts—brightly painted waste lines and decorated sewer pipeswith all the taste of a flasher presenting his dubious charms to the maiden of his choice. Designers instead must actively use all the parts of the building as an architectural expression. The building should be de-mystified for its users, and express the excitement inherent in a vibrant, functioning, lived-in machine. If bright colors help accomplish this, so much the better.

A building must be designed in recognition of the skills of the labor force that will manufacture and construct it. The long-predicted development of industrialized labor skills has indeed occurred in our time, due to increasing industrial sophistication, and the ultimate computerization of production processes. But the point that IKOY has grasped and others have not is that the new skills are not shared equally.

Forrest Wilson, Ph.D is a professor of architecture and director of the doctoral program at Catholic University in Washington, D.C.



The competency of today's average worker is as hard to judge as the sanity of a psychologist with one foot in the fire and the other on a block of ice who claims, "on the average, I am comfortable." Industrialization has given us a similarly deceptive average level of competency. Those on the lower end of the skills hierarchy have become less and less competent. The typical assembler in today's industrial plant knows much less than an apprentice 20 or 30 years ago. Although the U.S. Department of Labor describes them both as semi-skilled, there is no comparison. The semi-skilled apprentice of the past had at least three or four years of job experience. Today's semi-skilled worker may have learned what he or she knows in a few hours or weeks, and the job demands no more. In contrast, the skills of architects, engineers and industrial designers have become increasingly complex. The skill divisions and differences between designers and workers widen daily, leaving designers increasingly out of touch with the contractors' concerns.

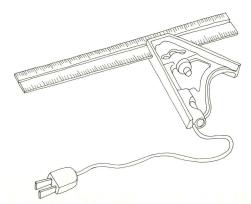
IKOY has accepted these conditions, and with them the responsibility for the entire building process, from the first client contact to delivery of a finished industrialized building and beyond. They assume responsibility for the fact that a building is a building, and

its uses will change, yet it must remain a viable capital investment. They limit design decisions by working only with materials and components that work well, are readily available and will be easy to replace and repair.

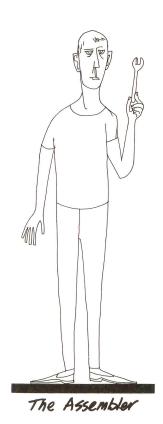
"A good architect can make any material look good," Keenberg says. "Only designers who are unsure of themselves rely on expensive chromes and marbles to cover up their lack of design skill."

IKOY has proven its system works; the firm's buildings look good, work well, go up quickly, and costs are usually under budget. Their success presents us with attractive professional possibilities. They have shown that designers can function as the masters of assembly, when architects work with and respect engineers and engineering science. IKOY's approach could, if widely adopted, place responsibility for manufactured products where it belongs—with manufacturers, who control the industrialized manufacturing process in their factories. Manufacturers of factory-produced building components should be willing to guarantee them for 15 or 20 vears—as they will guarantee other industrialized parts. Such a guarantee would be a striking improvement upon the one-year warranty given by the typical contractor.

Richard Rogers and Partners in England generally work without contractors, and coordinate with manufacturers through a project management company to prepare shop drawings. They have had considerable success in obtaining long-term guarantees



ARCHITECTURAL TECHNOLOGY

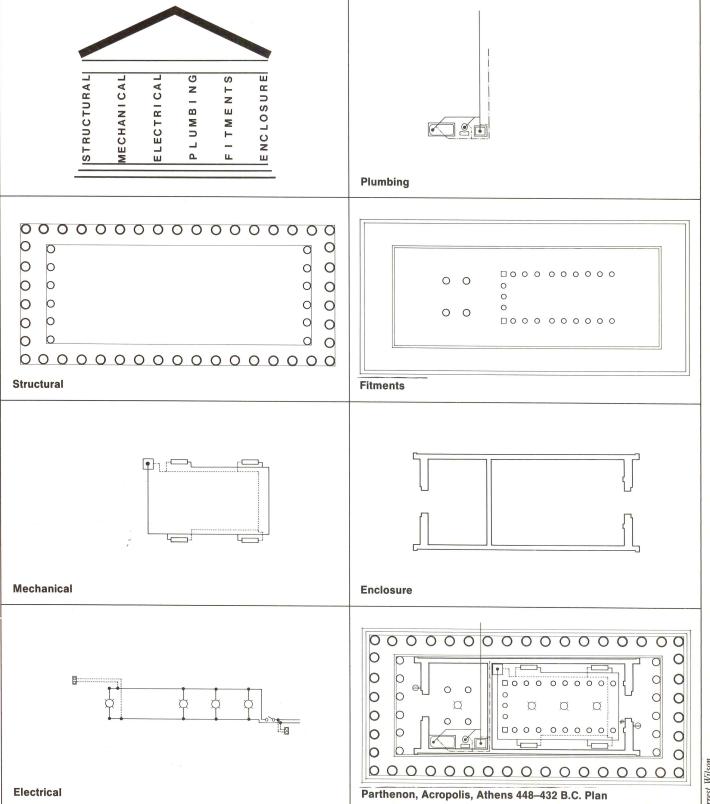


from the manufacturers. IKOY is beginning to get longer guarantees from the Canadian and American manufacturers they work with. Their superstructures are factory-made and site-assembled, and have a lifetime guarantee. Their raceways and switch gear also come completely assembled from the factories, and they have succeeded in obtaining a five-year guarantee from the switching gear manufacturer.

At a time when design architects and engineers are advised by their lawyers not to visit the building site for fear of litigation, IKOY presents a refreshing, aggressive alternative.

Ron Keenberg, Jim Yamashita and Don Blakey, the three IKOY principals interviewed for this article, do not claim that this is the only way to do good architecture. They do say, as did Corbusier, that their method makes bad architecture more difficult.

All good architecture throughout time has been done in an unself-conscious way, with the technology available at the time. The Greeks didn't even have a word for fine art; they had a word for technique, and the quality of technique. In the Cathedral-building age, the designers were master masons. Art comes from being responsible for what you build.



## Industrialized Buildings: Our theories and techniques

BY
RONALD KEENBERG, JAMES YAMASHITA, AND DONALD BLAKEY
AS TOLD TO FORREST WILSON

THE KEY TO EFFICIENT ECONOMIC design and construction is to realize that buildings consist of only six components, rather than a collection of building details like doors and windows and fine marble trim. Architecture is made by designing these component parts to perform their functions to meet the needs of the most essential building component—the people within the building.

#### THE SIX-COMPONENT SYSTEM

Buildings can be visualized as a collection of industrially produced elements—a six-component system, including:

- Planning System
- Structural System
- Mechanical System
- Electrical System
- Skin (or enclosure)
- Fitments

Some of the systems include both elements that are primary and rarely moveable, and elements that are secondary, moveable and easily changeable.

#### Primary systems define matrix

The placement of the primary elements defines the basic matrix of the building. The primary structural system generates the matrix.

The primary planning system determines the main movements (of services and humans) within the building, and the building's potential functions in the future. A primary planning system might include an elevator and stairwell and spine; other parts of the planning system are moveable. The mechanical and electrical systems include the main mechanical plant, transformers,

Ronald Keenberg, James Yamashita and Donald Blakey are principals at IKOY Architects in Winnipeg and Regina. switching gear and primary raceways that are not moveable, and ducts, pipes, raceways, troughways and moldways that are.

The skin or enclosure is a system that encloses the other systems, but does not depend on the matrix of the other five systems. Partitions and fitments are by definition not permanent and therefore must be designed to meet that definition.

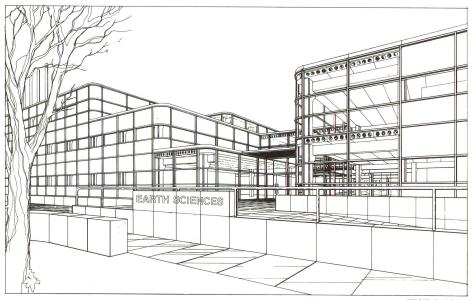
#### THE DESIGN PROCESS

Designing primary structural, planning, mechanical and electrical systems involves a series of simultaneous choices regarding each component. Engineering systems are architectural and thus an integral part of the initial concept in an IKOY design. The customary practice of asking engineers to design the structural, electrical and mechanical systems after the architect has developed the design imposes the engineer-

ing systems on the architecture, and compromises the potential flexibility of the building. The engineering systems in this instance are not part of the initial design process, but something that is threaded through it after the fact, which disrupts the architectural direction.

We select, design, locate and detail the engineering systems as an original part of the architectural concept of a building, locating them in the building to best serve their program function and react to future change.

We believe that the architect must design the mechanical system, consulting with the engineer to determine the best applicable technology for the building type, with an understanding of and respect for the principles of the systems the engineers describe. The architect selects the primary system and its form of distribution at the outset of the design process. The engineer proportions it—mathematically sizes it.



**IKOY Architects** 

#### IKOY's building sites are assembly sites

Engineers normally connect things so that they work, and then hide them because architects do not like to see them. The engineer achieves a mathematically correct connection, but he or she does not design a visual connection. An engineer can tell you that there are 50 to 100 different ways that members can be connected.

Architects must understand, respect, and work with these elements without compromising the engineer's mathematical proportioning. The engineer must direct the architect toward the principles of connections. When the architect understands this, then he or she can design connections, and the engineer can make minor modifications. Architects have to study industrial design to learn how machine connections are made.

## THE ARCHITECT AS PURCHASING AGENT

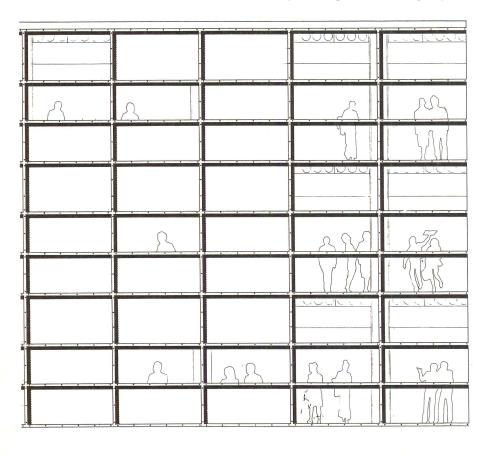
Very early in the design process we decide what materials and components we are going to use, so we never find ourselves in the position of having specified a product in a size that we cannot find. We use only standard industrial parts. Everything we use is manufactured by several North American firms. If only one firm manufactures a component we will not touch it. They could go out of business, not replace parts, or not deliver.

Value is added by purchasing wisely for the client—making sure that the client gets the most for his or her money by selecting the best products to go into the building. Wise purchasing means better quality and function. Frivolous decisions diminish the amount of money that can be spent on important parts of the building.

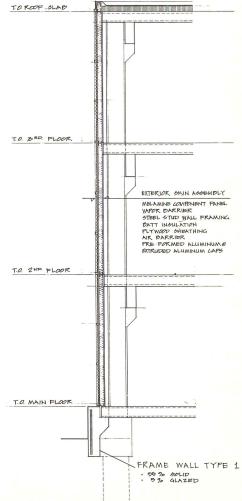
A good designer can work with any product and make it architecture. A poor designer specifies expensive products as a substitute for imagination.

Functional performance can be tested; beauty cannot. Machines made to look pretty instead of to work well invariably break down. Engineers have come to terms with this. They say that if it does not work well it will not look good, and if it works well we can find it attractive. The general public usually agrees with the engineers.

We always try to check our product selections with reliable researchers. We consult the National Research Laboratories of Canada, which are respected worldwide.



The skin is a system that encloses the other systems, but does not depend upon the matrix of the other five systems. The people within the building are the most essential building component.



#### ASSEMBLAGE

As our buildings become more industrially oriented, they are designed more for assemblage techniques. The same techniques cannot be used on all buildings.

All the things that can be done best in the factory are done in the factory. IKOY designs call for all building joinery to take place in the factory, with on-site assembly. About 90 percent of our work is now factory pre-assembled, and we design around the remaining 10 percent.

Modern construction workers are generally not as skilled as their predecessors. The potential for error is reduced by minimizing the number of connections. If a building has five million pieces, one will still have 50,000 errors if construction is 99 percent correct. Some of those errors will correct themselves, but the vast majority will plague the architect and owner for years.

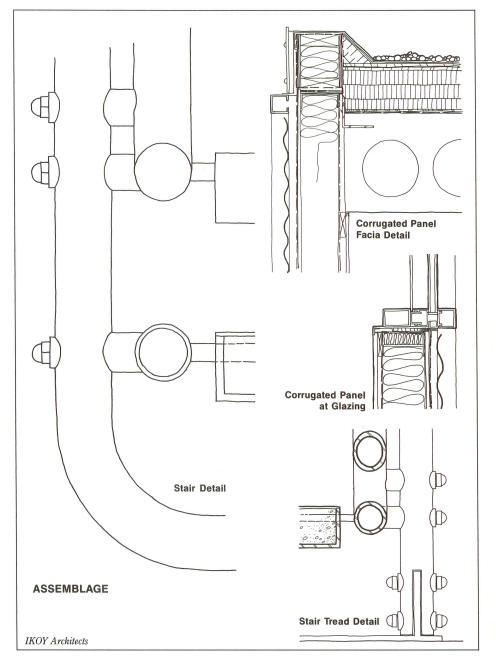
IKOY's building sites are no longer construction sites, but assembly sites. We use assembly rather than construction techniques. That means marshalling all the equipment necessary to lift, put in place and connect large building objects, and minimizing the number of pieces. If we use only 100,000 pieces, and are 99 percent correct, we will have 1,000 errors, not 50,000.

#### TECHNOLOGY AND DESIGN

Today's buildings are not static. Before the turn of the century there were few or no electrical and mechanical systems. The building was primarily structure, and its spaces provided shelter. Some were small, like homes; some grand, like churches.

Buildings have changed from static to active. Today's buildings are extremely complex with mechanical and electrical elements that no longer simply shelter, but work as well. It is the expression of the working parts as architecture that challenges architects today.

When people walk through a building, they should feel it as a living thing. Our buildings have excited the public because people see the reality of the building displayed through the texture and kinetics of its mechanics and their delightful forms. Our designs enhance structural, mechanical and electrical images. People see the parts that work, not just dry-



wall and hung ceilings.

Our contemporary society has grown sophisticated enough to have gone beyond the miracle of electric light and to now appreciate the wire that conveys the current and the ingenuity of the switching system that manipulates it.

Some designers, usually for lack of money, expose the building's innards.

Exposure is not what we are talking about at all. To expose garbage that was previously hidden and say it is interesting, without regard for the building's primary systems, is ridiculous.

If the parts are attached to the building so that they express their reason for being there, a different texture results with a purpose beyond decoration.

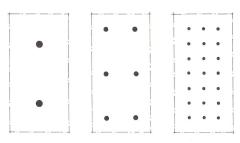
#### Innovative design and drawing techniques

## TECHNIQUES: STRUCTURAL AND PLANNING SYSTEMS

The structure is the generating matrix. The planning and movement systems are submatrices.

The planning system accommodates the movement of people and their comfort and enjoyment needs, and also the mechanical and electrical distribution and fitments.

Span selection is critical to the planning system. There are long, short and medium spans. Short spans involve column bays of 15'; long spans are 50' or more. Once a short span is accepted it must be lived with, the columns becoming a dynamic, not an encumbrance.



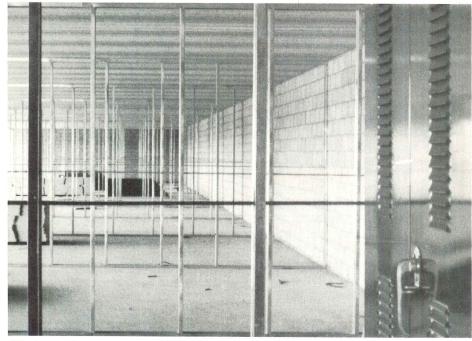
The beauty of short spans is the light and lacey column structure. An office building cannot be an auditorium because of the column spacing, but the spans of an office building make many other functions possible.

In many places in the United States and in all of Canada, working conditions for making concrete on the job site are difficult and uncomfortable for most of the year. We do not use poured-in-place concrete or other wet structure in our buildings, with the exception of grout for precast.

Precast hollow core concrete planks are ideal. They can be put in place efficiently, and even replaced and relocated. They can be perforated for access to the cores, and used as ducts or raceways. They lend themselves to standard design concepts. As a rule of thumb, the 8" planks span to 33'; 12" to 58'; 15" to 70'.

## TECHNIQUES: MECHANICAL SYSTEMS

Proper location of mechanical elements is essential. We would like to design an integrated system comprising a series of modular units fabricated in the factory. The



"The beauty of short spans is the light and lacey column structure."

units would contain the boiler, chillers, large fans, etc. The units might come in one large box or a series, designed and located according to the type of building. The units could be delivered in a truck and lifted into position with a crane. Ductwork could be connected to them in two days or less, since all the major labor would have been completed at the plant, and all that would be left is hook-up.

The modular approach accomodates simple, inexpensive energy retrofits. As the technology improves and more energy-efficient heating and cooling equipment is available, the owner could simply order another box from the factory, unplug the old box or boxes, and plug in the new equipment within a two-day period, without disrupting the rest of the building and the people in it.

## Techniques: Electrical systems

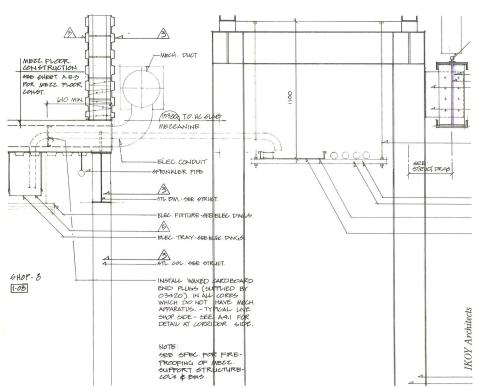
We always locate transformers so they can be moved. Switching gear and raceways are run exposed in the main corridors, which are the spines of the planning system. We then tap into them for any power that is needed



A building should outlive changes in its function.

for room functions. There is no wiring in the partitions. Our experience has been that factory electrical work is very efficient. All our electrical equipment is factory-wired, but we leave provisions for wire pulling, if necessary.





Top above—Ron Keenberg at the site of the Red River Community College Addition in Winnipeg. Above—a portion of wall section working drawings from the Red River project, completed this year at a cost of \$4.7 million—\$600,000 under budget. Because of the precision of the working drawings, the four lowest bidders were within a one percent spread.

#### TECHNIQUES: PLUMBING SYSTEMS

Plumbing must relate to and constitute an integral part of the architecture.

All pipe fitments are usually exposed, although some may be concealed by a hung ceiling. Hung ceilings are used in from 10 to 30 percent of the interior space of a typical IKOY building. Full exposure is not necessarily advocated. If the room needs to be sound-enclosed, we allow the enclosure to happen. We run our pipes six inches away from the partition wall and put up a "shrouding" panel to conceal risers, but leave the pipes accessible to maintenance workers.

IKOY is working toward the development of a plug-in, plug-out moveable washroom system that will permit relocation of complete washroom units with a fork lift truck.

#### PRODUCTION DRAWINGS

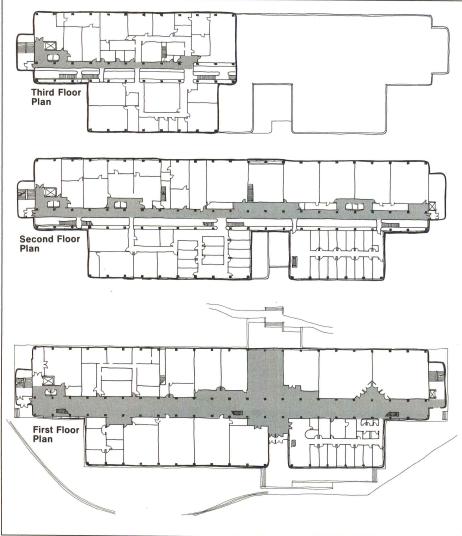
IKOY uses a form of drafting that it calls the "multigraph system," an overlay system that incorporates quality control, tutorial direction, and signals to the tradesmen, contractors, suppliers and manufacturers.

Each of the six component systems is a separate section of the contract drawings, consisting of several overlays. Then there are several drawings showing the connections and integration of the components. IKOY uses four-color printing plus halftones to emphasize the building systems. The result is an exceptionally clear delineation of building parts, which is a significant help in all phases of design, manufacturing, bidding, construction and quality control. Architects, engineers, draftsmen, manufacturers and contractors can all visualize the integration and separation of the systems.

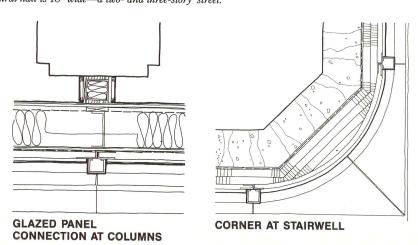
The bid spreads and construction costs for our projects are proof of the clarity of our designs and drawings. For example, the lowest four bidders on the 60,000 sq. ft. Red River Community College Shop Building completed in July of this year came in within a one percent spread. The building was budgeted at \$5.3 million; actual cost was \$4.7 million—\$600,000 under budget.\*

\*In Canadian dollars

#### Case study shows theories in action

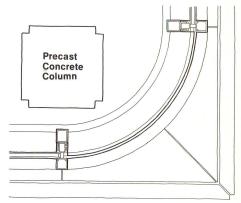


"The central hall is 18' wide—a two- and three-story 'street.'"

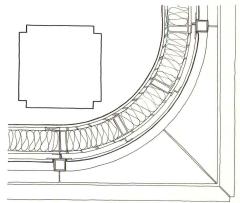


STRUCTURE AND ENCLOSURE

Precast concrete columns and beams support hollow core planking cantilevered beyond columns to enclosing skin. Exterior frame walls are 20 gauge corrugated anodized aluminum siding. They have prefinished extruded aluminum feature caps with continuous pressure plate back-ups. Behind these are furring bars, air barrier, waterproof drywall, steel studs, batt insulation, 6 mil polyethelene vapor barrior and drywall with paint finish. Windows are double glazed, with heavy glass single glazing at curved corner sections. Stair tower has concrete block wall back-up.



**GLAZED CORNER** 



SOLID PANEL CORNER

ARCHITECTURAL TECHNOLOGY

#### EARTH SCIENCES BUILDING

Scheduled for completion in December, the Earth Sciences Building at the University of Manitoba illustrates IKOY's design philosophy in action.

The building can, and most probably will, change functions—as do most of the campus buildings. It may become a school of architecture, or mathematics, or philosophy—or a library or administration building. Planning for these possibilities has not compromised the facility's ability to function as a high technology, state-of-the-art earth sciences building.

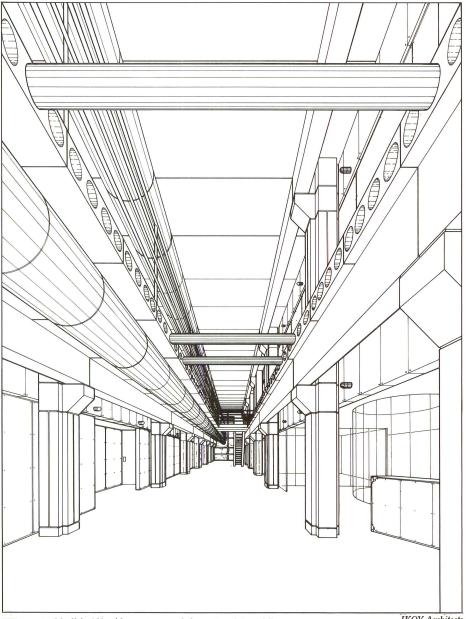
The siting of the building is important in the campus plan. The eastern end houses a museum and lecture theaters that are not connected with the remainder of the building, and will be used by the entire university population. The largest parking lot on campus is located at the opposite end of the central corridor. The building will be used as a covered walkway during the extremes of the Canadian winter.

The central hall is 18' wide—a two- and three-story "street." The upper corridors are less public and narrower, but allow views of the walkway below. The third floor is the ivory tower of research laboratories for university professors and graduate students. The building is organized around the central corridor, a major distribution route for people and building systems.

#### STRUCTURAL SYSTEM

The building is set on piles, as are most major buildings in Manitoba, because the soil is predominantly clay. Single precast concrete columns extend three and four stories high. Precast concrete beams span the columns, resting on column haunches. The column system will allow the addition of another two stories.

Beams are spanned by 12" hollow core concrete planks that are cantilevered into the central atrium corridor space on one side, creating the upper level walkways. The building skin is steel studs and an extruded aluminum control grid, which is capable of supporting corrugated annodized aluminum panels, or glazing. Hollow core planks, columns and beams are sandblasted. Exposed ducts, switchgears, electrical raceways and



"The central hall is 18' wide—a two- and three-story 'street.'"

IKOY Architects

trays are factory-finished. Ductwork is run in the cores of the hollow planks.

The hollow core floor panels have excellent spanning ability and penetration characteristics. Cores are 9" in diameter. Holes can be cut perpendicular to them, the full width of their diameter, 12" on center, for distribution access. A maximum perforation of  $9'' \times 12''$  is also possible without

compromising their structural integrity. This allows almost unlimited access to distribution systems.

Plank loading capacity is 150 lbs./sq. ft. Plank bridges can be moved, removed, or additional bridges can be installed, using a fork lift truck with an extended lift mechanism. A craneway has been incorporated into the structure to move heavy laboratory

#### Plug-in washrooms

equipment. This also allows the shifting of building components.

Electrical and mechanical distribution systems are paired with the major beams of the structural system running the length of the building. Electrical distribution is located on the laboratory side of the beams and was installed pre-finished and pre-wired.

The advantage is obvious. Factory labor is about \$6/hr.; on-site labor costs about \$24/hr. The quality of the factory work is higher. Electricians simply connect to secondary distribution systems in the building. The more complex the wiring required, the greater the cost savings achieved using factory wiring.

Major air replacement is required, due to the loss from fume hoods and direct exhaust from laboratories. IKOY selected heat pumps because they adjusted well to the floor core distribution system.

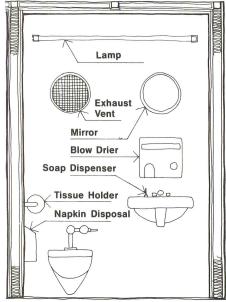
#### PLUMBING

Toilets are located in individual units with sinks and lockable doors, which is unusual in large institutional buildings, and a first step toward a moveable toilet system that will allow relocation of washroom units with a fork lift truck. Moveable washrooms can then become part of the secondary, rather than primary, plumbing distribution system.

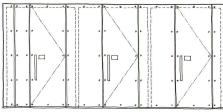
#### **FITMENTS**

All partitions are steel stud and melamine panels. Security problems are severe, so all partitions must extend to the under side of the hollow core slabs. When walls must be relocated, panels can be detached, and the metal studs discarded. New metal studs can be erected, and the panels attached to them simply and quickly, as they contain no mechanical equipment or wiring. There are hung ceilings for soundproofing in less than 15 percent of the space. We were able to use the mechanical elements in the remainder of the space for architectural expression.

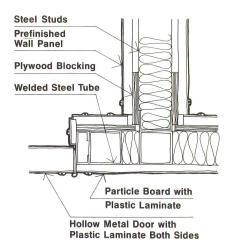
Total cost for construction of the 110,000 sq. ft. building will be about \$10.5 million, \$1.6 million under budget.

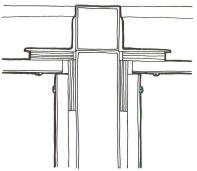


**ELEVATION TOILET UNIT** 

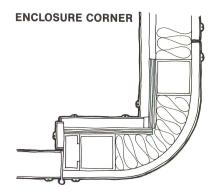


THREE BAY WATER CLOSET ENCLOSURE

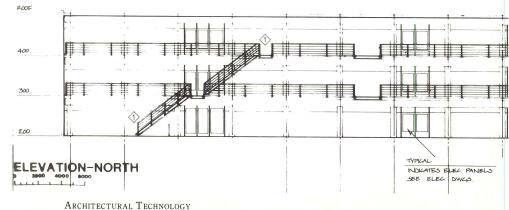




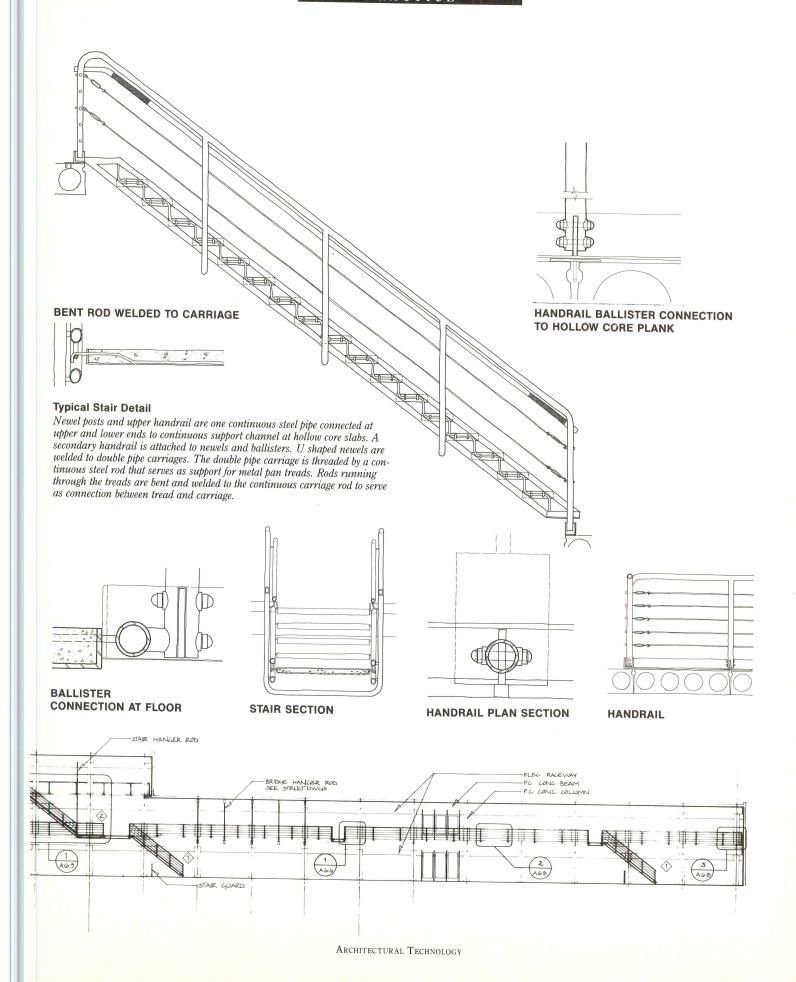
TOP OF INTERIOR WALL PARTITION BETWEEN ROOMS



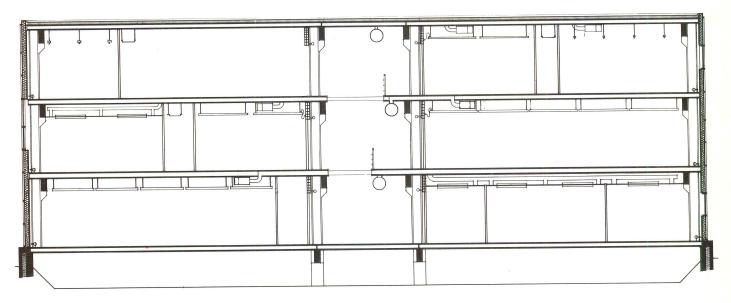
WASHROOM ENCLOSURE DETAILS



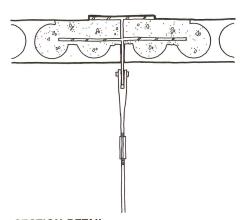
IKOY Architects



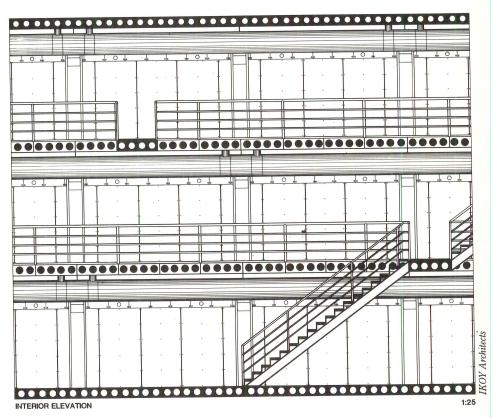
### Clean detailing translates to clean design



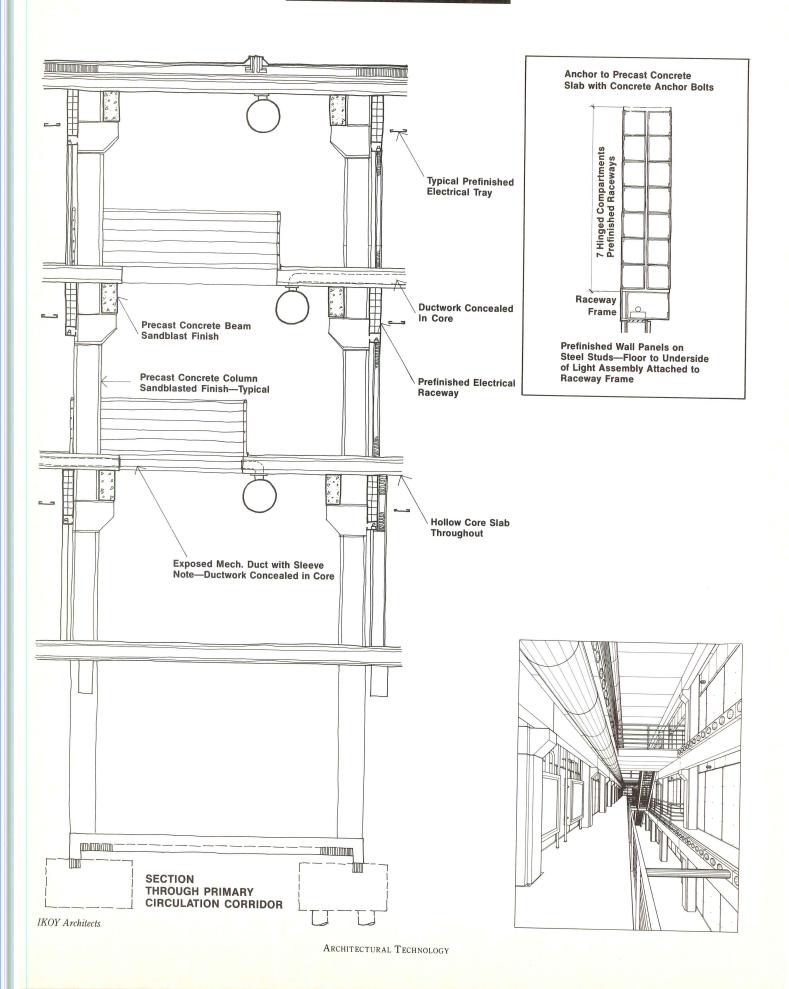
SECTION 1:50



SECTION DETAIL
ATTACHMENT OF HANGING
STAIR SUPPORT TO
HOLLOW CORE PLANK



#### PRACTICE



## Lessons Learned from DOE's Commercial Passive Solar Buildings Program

By WILLIAM J. FISHER, AIA AND ALEXANDER SHAW

The U.S. Department of Energy has spent five years and \$3.2 million conducting an experimental program to assess the use of passive solar technologies in non-residential buildings. Here are some of the major design lessons learned.

The Office Buildings, Retail Stores, community and health care centers, airports, educational facilities and other buildings being studied under the DOE Commercial Passive Solar Buildings Program are located throughout the U.S., and were chosen in 1979 from submissions by 400 architect/engineer teams.

Figure 1 lists all the projects constructed under the DOE program and the passive solar design features used in them. The accompanying map shows where the projects are located.

While all the applicants were required to have previous solar design experience, and to submit plans for a current project that had the potential for addition of passive solar features, only about 10 percent of the 400 design teams were judged to have sufficient technical background to qualify for a DOE award to cover design fees for incorporating a passive solar system into their project.

A panel of technical experts judged 23 of the revised designs technically acceptable, and DOE awarded them subsidies to pay for construction of passive solar features; 21 of the buildings remained with the program through construction and monitoring.

The technical experts worked with each of the 23 teams in 1980 to develop and refine their passive solar designs. In many cases the designs were substantially and fundamentally changed in response to critiques from the experts. The most common mistake made by the design teams was to misunderstand the nature of the energy problem, which led them to design passive solar heating systems when cooling or lighting was the major energy load in the building. The apparent reason for the mistake: the designers were experienced in residential passive solar design, and did not realize that larger, more complex commercial buildings generate considerable internal heat gain from people, machines and lights.

All the buildings in the program are equipped with instruments to monitor their energy performance. By January 1985, DOE expects to have collected at least one year of performance evaluation data on many of the buildings to determine how much conventional fuel they are using for heating, cooling and lighting. Major areas of research interest in the program are comparison of actual energy consumption to estimated performance; and assessment of occupant response to the buildings. Researchers are also investigating the influence of

thermal mass; integration of passive systems with conventional HVAC systems; and the integration of heating, cooling and lighting systems.

The DOE program used a base-case approach to the energy estimation process. A major benefit of the base-case procedure is that it helps the designer understand all the energy variables and their relation to one another.

Each A/E design team chose or developed a "base-case" conventional building of the same type and size as the proposed passive solar building. Estimates of the energy requirements for the base-case building and each of its energy systems (heating, cooling, lighting) were calculated, based on internal loads, occupancy and lighting schedules, and climate data. The design teams used a variety of estimating procedures, including the simple "Energy Graphic" method developed by Booz, Allen & Hamilton; the solar load ratio and solar savings fraction research programs developed by Los Alamos National Laboratory; and complex mainframe computer simulation programs such as DOE-2 and BLAST.

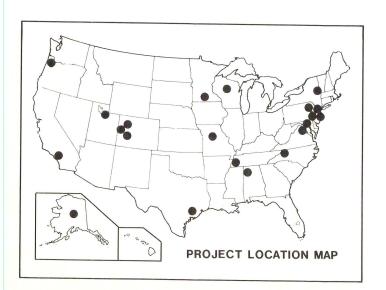
The energy performance estimates for the base-case provide a benchmark against which actual energy performance can be compared.

The energy performance of the buildings in the DOE program is better than that of conventional buildings, and in most cases better than the levels required to meet DOE's voluntary Building Energy Performance Standards (BEPS). (The BEPS performance requirements, in terms of Btu's/sq. ft./yr., are published in AIA's *Energy in Design: Techniques*, one of the workbooks used in the Institute's Energy in Architecture seminar series.)

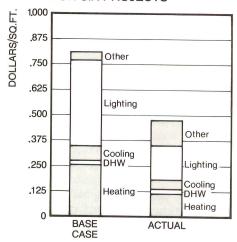
The DOE Commercial Passive Solar Buildings Program has shown that passive solar non-residential buildings work. It has also provided a wealth of information on the real nature of the energy problem in non-residential buildings, and the range and interrelationship of reasonable, practical solutions. Because these experimental buildings were in actual use, and the occupants are generally not concerned with the passive solar features of the building, the program has shown us why some design ideas that look good on paper do not function as anticipated in actual buildings. Although the lack of laboratory conditions and experimental controls has meant that the conclusions emerging from the program cannot be taken as scientific fact, we can describe valuable "lessons learned" from a carefully documented set of occupied energy-efficient buildings.

#### FIGURE 1

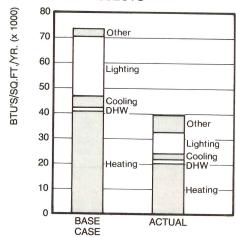
	PASSIVE SOLAR STRATEGY											
	HEATING			COOLING				DAYLIGHTING				
	Sunspace/Atrium	Mass Floor	Mass Wall/Water Storage	Earth Contact	Natural Ventilation	Forced Vent./Night Flushing	Shading Mechanisms	Evaporation/Radiation	Windows (More Nat. Light)	Lightshelves	Clerestories/Skylights	Sunspace/Atrium
Two Rivers School			•						•			
Abrams Primary School			•				•				•	
St. Mary's School Addtn.		•	•			•					•	
Blake Ave. College Ctr.	•	•	•			•	•		•	•		
Princeton School of Arch.					•				•	•	•	
Mt. Airy Public Library		•	•		•	•	•		•	•	•	
Johnson Controls Branch		•						•	•	•	•	
Kieffer Store Addition	•	•				•	•		•	•	•	•
Princeton Prof. Park	•				•		•	•	•	•		•
Wells Security State Bank		•	•			•	•		•	•	•	
Community United Church		•	•		•	•	•	•	•	•	•	
Deadwood Creek Comm. Ctr.			•		•		•		•		•	
Shelly Ridge Girl Scout Ctr.	•	•	•	•	•	•	•		•		•	
RPI Visitor Info. Ctr.	•	•	•		•		•				•	•
Essex Dorsey Senior Ctr.		•			•		•		•		•	
Comal County Health Ctr.		•	•		•	•	•		•			
Gunnison County Airport			•			•	•		•	•	•	
Walker Field Terminal Bldg.		•			•	•					•	$\dashv$
Phila. Municipal Auto Shop					•		•			•	•	$\dashv$
Touliatos Greenhouse		•	•	•	•		•		•		•	$\dashv$
Mennonite Home			•									$\dashv$



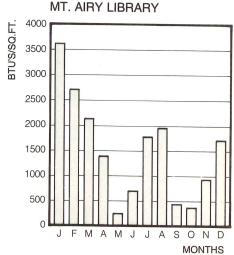
## END USE AND END COST FOR SIX PROJECTS



#### COMPARATIVE FUNCTIONAL ENERGY USE FOR ALL PROJECTS



ENERGY DATA FOR



#### Analyze energy loads and costs

#### LESSON 1:

#### DETERMINE THE ENERGY PROBLEM FIRST

In residential design, common sense tells us to design for passive solar heating in Chicago and passive solar cooling in Phoenix. But with larger buildings, it is vital to analyze the relative proportions of the energy load attributable to cooling, lighting and heating. For most large commercial buildings, cooling is likely to be the dominant energy load, even in cold climates. If cooling is the major problem, it is also likely that daylighting will be the most beneficial passive solar design strategy, because it can reduce the heat generated from artificial lights—cutting the cooling load—and reduce the lighting load at the same time.

#### Lesson 2:

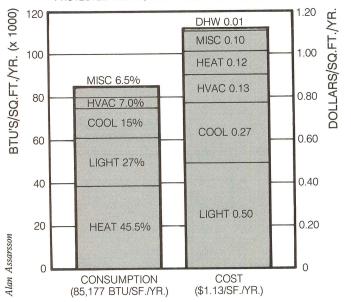
## ENERGY COST, NOT CONSUMPTION, IS THE BUILDING OWNER'S PRIME CONCERN

Building owners judge the success of energy-efficient design based on utility bill savings. Predicted performance must be presented to owners in terms of utility cost savings.

### BASE CASE ENERGY PROFILE SECURITY STATE BANK

#### **HEAT RETENTION**

- "CONTROLLED" INTERIOR MASS
- SUPER INSULATED ENVELOPE
- MINIMUM AIR INFILTRATION
- PROTECTED NORTH, NORTHWEST EXPOSURES



Analyzing the energy load requirement for a base-case conventional building is the first step; it tells the number of Btu's needed to offset heat gain and loss in the conditioned space. Energy consumption can be estimated from the load requirements by factoring in the operating efficiency of the space conditioning equipment and fixtures. The local cost of the types of fuel used in the building is then used to project the energy costs. Since electricity rates typically vary according to demand and time of use, occupancy information is necessary for cost analysis.

Peak demand charges for electricity are like rush hour—they should be avoided if at all possible. Where electricity rates are higher for peak daytime hours, a passive solar daylighting design that delays demand to off-peak hours can save the owner a considerable amount of money.

Many designers in the DOE program soon realized that intuition based on experience in passive solar residential design did not apply to small commercial buildings. In most cases, the utility cost profiles showed that lighting was the prime utility cost, since the high efficiency of cooling equipment lowered cooling costs, and the smallest energy load—heating—could be met by natural gas, a relatively lowcost fuel.

The base case energy profile prepared by John Weidt Associates (Chaska, Minn.), shown at left, revealed that lighting costs were the primary expense even for an 11,000 sq. ft. building in Wells, Minn.

Owners will weigh the utility cost savings against the cost of design and construction of an energy-efficient building. The attractiveness of an investment in energy-efficient design and construction depends on the owners' time commitment to the building, and their cost of capital. Government agencies and non-profit organizations are in a position to take life-cycle costs into account, since they generally own the buildings they construct throughout the building's life, and have access to inexpensive capital. Private sector owners will generally be more interested in energy investments if they plan to occupy the building themselves for a long time than if they plan to sell or lease after a brief occupancy period. Developers of speculative buildings for resale or lease generally have the least economic incentive for investments in energy-saving features.

#### LESSON 3:

#### Construction costs were 0-10% more

Construction costs for the buildings in the DOE program were 0–10 percent more than for similar conventional buildings.

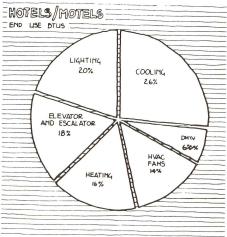
We found this cost range to be encouraging for this experimental program, because it suggests that it is possible to provide energy conscious design for a minimal increase in first costs. Moreover, it is reasonable to assume that the designers will be able to increase the cost-effectiveness of future projects based on the experience they gained from their first efforts.

SAUP PERFORMANCE / COST ANALYSIS 3.10.80 PERFORMANCE-COST ECONOMIC ANALYSIS 19 YR. ROI AVG ROI BTI SAVED/YEAR & SAVED TROMBE WALL SINGLE GLAZED 71 × 106 9 426-\$ 22,500 -1.9% 4% DOUBLE GLAZED 129 × 106 774-26,500 DIRECT GAIN SINGLE GLAZED (DBL) 144×106 864 -17,800-4.8% 10% DOUBLE GLAZED W/R-5 164×106 4.1% 984-23,800-8% TROMBE (DBL)/D.G.(5) 250×106 1500-44,300-3.3% 7% W/R-5 ON D.G. 278×106 1,668-50,300-3.3% 7% SKYLIGHT REGLAZE/R-15/SKYFLIPPER 104×106 624 -DAYLIGHT 194×106 2,800-TOTAL 298×106 3,424 -31,200 -10.9% 21% CONSERVATION CAVITY INSULATION 74×106 3,420 -17,100 -10,300 -12.9% 6.2% 8.9% 3.3% 444 -25% 12% NIGHT INS. N.E.W NIGHT INS. SKYLIGHT 1104 -184×10° 154×106 8% ROOF INSULATION 246×106 1.476 -45,000-7% ALL INSULATION 556×106 3,336-5.1 % 76,420-THE "WORKS" 879×106 5.274-DATLIGHT 194×106 2800-TOTAL 1073×106 8,014-137,320-5.8% 12%

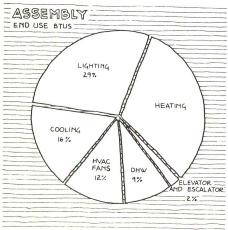
47,800 BTU/S.F./YEAR (63% REDUCTION IN AUXILIARY)

The chart at left was prepared by Harrison Fraker, AIA (Princeton Energy Group, Princeton, N.J.) to show options for energy saving features at the School of Architecture and Urban Planning at Princeton University.

The pie charts below show how load requirements vary for different types of buildings. (source: Energy in Design: Techniques, Level II Workbook, AIA Energy in Architecture professional development program.)



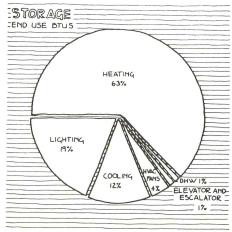
Hotels/Motels

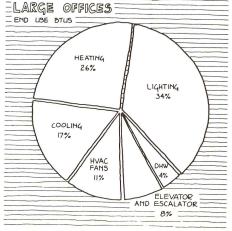


Assembly

OB

Storage





Large Offices

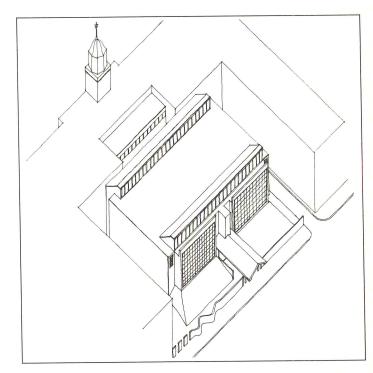
#### Early engineering involvement refines design

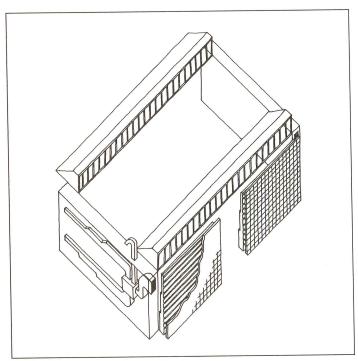
#### LESSON 4:

#### MULTIDISCIPLINARY SKILLS ARE NEEDED

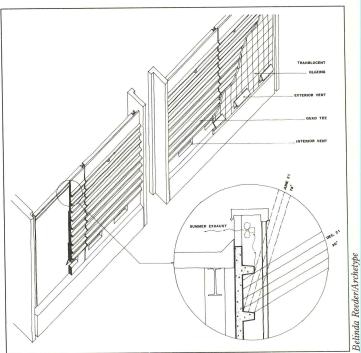
Traditionally architects develop a design concept, seek client approval, and proceed to schematic design. Engineers are generally not involved until the building design has been determined. This process short-circuits opportunities for the engineers to contribute to the design process.

Timely input from structural engineers helped architect David Gallagher, solar designers Belinda Reeder and Cy Merkezas and solar analyst William Glennie design a mass trombe wall with graduated thicknesses of 4", 6" and 8" to release heat into the St. Mary's Parish gymnasium addition in Alexandria, Va. The thinnest walls are sized to deliver heat immediately in the morning and continually during the day. The thicker sections allow for residual heating into the early evening during spectator sports events. The bleachers are located near the thicker walls.





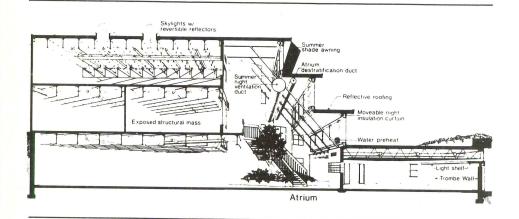
The St. Mary's Parish gymnasium addition used about 26,000 Btu/sq. ft./yr. from May 1983 to May 1984, about one third the energy used in a typical school gymnasium in Northern Virginia. Two 90' by 8' roof monitors provide 99 percent of daytime lighting. Construction costs for the trombe walls were minimized



by horizontally stacking and bolting pre-fabricated concrete tees to the steel frame. The concrete tees increase thermal collection surface area and provide self-shading in the summer.



The atrium at Colorado Mountain College was designed as a pass-through space, but students have adopted it as an area for socializing between classes. The section drawing shows the passive solar features in the 31,870 sq. ft. building, designed to use 33,000 Btu/sq. ft./yr. Peter Dobrovolny, AIA (Sunup, Ltd., Snow Mass, Colo.) was project architect; solar consultant was Ronald Shore (Thermal Technology Corp., Snow Mass, Colo.).



#### Lesson 5:

#### Anticipate occupancy patterns, and change

One unique aspect of the DOE Passive Solar Commercial Buildings Program is the funding of the designer's involvement in the post-occupancy phase. Changes in staffing levels, company reorganizations, and occupancy schedules have resulted in revised spatial requirements in many of the buildings in the program. This is always a problem in building design, but passive solar buildings tend to be less "forgiving;" moving into a space that was not designed for occupancy generally presents more problems in a passive solar building than in a conventional one.

At the Gunnison Airport in Gunnison, Colo., areas designed for

storage are now being used for computer operations. The storage area was originally a thermal buffer zone between the exterior wall and the occupied space, where temperatures were allowed to fluctuate. The need to heat and cool the space during working hours changes the building's thermal performance considerably, requiring adjustments in operating procedures throughout the building.

A reverse situation developed at the Blake Avenue College Center at Colorado Mountain College in Glenwood Springs. The atrium was designed as a pass-through space for students and administrators on their way to classrooms and offices. But the delightful atmosphere of the sunlit interior has enticed occupants to adopt the space as a living room for socializing after classes or during lunch.

#### Case study reports, performance data available

#### Lesson 6:

#### K.I.S.S.—KEEP IT SIMPLE AND STRAIGHTFORWARD

Energy-efficient systems should be simple in concept and easily integrated into the architecture and building system operations.

The most cost-effective passive solar components address more than one building load requirement. For example, the Walker Field Air Terminal's roof monitors provide direct sunlight for both heating and daylighting in the waiting areas and lobby, as well as ventilation for overheated air that rises to the roof. One design feature addresses heating, lighting and cooling.

#### Lesson 7:

#### **ENERGY CONSERVATION COMES FIRST**

Passive solar features should be considered after all reasonable energy conservation measures have been incorporated. This is particularly true in retrofits.

After roof insulation was applied to the 100-year-old City of Philadelphia Auto Maintenance Facility, it was appropriate to consider replacement of broken metal-framed windows with an inexpensive plastic glazing system that provided both natural light and thermosyphon solar heat collection.

#### LESSON 8:

#### COMMUNICATE WITH CONTRACTORS

Because passive solar buildings use new products and apply existing products in innovative ways, even conscientious installers can easily misunderstand instructions if they do not understand the operation and control of passive solar systems.

In one project, an overzealous electrician wired electric resistance radiant panels for continual operation, overriding the specified control system that used a thermostat deadband. The mistake was not discovered until the building failed to save as much electricity as expected in actual use.

Another case of misguided good intentions occurred during construction of a trombe wall. Although the drawing specified a 12" poured-in-place concrete wall, the contractor already had 14" forms at his shop. The contractor thought the client would appreciate a more solid building for the same price, so he poured a 14" wall. He did not understand that the added thickness would delay the transfer of solar heat into the occupied space. Two projects reported that contractors had failed to follow specifications for "tight-fitting dampers," resulting in unexpected system inefficiencies and contractor adjustments.

Sometimes installers become flustered by the unique requirements of a passive solar job and forget routine tasks. In one project installers forgot to connect the hot water lines. In another they reversed the supply air fan.

#### Lesson 9:

#### SPECIAL PRODUCTS REQUIRE SPECIAL ATTENTION

Careful scrutiny of new products and materials can save maintenance and repair costs. Automated moveable shading devices produced

problems for a number of projects in the DOE program. In some cases the motor torque was not appropriate for the installation, causing excessive wear on pulley systems.

#### Lesson 10:

## Post-construction inspection and adjustments needed

Energy-efficient buildings tend to be more interactive with the outside and inside environments than many conventional buildings. It is

# AIA FOUNDATION IS REPOSITORY FOR PROGRAM DATA

Information on the DOE Passive Solar Commercial Buildings Program can be obtained through the AIA Foundation.

The Foundation is maintaining an archive of project plans and specifications, the interim and final reports from the design, construction and evaluation stages of the program, monthly and annual performance and occupancy reports and analyses, graphics, and other miscellaneous publications and articles that have appeared in connection with the program.

The archive is still under development, but case study reports are already available for each building. The case studies describe the designers' approaches to fundamental energy and functional problems, and future energy performance estimates.

DOE is also funding preparation of reports by consultants to describe the actual energy performance of each building, including analyses of significant performance issues.

Forthcoming overview studies will summarize program experience in the following areas: (1) design process; (2) evaluation of design alternatives; (3) integration of solar and conventional systems; and (4) economics, energy consumption and occupant satisfaction. Lawrence Berkeley Laboratories is preparing system study reports on roof monitors for daylighting; and on thermal mass in non-residential buildings.

Project notebooks will also be available for those interested in studying individual building projects in more depth. They will include a table of contents for the program archive, and interpretations of documents such as occupancy analyses, design review comments and annual performance summaries.

Information from the archives can be obtained by written request to:

Terry E. Griffith, archive manager AIA/F Passive Solar Experimental Building Archive AIA Foundation, 4th Floor 1735 New York Ave., N.W. Washington, D.C. 20006 necessary to check and adjust the equipment set points and thermostat deadbands after occupancy. It is also important to check air velocities. In one building, a ventilation fan was bringing in more outside air than required, blowing papers off work surfaces, and causing an annoying racket.

#### LESSON 11:

#### OCCUPANTS MUST UNDERSTAND THE SYSTEM

The design team must explain the system operation logic to the building superintendent. One building night manager routinely turned the thermostat down to 55°F. He thought solar buildings did not require any auxiliary energy. Occupants complained that the building was too cold in the morning. The nighttime temperature was raised to 63°F.

User's manuals for maintenance staff and occupants are recommended. They should explain how to maintain comfort and energy savings, and give reasons for every recommended procedure.

Use of a user's manual might have avoided the problems experienced in one project, where office workers placed plants on light shelves, blocking daylight from entering the space.

#### LESSON 12:

## AUTOMATIC DIMMING CONTROLS WITH MANUAL OVERRIDES NEEDED

Most occupants are accustomed to switching lights on when they enter a space, and leaving them on until they leave whether they need them or not. Users are too involved in their tasks to be expected to adjust lighting levels to take maximum benefit from natural daylight.

Automatic dimming controls adjust artificial lights according to the quantity of available daylight. These automatic controls are recommended, but designers must realize that occupants will go to great lengths to override the controls if they feel that the lighting levels are not appropriate. In one case, occupants used a crow bar to break open a locked light panel and gain access to controls.

#### Lesson 13:

#### CONSIDER BUILDING MAINTENANCE

Window replacement, cleaning and accessibility are important concerns. In one project maintenance workers have to use a hydraulic lift to reach roof monitors. A catwalk might have made it easier to adjust moveable shades and replace glazing.

#### LESSON 14:

#### OCCUPANTS APPRECIATE PASSIVE SOLAR BUILDINGS

Researcher Min Kantrowitz has sent questionnaires to full-time and part-time users of the buildings in the DOE program. Kantrowitz has found that occupants appreciate the amenity of passive solar design—the open interior spaces and natural light. In some cases occupants did not realize the building they occupied was "different"—and certainly did not realize it was solar. Occupants studied noticed details like high-quality finishes.

#### Lesson 15:

#### ACOUSTICS ARE IMPORTANT

Site visits, designer interviews and occupant surveys revealed that acoustics can be a problem in passive solar buildings. Open spaces allow solar heat and light to penetrate into the building, but noise levels can be distracting. The problem is compounded by hard surfaces, such as brick or concrete block thermal storage walls and floors, which allow sound to bounce back into the occupied space.

#### LESSON 16:

#### VERTICAL GLAZING IS BEST FOR DAYLIGHTING

Clerestories, roof monitors, skylights, lightshelves, sunspaces, atriums and specially placed or enlarged windows were all used for daylighting in the buildings in the DOE program. Vertical glazing produced the best results, and was least expensive. Skylights and other horizontal glazing elements expose the building to direct sunlight throughout the day in the summer, when the heat gain may be undesirable and is difficult to control through shading devices. Designing and constructing horizontal glazing elements to avoid leakage is difficult.  $\hfill \Box$ 

## THE PROGRAM TEAM

Program Management: Robert Holliday, DOE Headquarters, Washington, D.C.; Ronald Lutha, DOE Chicago Operations, Chicago, Ill.

Consultants participating in the DOE Passive Solar Commercial Building Program included:

Burt Hill Kosar Rittelmann Assoc., Washington office, Technical assistance, technical monitoring; Sizemore/Floyd, Atlanta, Technical monitoring; Booz, Allen & Hamilton, Bethesda, Md., analytical services; Lawrence Berkeley Laboratory, Berkeley, Calif., daylighting, thermal mass and occupancy analysis, technical assistance; Min Kantrowitz & Associates, Albuquerque, N.M., occupany evaluation; Architectural Energy Corporation, Westminster, Colo., performance instrumentation specialists; Energy Systems Group, Atlanta, daylighting computer model calibration; Hart, McMurphy & Parks, Middleburg, Va., economics specialist; William I. Whiddon Associates, Bethesda, Md., analytical services; Ben Evans, AIA, Blacksburg, Va., daylighting consultant; Karen Haas Smith, Washington, D.C., technology transfer specialist; AIA Foundation, Washington, D.C., data archives. Technical expert panel: William Lam, Lam Associates, Cambridge, Mass.; Richard Rittelmann, Burt Hill Kosar Rittelmann Assoc., Butler, Pa.; Steven Selkowitz, Lawrence Berkeley Laboratories, Berkeley, Calif.; Michael Sizemore, Sizemore/Floyd, Atlanta; Benjamin Evans, Virginia Polytechnic Institute, Blacksburg, Va.; Lawrence Bickle, Bickle Group, Houston; Sarah Harkness, The Architects Collaborative, Cambridge, Mass.

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## FINALLY—A DATA BASE ON BUILDING PERFORMANCE DYSFUNCTIONS

By John Loss, AIA

One of the marks of a profession is the sharing of information among its members for the benefit of all, especially the public which it serves. Architects and engineers have tried to do this over the years, but unfortunately the lack of a permanent system has precluded much valuable information from being shared—instead it yellows in the back of crammed filing cabinets waiting to be tossed out. AEPIC is trying to prevent the waste of such a valuable resource by operating a total system of collection, collation, computerization, categorization and dissemination of performance information for architects and engineers. First proposed in 1964, it has taken twenty years for this service to become established. Now that AEPIC is a reality it is the professions that must support it—by contributing to it and by drawing from it.

—Neal FitzSimons, C.E. Chairman, AEPIC Advisory Board

ESIGN CAN BE A MATTER OF LIFE OR DEATH. WE ARE reminded of our enormous responsibilities every time a head-line announces loss of life from the failure or collapse of a structure. Leaking roofs, walls or skylights, and multitudes of lesser problems, add up to the largest single source of economic loss in the building industry. Design professionals are faced with ever-increasing risks of litigation and ever-mounting insurance premiums.

The professional societies in architecture and engineering have responded to the growing awareness of performance issues in a number of ways. The American Institute of Architects appointed two special task forces: one to clarify the reasons for failure of long-span structures; another to address life safety issues. The American Society of Civil Engineers created the Committee on Forensic Engineering, and the Engineering Performance Information Committee. All the professional societies have developed programs and committees to address the related issue of professional liability.

By becoming members of the Architecture and Engineering Performance Information Center (AEPIC) at the University of Maryland, architects and engineers—indeed, all professionals engaged in the design, construction and use of buildings—can more easily fulfill their obligation to remain well-informed about standards and performance failures related to their work. AEPIC provides the data base that is the first giant step toward reducing performance failures in buildings and civil structures.

#### **AEPIC'S FOUNDING**

AEPIC was founded at the University of Maryland in July 1982. The Center, a joint endeavor of the School of Architecture and the College of Engineering at the University of Maryland, was given its initial support by a \$150,000 National Science Foundation grant. That grant, with considerable additional support from the University of

Maryland, the College of Engineering, the Department of Civil Engineering, Victor O. Schinnerer & Co., Sperry/Univac Corp. and others with enthusiasm for the project, has now made it possible for the Center to enter the operational phase of its development.

Architects, engineers, contractors, developers, manufacturers, attorneys, building owners and users, federal and state agencies, insurance underwriters, and university and private research organizations can use the information in the data base for:

- Planning new projects
- Rehabilitating or restoring existing structures
- Teaching (case studies)
- Modifying codes and regulations
- Planning research
- Preparing professional texts
- Investigating for dispute resolution
- Developing new products for the industry
- Implementing effective quality control measures
- Improving professional and industry practice
- Creating an in-house resource base with lessons learned from project performance.

In the future it is reasonable to expect that the normal procedures in the process of design will include a summary of AEPIC data for the building, structure and material type contemplated for it.

#### **AEPIC** PERFORMANCE DATA

AEPIC uses a broad definition of performance: "fulfillment of a claim, promise, request, need or expectation."

AEPIC's data base covers performance information about buildings and civil structures, and includes all aspects of problems arising from: the building envelope; structural, mechanical and electrical systems; moisture barriers; economic and environmental concerns; as well as thermal, acoustical, visual and behavioral dysfunctions. The Center's performance data relates to materials, elements, systems, processes and procedures. Factual information about cases currently under litigation is included in the files. All data is coded and classified without sensitive or personal information, to protect the privacy of involved individuals and firms.

The data is stored in either computerized data files or libraries, and includes:

- Computerized "Performance Incident" or "Case" Files: Professional and "informed reporter" reports on actual performance problems or malfunctions, such as water damage, masonry disintegration, structural collapse or distress, indoor air quality, etc. Victor O. Schinnerer Co. has donated 40,000 claim reports to this file.
- Computerized "Citation" Files: References to published information about performance problems that has appeared in journals, trade press magazines, newspapers, agency investigation reports, etc. This file currently includes Engineering News Record articles for the last 20 years as well as other references.
- *Dossier Library:* Documentation of performance data about the incidents and related information in the "Case" files.
- Visual Materials Library: Photographs, slides and other visual materials related to the "Case" files.
- Reference Library: Current and historical codes, standards and other technical references.

Businesses, agencies and institutions may contract with AEPIC to monitor and analyze performance data for a particular building or group of buildings.

#### **AEPIC DATA SOURCES**

AEPIC uses the "performance report" and "citation" forms reprinted on the following pages. Readers are encouraged to use the forms to contribute data. The address and telephone number of AEPIC are printed in the upper right-hand corner of the first page of the forms, should you need help in filling them out.

Readers are also encouraged to contribute to the dossier, visual materials, and reference libraries.

Building inspectors, building owners, managers and their agents are correspondents to AEPIC, and several hundred architectural firms have already indicated willingness to contribute and use data.

#### GETTING INFORMATION FROM THE DATA BASE

Care and precision in the choice of words is very important in framing a query to access the computerized data base. Users and reporters use words that are familiar to them, but sufficiently standardized to permit computer cross-referencing for effective storage and search routines. AEPIC uses existing reference bases for classification, and users and contributers identify the reference base for their word usage (CSI, ASTM, CIB, NFPA, AIA Standard Documents, etc.).

#### **AEPIC CUSTOM SERVICES**

Businesses, agencies and institutions may contract with AEPIC to monitor and analyze performance data for a particular building or group of buildings. The data is collected and stored with appropriate coding to permit analysis. Identifying information may be deleted from these files so the basic information can become part of the general data base and be of assistance to all the users of AEPIC.

Another special program is the "Building and Materials Register." Owners may register buildings or products to be monitored over time and to record their performance history as it accrues.

Research organizations may use AEPIC as the primary data source and the repository for collection and analysis of research data, again in a coded format to facilitate exclusive access by the research organization that is subcontracting.

#### AEPIC DATA RESEARCH

AEPIC will conduct no original basic research; AEPIC is to be a neutral, non-biased, university-based data repository and, as such, will not engage in basic research nor have any proprietary interest in the data that is analyzed.

AEPIC does process, update, and analyze trends and patterns in its data base. Some analyses by type of project, type of performance problem, state and municipal distribution, and firm type have already been completed.

AEPIC intends to publish a member newsletter to cover data trend analysis. Information will also be available by mail correspondence and through electronic communication, especially with the international repositories. AEPIC will publish selected portions of the data analyses in the journals of the professional societies. Plans are also in process for the development of a "journal of performance analysis" that will cover the theoretical and conceptual issues in performance and performance analysis.

## **AEPIC ADVISORY BOARD**

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Paul M. Lurie, Attorney Fohrman Lurie Sklar & Simon, Ltd.

R. Randall Vosbeck, FAIA, Principal VVKR Incorporated

## Readers are encouraged to use the forms to contribute data.

#### **AEPIC** ORGANIZATION

The University of Maryland serves as the International Center and the National Repository of AEPIC, and will be augmented by international repositories that will broaden the base of AEPIC users and contributors.

The most advanced international repositories are in Canada and the United Kingdom.

An Advisory Board of nine professional leaders provides advice and guidance on AEPIC policies, programs and technical operations. The Advisory Board was selected for expertise in architecture, engineering, engineering testing, geotechnical analysis, insurance, law, contracting and research.

In addition, an Advisory Council and nine Advisory Committees have been formed to provide a liaison between AEPIC and membership organizations, technical and trade associations, councils and institutes and major agency media, research, educational, legal and technical user networks. Approximately 150 members of the council and committees are assisting in dissemination of information about AEPIC, encouraging their constituencies to contribute data to AEPIC and reviewing AEPIC functions to make sure we meet their needs as users and contributors.

Any person, individually or as a representative of an organization, who is interested in the objectives of AEPIC are invited to participate as a member of one of the advisory committees.

Several hundred professional firms, agencies, organizations, institutions and individuals are "correspondents" to AEPIC. They have no council or committee affiliations, but share information of mutual interest. Several selected individuals are "correspondent reporters" who assist AEPIC from particular regions of the country by sharing news of interest, assisting in distribution of AEPIC material, and clarifying AEPIC objectives. The Third International Conference of AEPIC at AIA headquarters in May 1984 marked the formal inauguration of the Advisory Council and the Advisory Committees and launched AEPIC into its next developmental phase: growth.

#### THE FUTURE OF AEPIC AND POSSIBLE OUTCOMES

The major thrust of activity in the immediate future will be the expansion of the reporter network. The components and chapters of the professional and technical organizations, and local building departments, building inspection agencies, federal agencies and others will be encouraged to create an effective network of reporters of performance data.

Prior to the development of AEPIC, reports of performance failures were filed in isolated storage throughout the world. No centralized source of data on performance was available. During this next year the routine operation of AEPIC will be well established at the University of Maryland and the international repositories will begin operations.

In the future it is reasonable to expect that the normal procedures in the process of design analysis will include a summary of AEPIC data for the building, structure and material type contemplated. For a small sum and a little effort we should be able to avoid the repetition of many of the mistakes of the past. This should lead ultimately

to a diminishing rate of performance failures, fewer confrontations in the courts, an improved codes and standards development process, and a reduction in insurance premiums.

A special request is made to architects and design professionals in private practice, education, research, government and business:

- Please consider joining AEPIC and participating in one of the committees. Annual membership fees vary from \$100 to \$800, depending on firm size. The fee for each basic data search is \$75, and includes a report of up to 10 pages.
- Please contribute performance information to the data bank, using the forms in this magazine. Send the forms to AEPIC.
- Please contribute to the libraries of AEPIC: photographs and slides for the Visual Materials Library and historical codes, standards and references for the Reference Library.

## AVOIDING ROOFING FAILURES

Architects are advised to develop a continuing relationship with a knowledgeable roofing consultant to avoid the most common type of building failure claim.

About 30 percent of liability claims against architects are roof-related, according to AEPIC data. AIA's Architect's Liability Committee recommends use of a consultant to supervise roof installation. According to a recent subcommittee-commissioned review of insurance claims for roofing problems, architectural inspection and general contractor control over the roof installation were neglected in virtually all of the cases where claims were filed.

While a roofing consultant may be able to prevent such installation problems as insufficient asphalt mopping and improperly installed flashing—which account for the majority of roof leaks—it is also necessary for the architect to keep abreast of roofing design and materials issues to avoid design errors.

Gary Lewis, program director for the AIA Service Corp.'s MasterSpec product guide, notes that the recent introduction of numerous single-ply roofing systems has made it even more imperative for architects to study the quality of the materials they select.

"Get as many people as possible involved early in the design process," Lewis advises. "Organize a pre-installation roofing conference at the job site to clarify roofing requirements and open the channels of communication among all parties. The architect has the responsibility for selection of the best available roofing materials for the particular project conditions, and for insisting upon roofing warranties that provide coverage for both the materials and workmanship failures.

"When clients request roofing products that do not work well with the particular design, or insist on details that are contrary to good design practice, the architect has the responsibility to have an open discussion with the owner outlining the potential results," Lewis added.

Steven Greenhut

## ARCHITECTURE AND ENGINEERING PERFORMANCE INFORMATION CENTER PERFORMANCE REPORT

PART	A: REPORTER, ACCESSIONS DATA	3907 I	C, University of Maryland Metzerott Road ge Park, Maryland 20742 935-5544
Engine electri data n	This form is intended for a full description of a specific Architecture or eering problem.* Because Performance Reports can focus on structural, cal, mechanical, environmental or aesthetic functions, some categories of may be inappropriate or unavailable for any one Report. Please add new pries if needed to better describe events reported.		AEPIC use only accession number reporter code
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A120 or other	Investigative documents and other relevant reports, photographs, diagrams, er materials should be enclosed with the signed form.	update	entory-Repository Reference
enclos	Please note here documents, reports, photographs, etc., which are not sed, but which have been prepared in connection with the Reported mance.	R010	
A122 A123		R020	Test Reports
		R030	Investigation Reports
	Questions:  Have you performed any services in connection with this Reported Per-	R040	Drawings
	Are you willing to be contacted by AEPIC on this matter?	R050	Photos
A133	May AEPIC refer other persons to you for information regarding this matter?	R060	Slides
A140	REPORTER (A business card may be attached in lieu of writing name, etc.)	R070	Contracts
A150 A155	NameAddress	R080	Litigation, arbitration docu.
A160 A165	PhoneOccupation	R090	Judicial Opinions
A170 A175 A180	Registration/LicensureProfessional AffiliationPresent Position	R100	Settlement documents
A185	Organization	R110	Published articles
A190	Date this ReportSignature	R120	Keywords:
*An articles	AEPIC Document Citation form is used to report published and unpublished s, reports, etc. for bibliographic data collection.		aepic pr 14 84 feb

PART	B: PROJECT IDENTIFICATION & DESCRIPTION	Notes for Reporters
B200	TERMINOLOGY:	200 Technical or professional reference for terms used by Reporter; examples: CSI, ASTM, NSPE, AIA, NFPA, etc.
		210 Full project name, number designation, if any. Specify use if not obvious from name.
B210	PROJECT NAME, FUNCTION	220 Address for buildings; for other projects, nearest place, milestone, river, topographic feature. Give State if U.S.A.
B220	LOCATION	230 Describe project structural systems, construction type, structural, finish materials.
B230	OVERALL PROJECT SYSTEMS, MATERIALS	240 Describe size by dimension appropriate to project: length, width, stories, span, square feet, meters, height, etc. Use approximate measure if no exact size known.
B240	OVERALL PROJECT DIMENSIONS	250, 255 Date begun, completed; original cost; changes, reason, dates. Use range if no exact date. Costs as known; approximate or estimate if unknown.
B250	PROJECT DATES, COST	260 Describe part, system, subsystem, component, space or area, of project directly involved in problem events.
B255	ALTERATIONS DURING OR SINCE CONSTRUCTION	<ul> <li>270 See 240. Dimensions may be noted on sketch in Part D.</li> <li>280 Specify loads, pressures, forces, temperature and weather conditions. Note ac-</li> </ul>
B260	COMPONENT(S), ELEMENT(S) INVOLVED, MATERIALS	cumulations, impact, vibrations, etc.; designate factors as typical, unusual or extreme.  285 Specify contracts, codes, laws relevant to problem. Note whether allegedly
B270	COMPONENT, ELEMENT DIMENSIONS	violated, possibly applicable, violation established, etc.  290 List proprietary or generic type of product, transport, erection or fabrication
B280	CONDITIONS, AGENTS, CATALYSTS	equipment, tools involved. Listed items need not be the cause of the problem, but can be part of a remedy or repair procedure. Use Part C to describe use or function of listed items.
B285	CONTRACTS, CODES, LAWS	295 Unspecified data: Notes of experimental nature of systems, materials, components used, nonstandard applications, unsual conditions, etc.
B290	EQUIPMENT, PRODUCTS, TOOLS	usual conditions, etc.
B295	SPECIAL FACTORS	
		aepic pr24 84 feb

PART C: PERFORMANCE EVENTS, ANALYSIS, CONCLUSIONS AND RECOMMENDATIONS	
C300 DESCRIPTION OF EVENTS:	Reporter's checklist for Part C (Data of special importance to AEPIC are in bold type.)
	Date, timespan of reported events; year, month or season if no date known Stage or phase of Project; construction, survey, design, occupation, alteration, etc Signs, conditions, precursors, warning signs, accompanying factors Observed events, dates and timing, discovery, diagnosis, initial remedial measure Role or title of persons involved, in whose employ; "involved" includes all those taking part or affected, including the discoverer of errors, agent of repair, or victim Results: injuries, deaths, economic losses, time out of service, demolition, etc Replacement, repair, reconstruction, problem solution Estimate of actual total losses due to problem malfunction, failure Progress of legal proceedings, if any, or other dispute resolution process Outcome; settlement or allocation of duties, repair, payments, damages.
C310 ANALYSIS:	Analyses, investigations performed; by whom: reporter, investigator, government official, etc.
C320 CONCLUSIONS:	Apparent or established major cause or last agent, factor or error.  Apparent or established contributing agents, factors or errors; specific acts or omissions, missing information, unknown facts, miscommunication, noncommunication.
C330 RECOMMENDATIONS:	Overall recommendations. Proposed act or conduct which would have avoided problem or lessened severity.      Proposed changes in practice or procedure to incorporate lessons in quality assurance industry-wide.  aepic pr34 84 feb

PART	D: SKETCHES, KEYWORDS, COMMENTS
D410	Caption:
D420	Scale:
D420	Scale.
D430	Keywords: (List the most descriptive words related to the event.)
D440	Comments, postscripts:
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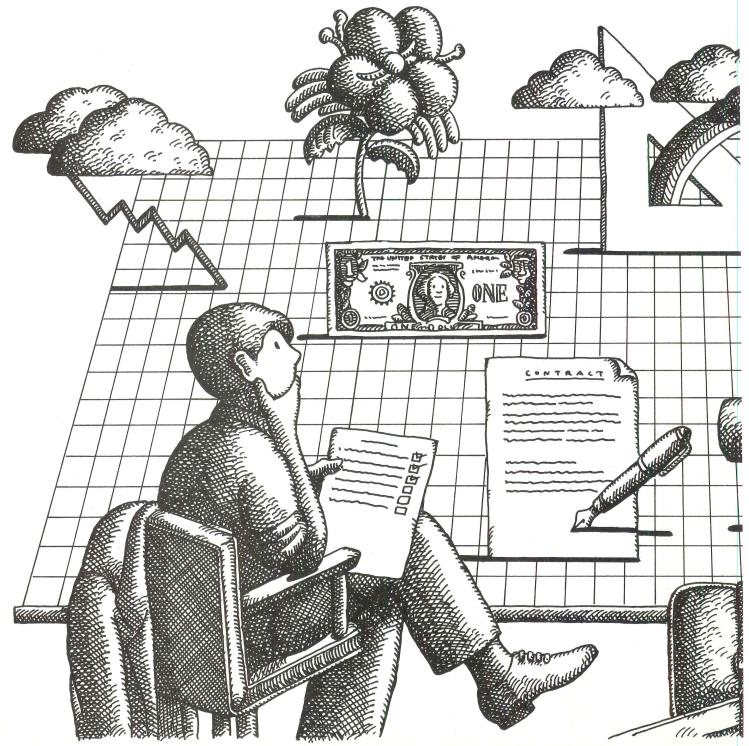
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# THE ARCHITECT AS EMPLOYEE . . . OR WHAT WE DO FOR LOVE

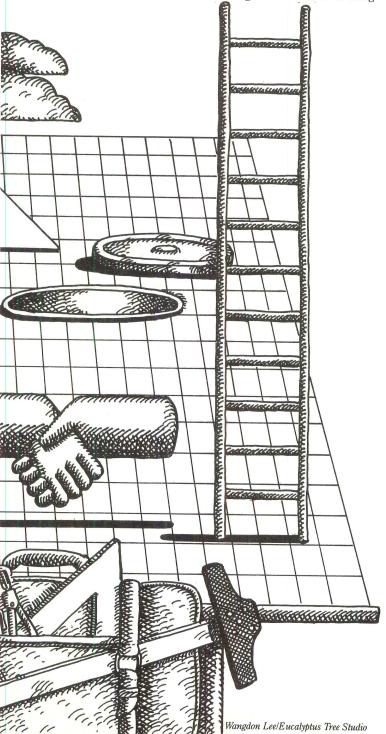
By Ann Nydele



ARCHITECTURAL TECHNOLOGY

EVERAL MONTHS AGO, A HIGHLY EXPERIENCED AND WELL-recommended young architect\* was hired away from his perfectly satisfactory job by the principal of a large and famous East Coast architectural firm, with promises of more money, a managerial position and the chance to do great things. The firm was undergoing reorganization, and the prospective member of the new team would participate in history.

However, the position as described never materialized. The newly hired manager was denied administrative support and given no budget or authority. He sat for a while, staring out the window or doing



a series of menial tasks—making lists and so on—that the secretaries were "too busy" to type.

Finally he was told—not by the principal who had hired him, but by another middle manager—that certain jobs had been put "on hold" due to lack of funds, and that he was out of a job.

When he consulted a lawyer he was further dismayed to learn that he had no recourse at all. He lived in New York State, where, as in most states, courts base employment dispute decisions on an old common law-derived rule that the employer has a "right to fire at will." The firm didn't even have to give a reason for letting him go.

What did he do wrong? Practically everything. He did not check out the firm first, or its reputation among the staff. If he had, he might have learned that the principal was erratic and unpredictable, frequently "reorganized" the firm, and had a penchant for new faces. While a superb salesman for the firm, the principal was a "lone wolf" who could not, for the life of him, delegate power. Finally, the principal habitually used the "probationary period" as a loophole through which he could have access to many people, their ideas and contacts, and then could rid himself of them without cost or onus.

He did not get a letter spelling out his responsibilities before coming aboard. In lieu of an employment contract, which is unusual in architectural firms, a letter of agreement is useful to both employee and employer. A letter of agreement is less formal and official-looking than an employment contract, but just as legally binding. The letter should describe the job, the salary and benefits, the starting day, and details of the conditions of hiring and termination. The statement of conditions of termination is intended to protect the employee from arbitrary dismissal and the employer from abrupt departures.

What other mistake did he make?

He passively assumed that the employer would "take care of him" and that all he had to worry about was doing a good job.

#### CONDITIONS OF EMPLOYMENT IN ARCHITECTURE

Part of the reason for the passivity of many prospective architectural firm employees lies in the gestalt of employment in the architectural field.

Salaries are low. According to William Fanning, a management consultant who prepares an Executive Management Salary Survey published by *Professional Services Management Journal* and co-sponsored by the Professional Services Management Association, the national median base salary of principals in architectural firms is \$41,700; with bonus the national median income is \$48,000. Project managers earn a national median salary of \$35,186; with bonus, \$37,578. Engineers do about 8 percent better and "mixed" firms (A/E, etc.) are in-between.

With this level of compensation at the top of the profession, staff architects obviously cannot command high salaries. According to Barry LePatner, a New York lawyer who is a consultant to architectural and design professionals, the salary of employees of architectural firms is lower than that of any other group of professionals. LePatner's firm newsletter reported that in 1981 the average salary for technical employees was:

- \$11,900 for new graduates
- \$28,300 for top supervisory personnel

<sup>\*</sup>To protect privacy, this example is presented as a composite case history. The incidents occurred as reported, but identifying information has been changed.

Because of the abundant supply of young architects looking for work, most firms can easily replace a typical staff member. There are 60,000 registered architects in the U.S. and 30,000 architectural students. No one knows the number of jobs for architects, but the general consensus is that the architects far outnumber the jobs.

These circumstances have led to a general sense of anxiety among young architects about their futures. Poorly paid as they are, architects are less worried about money than they are about opportunities for professional development.

As his thesis project for his M.B.A. degree from Drake University, architect David Stivers surveyed 150 Iowa AIA members to determine their reasons for changing jobs. The questions were designed to ascertain the extrinsic (external, such as pay and working conditions) and intrinsic (personal, such as satisfaction and ambition) values that come into play in the decision to make a mid-career job change. The extraordinarily high number of responses—102—indicates the degree of interest in the subject among working architects.

While "success" literature abounds in magazines and books directed to young people entering the business world, the tradition in architecture represented by the phrase "a gentleman's profession" has mitigated against the kind of hard-hitting advice offered the young M.B.A.

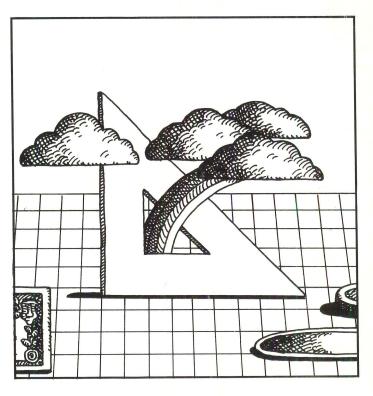
Stivers found that the strongest intrinsic reason for switching jobs, which far outweighed not only the other intrinsics but extrinsics as well, was "opportunity to develop my career." The strongest extrinsic variable, "pay, fringe benefits" was far down the line of statistical importance.

The major reason for choice of a firm was "quality of design," with "opportunity to design" second. Thus, a major reason for joining a firm would be the opportunity it provided for the young architect to develop his or her talent and move ahead in the firm. The main reason for leaving would be the sense that there was no opportunity to progress.

In architecture, as in other businesses, the number of positions in a firm fluctuates with the amount of work in the office. Few architectural firms keep more than four or five key people, unless they are large and multi-disciplined, or actively seeking business and thus able to maintain a large work force. Architects accept insecurity as the price they pay for doing what they love to do. They accept jobs knowing they may last only a year or two, but always hope that "something will come in" for them to do after the current project is completed. Often it does, but uncertainty is a constant companion.

#### Pressure on firms to change

Architectural firms are under increasing pressure from clients to become more cost- and efficiency-oriented, and to maintain a level of stability and profitability, a trend that may result in more secure employment conditions in the profession. There is pressure now to improve billing procedures, to maintain better control of fees, and to integrate accounting procedures with those of the corporate client.



At the same time there is a growing awareness in the architectural offices of new business development techniques, fostered by market consultants who encourage an aggressive, systematic and well-financed approach to maintaining a steady flow of work for those firms that can make the investment.

To operate in this new environment, young architects are going to have to know more, to learn the kind of job-seeking skills fostered among business neophytes by the business media. This involves an awareness of trends in the architectural field as they affect employment, and awareness of how to function in a more competitive, business-oriented and sophisticated environment.

#### GETTING THE JOB—INFORMATION THE KEY

While "success" literature abounds in magazines and books directed to young people entering the business world, the tradition in architecture represented by the phrase "a gentleman's profession" has mitigated against the kind of hard-hitting advice offered the young M.B.A.

Young architects are not counselled on what clothes to wear, how to behave in interviews, how to "work" contacts—how, in short, to take a pro-active approach to their careers. Colleges and schools are often criticized for failing to prepare graduates for the "world of work," beyond developing the portfolio. Schools are practicing a wholesale deception on students, by emphasizing design over everything. They turn out some very good designers but fail to emphasize many of the technical activities that the young architect is going to be performing—working with codes, specifying furniture, "doing the numbers." They also fail to prepare students adequately for interviewing and negotiating.

Skidmore, Owings & Merrill traditionally canvasses campuses each year interviewing young graduates. According to James Guequierre, associate in the New York office and head of the interior design department of SOM, they expect the interviewee to want to

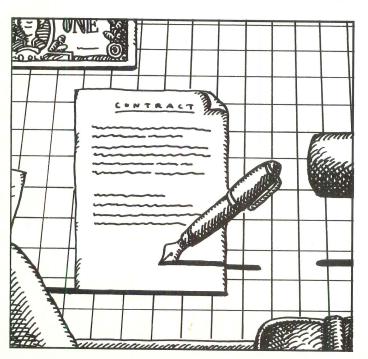
know about living conditions in the area, including housing, taxes and the cost of living; about the history of the firm; seniority and contributions of the staff; growth potential within the firm; the ages of the partners; as well as the usual questions about salaries and benefits. They pay attention to portfolios, looking for originality of thought as well as design ability, and are interested in any professional experience the graduate may have had during college through co-op programs. They also look at "personality"—the way people present themselves and how well they might be able, over the long haul, to relate to clients.

"Networking"—scheduling interviews with contacts within firms that do not currently have positions open—is a time-honored way of getting information that can be useful in a job search, and for getting a "leg up" on the competition when openings do occur. But experts caution against going too far. The fiction that "I'm just looking for information" fools no one; it is better to be frank and say you'd like to be considered for future openings. Ask to see the contact person for about a half hour during the working day, rather than inviting them to lunch or dinner. Applicants should be concise about what they want, not long-winded, and courteous and well-prepared about the firm they are researching.

#### HOW TO DEAL WITH THE AGENCY

Another useful source of job leads is the specialized search firm. Small-town firms often use architecture-oriented employment agencies in New York, Chicago or Los Angeles to recruit from major universities. The recruiter is retained and paid by the firm, and in order to earn a fee for the agency, must make a match. An ethical firm will be careful that neither the applicant nor the client are misrepresented. Applicants have to understand, however, that the search firm is working for the client—the architectural firm.

"In interviewing the client," says Margot Jacqz, director of placement for architecture and interior design at the RitaSue Siegel Agency in New York, "the recruiter will try to get as much information as they can about the job requirements. If it's for someone with



a specific background, the agency can assume that it's for a particular project, rather than a staff position. However, the recruiter will try to encourage the client not to hire for one project."

Networking, dress, presentation, Jacqz says, are things that "everybody should understand." A good agency will counsel on portfolios and behavior in the interview, and will know a lot about the particular firm. They will tell the candidate everything they can that will help them make the best possible impression.

A benefit of working through an agency is that a firm that pays a fee of several thousand dollars is likely to be extra careful in choosing appropriate candidates, and feel a strong commitment to make the marriage work.

Jacqz emphasizes that candidates must do their homework to be in the best negotiating position regarding salary. It is important to find out the going rate in the area for someone with comparable experience. "Stick to it," she advises, "because if you are way over you won't get the job. But don't go under what you can live on, even if you want the job.

"Larger firms have a standard payment rate. Smaller firms pay less, but offer different kinds of experience. You have to really know what you want from the firm as much as the firm has to know what they want from you. It also helps to have a specific objective."

#### Know your rights

To be active rather than reactive in negotiating with employers, architects need to know their rights. Most states still uphold the old common law doctrine of "employment at will," under which either the employer or the employee may terminate the relationship at any time for any reason.

Federal law narrows the scope of the "termination at will" doctrine by protecting employees from dismissal for aiding in the enforcement of federal law. Employees may not be fired for revealing a company practice that is against public interest, or for refusing to participate in an illegal activity, or when the firing is designed to circumvent the payment of pension.

The right of employees to object to a practice that is detrimental to public safety is particularly important to staff architects. If firm management does not respond to concerns voiced by a staff architect about possible weaknesses in a specified material or design feature, a staff architect has an ethical responsibility to bring the concern to the attention of code officials, and his or her employer cannot legally retaliate (if the concern is legitimate).

Judicially enforced exceptions to the right to fire at will center around the safeguarding of public policies, where protection for workers is not always spelled out in the law, but courts often recognize that the goals of the law could be thwarted by the threat of dismissal.

Courts have refused to uphold termination-at-will where the employee was fired for refusal to commit perjury, for filing workers' compensation claims, for accepting jury duty or for testifying before a grand jury which indicted the employer.

The courts will also allow suits in cases which are considered "breaches of covenants of good faith," such as discharge immediately before a long-term employee becomes eligible for pension rights, or in cases of sexual harassment.

In several more progressive states, like California, there is a judicial leaning toward the concept of the employee's "right to the job," according to David W. Ewing, managing editor of *Harvard Business Review* and an employee rights expert.

"It seems predictable that the motive for discharge will become an increasingly weighty factor in the years ahead," Ewing wrote in a March–April 1983 article on "Your Right to Fire," for *Harvard Business Review*.

Employment terms don't always have to be stated in writing to be binding. According to one list, courts in 16 states have upheld wrongful discharge suits on the basis of contract terms expressed or implied in company policies, handbooks, manuals, oral assurances and pre-employment interview statements. But courts in those states are not necessarily consistent in upholding actions on these grounds.

#### THE PERSONNEL MANUAL

It does not seem unreasonable to ask to review the prospective employer's personnel practices manual before accepting a job offer. It might be food for thought and discussion.

In addition to the possibility of an employer abusing the threemonth probationary period, employees should take a careful look at those policies relating to termination, professional liability, professional recognition for design accomplishments, design credit, profit-sharing, the basis for promotions and raises, and opportunities for participating in professional activities away from the office.

#### GOOD COMMUNICATION ESSENTIAL

Gerald Weisbach, a partner in the law firm of Natkin & Weisbach in San Francisco, sponsors seminars for design firm owners on employee and client relations. Weisbach believes the two are interrelated.

Weisbach's work with A/E firms focuses principally on improving client relations. But, he says, if "the employer-employee relation is stretched or not good, it's generally reflected in the behavior between the employee and the firm's client. It kind of spills out: the unhappy employee tends to do a rotten job for the employer.

"Part of it," he says, "arises out of the staff member not knowing what their responsibilities are. A lot of it arises out of the employees' lack of training on how to deal with clients."

For this reason, principals and executives of architectural firms are looking more and more to the AIA and to consultants like Weisbach for ways to enhance the performance of their staffs by improving the staff's relationship with the firm.

"The question of professionals leaving a firm and taking clients has come up a number of times and what I've tried to do, in two instances, is develop policy statements which would go into the employee manual so that the employee can understand the employer's position," Weisbach said.

An employee, he points out, has access to a lot of information about a client, as well as client contact, and if they are unhappy and the client makes an offer—as some do—the temptation to walk off with the client can be overpowering.

"Most firms don't use a waiver because the reality is that covenants not to compete are generally not upheld by the courts," he explains. "If a company needs them to frighten employees into behaving, the truth is that there is a bad employee-employer relationship to begin with."

#### Professional Liability: A HIDDEN THREAT

Employers are struggling to improve their relationships with their staffs, but there are still areas, other than income, in which the staff architect receives little or no protection at many firms. One problem is liability exposure. Employees are not always aware of their liability

"if the employer-employee relation is stretched or not good, it's generally reflected in the behavior between the employee and the firm's client." —Gerald Weisbach

exposure because they assume that somebody else is taking care of the liability, Wiesbach says.

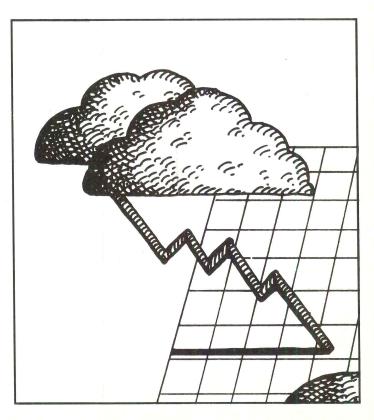
In many firms the principals travel and are not always available to seal drawings. When staff architects seal drawings, they become individually liable. The firm has the moral and practical responsibility to stand behind them, but is under no clear legal requirement to do so.

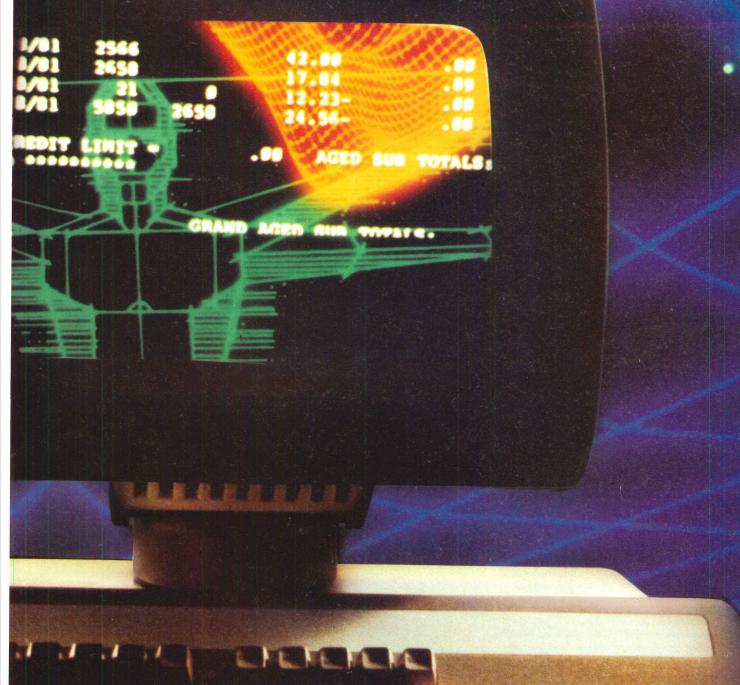
Most firms would prefer a united defense against a professional liability suit, and will if possible provide counsel for an employee who is named in a suit.

But if the firm's resources are not sufficient to take care of any claim, the staff member who has signed may be very much exposed. Weisbach reports he has worked out agreements whereby the company agrees to insure the employees' interest, by specifically naming them in the policy, in addition to indemnifying them against any claim beyond the terms of the insurance, through a separate indemnifying agreement.

"They are putting their license on the line for the convenience of the firm," Weisbach says. "It's only fair that the firm picks up the liability."

Insurance coverage does not provide total protection. The employee must realize that he or she will bear legal responsibility for (continued on page 41)





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#### Introduction THE LONG DAWN

The most senior among us remember the coming of the computer into architectural offices in the early 1950 s. Slide rules were still in common use, but the new tool became increasingly adapted to structural calculations.

A decade later, computers were wed to plotters to generate the first computerized designs. One who was present at the unveiling of what was then called the MEISENG system wrote, "The productivity and contributions of the individual, given such a tool, can be multiplied by a factor of many hundreds." The observation was less than profound.

In some respects the new era has, however, come slowly. It is only now that computer technology is becoming common to the architectural profession. Few ever doubted its value, but much of what has been available has also been expensive, baffling and difficult to justify for all but the largest of firms.

The great breakthrough has come, of course, with the introduction of the personal computers, and the proliferation of "user friendly" software which permits those other than

computer specialists to utilize the technology.

Computation functions of the '50s are now performed by pocket calculators. The computer-plotter systems of the '60s have given way to far more sophisticated systems, increasingly practical for a broader segment of the profession. The computer capabilities available only to the larger firms in the '70s, are now largely available to all. A new world surely beckons.

Dr. Bruce Sanders, whose column FOUNDATIONS appears in this issue, has determined that the costs of computing power are being reduced by about 50% every 24 months, as personnel costs continue to rise...that processing capabilities for a "package" of comparable size are doubling about every 14 months. Thus, computers are very rapidly becoming both smaller and less expensive, but much more powerful

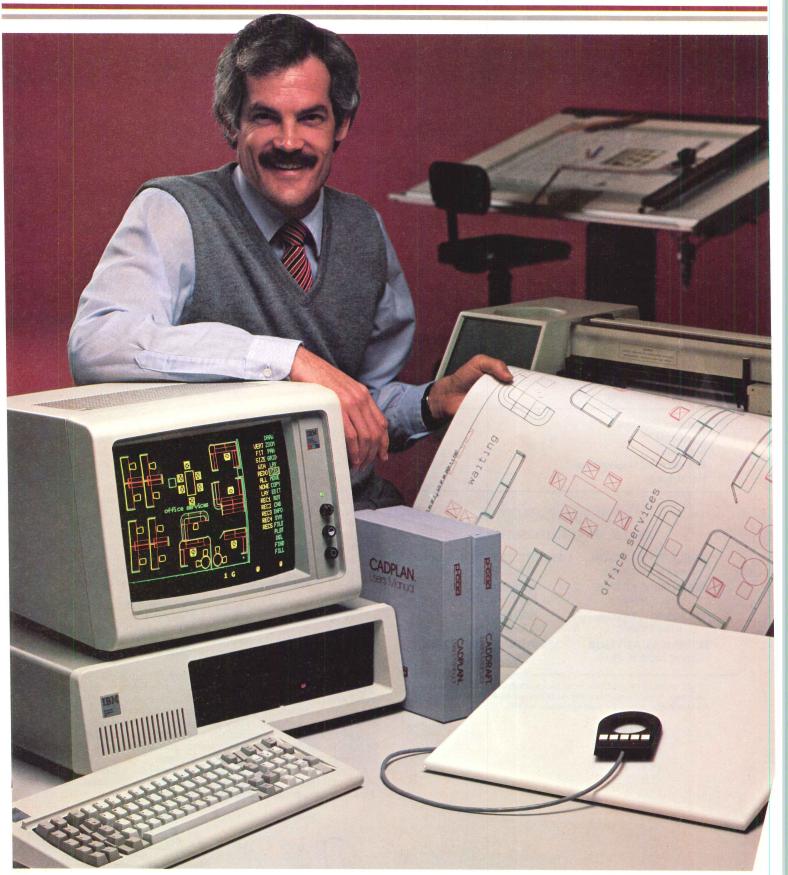
In 1960 a cubic foot of computer memory would accommodate about 15 pages of normal text material. Today, a memory package of comparable size will store the text of some 3,500 books of average size. Dr. Sanders has said that by the end of this decade, a cubic foot of memory capacity will be adequate to store the entire text collection of the Library of Congress.

A given architectural office can no longer debate whether to join the trend. The questions are simply when and how? In the early years we were so enamored with engineering

and design uses for the computer, few of us foresaw that its greatest utility for architectural professionals would be simple office automation.

Computer technology today enables the smallest of architectural offices to function more efficiently, to compete more effectively. Data processing systems free senior professionals from administrative tedium and the endless handling of project information. They permit the rapid evaluation of design and material alternatives to determine economic feasibility. And so they enable senior personnel in the firm to devote more time to what they do best.

Forevermore, computer technology will be a highly significant factor in lives of both architectural professionals. This supplement addresses these opportunities.



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## Computer Savvy Spells Survival for **Small Firms**

The competitive climate in architecture appears destined to remain. So efficiencies and marketing advantages of using a computer—for information management or design/drafting-could very well spell survival for some small firms.

So it seems to a number of architects who've gotten their feet wet with the technology.

The message is clear: Today, fewer architects resist the idea of using data processing to better manage their practices than did just a few years ago. Yet many architects still question whether the "ultimate" in technology computer-aided design/drafting—is appropriate for many small firms. They caution that sufficient volume in the type of projects efficiently handled on a CADD system is vital.

Word processing and accounting are two of the most common applications of a computer in an architectural office. They're also cost-justifiable.

"For us, the cost-justification was word processing," notes Paul Henderson, partner, Henderson Gantz Architects, St. Louis. This 20-person firm uses one IBM Personal Computer (PC) and two Compaq portable PCs that are IBM-compatible. "The computerized management systems were a plus," Henderson adds. "We issue internal management reports. During a project, we issue monthly and bi-monthly updates so we know if we're performing according to budget...for both hours and dollars.

"It helps us set objectives and monitor our activities against our objectives."

Henderson and other architects interviewed list a number of benefits reaped by hooking up with a computer.

"There's a dramatic impact on the bottom line—some direct, some indirect," Henderson says. They include accurate fee proposals, work-load scheduling, improved monitoring of cash flow and better information that affects financial decisions made by the partners.



"The computer makes us better professionals," says Joe Stoeltje, vice president, Wilson, Stoeltje, Martin of Austin, TX, referring to his 19-person firm's use of a CADD system. "We're better professionals because we're building a library of solutions to problems."

Several other principals note that the work loads are less chaotic since computers have been employed by

By reducing the routine, drudge work, computers have allowed employees to turn their attention to the challenge of more interesting tasks. And better-quality typed documents are the product of word processing systems, say architects. "Our proposals look more professional than they did before," admits another architect.

What's more, marketing efforts enjoy a boost. Quicker response times and capacity for greater frequency of direct mail solicitation are two commonly cited marketing advantages gained by using a computer.

Finally, in the area of accounting, the benefits of computers are easily tracked. "Our accounting is more accurate now," asserts one architect. Another principal adds that the firm's billing time has been cut substantially, improving cash flow and the firm's profitability.

"To calculate the fee via computer is an immense benefit. We have a good statistical base on what it costs us to do business, so we do very accurate fee proposals," Henderson says. "The

certainty of our information lets us stand firm but explain why a fee is what it is. That's helpful from a marketing standpoint, too."

More important, Henderson is comfortable with the proposals he writes. "We feel good about our proposals whether we get the job or not...because if we can't perform the job profitably, we don't want to accept it."

#### **Increases Profitability**

The reports generated by a computer help Henderson/Gantz monitor the firm's cash flow. "If there's excess money, it's invested well and for as long as possible," says Henderson. We know when we'll need money, or we can let the bank know three or four months early if we'll need to borrow. The timely reports also let us make good decisions on whether to finance or pay cash."

#### **Improves Service**

Joe Stoeltje of Wilson, Stoeltje, Martin believes his firm's new CADD installation will ultimately make the architects perform better. That will happen, he believes, because a library of solutions to problems will be compiled over the long run.

Meanwhile, Wilson, Stoeltje, Martin plans to add new services, including facilities management and life-cycle costing at the front end of a job. The firm's only been using the DEC VAX 11751 system since mid-February. But already Stoeltje can see results.

"It's not an easy transition. You don't draw the same on a CADD system as you do by hand. You multiply walls with the CADD system. That requires a change in your thought process," he says.

"We're already using it very effectively at the level we understand it," he adds.

Yet for Wilson, Stoeltje, Martin, word processing, accounting, spread-sheet and project management comprise the heaviest use of the system. Ideally, says Stoeltje, the computer will interface and integrate information with those used for word processing and accounting within 12 to 14 months. "We do have a long-range plan and the tools we'll need to get there, but all the steps are not outlined because we have to do buildings and keep up the cash flow in the meantime," he says.

Stoeltje foresees a data base that includes a description of the property, with built-in financial analysis for real estate decisions. "When we have that in the computer, when we get into the architecture, the computer will run interference and tell us the plumbing can't go where we've put it because there's a concrete beam there," he says.

On the construction side, this ideal system will produce updated drawings so manually produced supplemental drawings will be eliminated. Additionally, accurate special drawings for the building owner's maintenance use will be easily generated. And the professionals can monitor the building and issue yearly reports if needed on building products and their performance history.

Stoeltje worked with Mark Estes, an Austin architect and computer consultant, who advised him on the acquisition of the computer system and how to maximize output from it. But more important, he believes, is total commitment to the computer from all partners and department heads. "You have to be able to understand the computer and operate it. If you don't, you've lost control of your business, and you'll never get any benefit out of the computer," Stoeltje says.

#### **Reduces Chaos**

Though many business owners believe a computer will aid them in reducing their work force, a few architects say that's not always the case. But they do credit a computer with minimizing confusion in the office.

"It hasn't reduced our work force, just the chaos. The secretary can get a lot more done," notes Kathlyn Messer, marketing coordinator, EDI, Dallas.

On the professional side, Henderson of Henderson Gantz adds, "I do a sixmonth work-load projection. This includes the administrative work load, projects under construction and projects that may come in," he explains. "The probabilities of whether we'll win the new jobs are included. We can schedule our workload and that allows us to have the right number of people for staffing. Now, on the computer, it's more accurate and takes less time to do than when we handled it manually. This allows us to hire people if need be ... or if we're very busy but foresee a flat spot we can hire temporary people. It makes the work load in the office saner."

#### **Reduces Repetition**

For Crigler Topping, Reston, VA, and



Joe Brown: Helps expand markets.

IBM PC and Auto-Cad computer and plotter have helped cut repetitive changes, even on a small project. Their first CADD project is a \$1- to \$2-million townhouse development.

"We draw the elevations on the CADD system. For instance, we have a library or data base of windows, so we don't have to draw the same thing over and over again," explains partner Wayne Topping. "It's a hundred times faster than drawing a window by hand. The repetitive, boring work is removed, but you do have to spend time building your own data base"

The main problem this team cites is the uncertain start-up time and learning curve. "You don't know how much time it will take when you start out, and you compare it constantly to the manual method and try to use those same techniques," Topping says.

Still, these professionals say the learning curve was modest. "We had both worked on larger CADD systems while working for another architectural firm before opening our own practice," says Don Crigler.

"Once you overcome the one-to-twomonth-long learning curve on a CADD, the system will pay for itself. Larger machines-in the half-million dollar range—have a learning curve that's a year or more long," Topping says.

Yet the Henderson Gantz firm found CADD wasn't effective for the firm's high volume of small projects. As a test for how the firm might have added CADD to its computer capabilities in the near future, Henderson contracted to use a service bureau for three projects over a two-month period. "We approached it correctly, an experiment using a service bureau to discover the potential hassles, cost and capability," stresses Henderson. "But our projects are not of the scale or complexity to warrant using CADD. A CADD system is ideal for a hospital or a multi-story hotel. If we had a project like that, I would use CADD again."

#### **Boosts Marketing**

The benefits of computerized information management are manifold according to professionals who talked with DP/ARCHITECTURE.

Though the 400-plus employee Everett I. Brown Co., Indianapolis, has used computers for 12 to 13 years, managing partner Joe Brown credits acquisition CADD systems with allowing its new, small-size subsidiaries to grow.

"We became involved with our subsidiaries in the middle of the recession, and since then they have doubled in volume and size," Brown says. "CADD opens new markets. It gets us involved with clients that in the normal course of business we would not have become involved with—like industrial markets and the military."

One of the firms Brown acquired is 25-employee EDI, a Dallas architectural, master planning and space planning practice. The firm uses two TRS-80 model 16 PCs with Scripsit, D-base, profiles, Profiles II and Visicalc spreadsheet software and is switching to IBM PCs in the near future. It also has an Arigonni CADD system.

Marketing coordinator Kathlyn Messer cites these advantages:

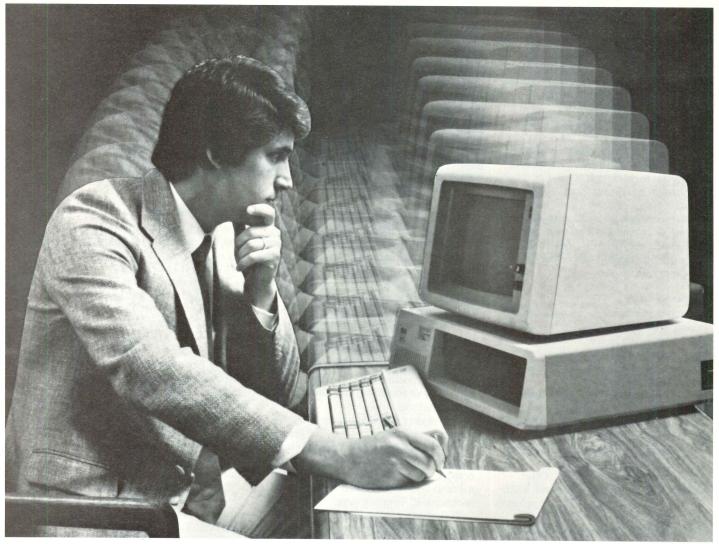
- All mailing lists are on computer. The data base filing system merges names with word processing for custom mailings.
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Paul Henderson (standing): Improves marketing, management.



Joe Stoeltje (standing center): Plans to integrate info.





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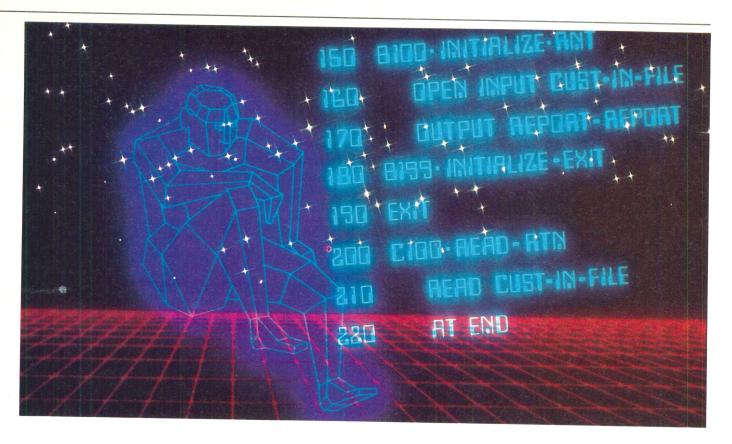
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"The computer helps speed up marketing efforts and makes it easier to complete marketing projects," Messer says. EDI is switching from Radio Shack to IBM PCs and is adding an Intergraph CADD system to supplement its Arrigoni system.

Messer's not alone in praising the wonders a computer can make in a marketing campaign. Notes Crigler of Crigler Topping, "We hope the computer will give us free time to market ourselves, which we need to do because we're a young company."

Partner Topping is more explicit. He uses the D-base II application software to keep track of all hospitals in the threestate Washington, DC, region. "We note their names, number of beds, utilization rate level, etc. We generate mailing lists for direct mail and also determine which hospitals to focus on," he explains.

In addition to the information the computer offers the marketing planners, the existence of a computer in an architectural firm is a psychological marketing plus. "It's a competitive edge to have a computer...gives the firm a distinction," Topping remarks. Yet Bud Hopkins, EDI's president says, in the Dallas market, a computer is not as much of a marketing tool now as it was when EDI acquired one two years ago. "It is an aid in our production capabilities-getting the work out faster -so that's an advantage," he says.

Using a computer also helps Henderson Gantz. "We can respond to more proposals since we've begun using a computer because it's easier to do a proposal now," Henderson notes. "It's quicker. We can do most proposals in a few hours, customizing and spending meaningful time responding to the specifics the owner has asked for. It lets us focus our intellect on the meat of the project."

One concern that should dissolve within the next few years is the shortage of draftspeople and architects with CADD experience. Because relatively few architects have CADD skills, there's the tendency for some firms to lure trained people away from other architectural firms. One firm figures salaries for employees with CADD experience will increase 25 per cent over the next few years. After that, salary increases and employee turnover should settle down as the crunch for trained people eases.

Most architects who use computers to aid their practices agree that the project has just begun. It takes time to learn and experiment. As architects become more proficient at using the computer to manage information, they're dreaming up new ... and potentially more productive ways...to use their new tool.



Kathlyn Messer, Bud Hopkins: Aids marketing, production capabilities.



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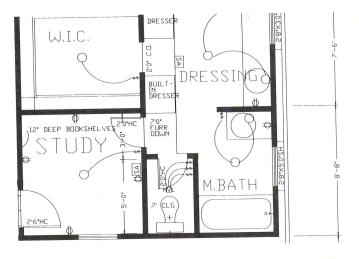
Lansing Pugh, Architect Austin, TX

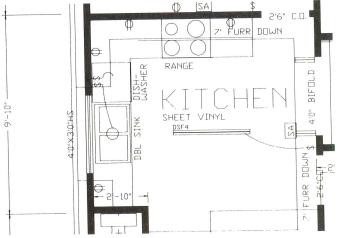
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Marshall Martin, Engineer Los Angeles, CA

"AutoCAD software on a personal computer accomplishes over 80% of the functions of a \$100,000 system for a total cost of less than \$15,000. And, this includes the computer, a graphics board, all the necessary expansion boards, a plotter, and AutoCAD software. That makes sense to me. We improved our productivity by using the data we stored, and making quick revisions on existing drawings. I'd like to see more architects using AutoCAD. They'd be amazed at the results they can achieve using computer-aided design techniques."

Rudolph Horowitz, Architect Pound Ridge, NY





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# Large Firms Change with the Computer

by Dennis O'Brien

It is getting costlier to play in the big leagues of architecture, and automation is subtly changing the rules.

Most of the largest architectural firms have millions invested in hardware and software, and are budgeting big sums for the care and feeding of their systems, including maintenance, upgrades, and especially training.

The giants-much more than the smaller firms—are being pushed into the automation of architecture by clients who are themselves automated and want computer-to-computer communications.

While there are still some notable holdouts, large firms are jumping into computer-aided design and drafting (CADD) with both feet. Often they make the jump not because they find CADD all that efficient, but because they want experience in it for the day when there will be more sophisticated integration of design and construction documents and more automated routines.

Automation has increased the capital investment required to stay in the game, and created a new category of expertthe architectural tool user and manager who creates software and data bases, and has made it possible for the big firms to offer new services like facilities management or to enter entirely new businesses.

Direct computer links have more closely tied big architect to big client.

Some of the new businesses which the larger firms are in or about to enter include time sharing their own main frames and selling or leasing architectural and engineering software. One firm, having automated itself, is offering to do the same, for a fee, for all comers.

#### Prefers to Develop Own Software

One of the most computer-experienced of the big firms is Skidmore, Owings, & Merrill, Chicago, which has written more than 600 software programs. Douglas Stoker, director of computer services, estimates that SOM has

invested more than \$1 million to create software along. Stoker's department, which consists of 15 architects and two engineers, has written most of the application programs which tie architecture, engineering, and project management together for eight offices.

Stoker denies that his is becoming a capital-intensive business or that architectural practice is changing all that much.

"The business is more capital intensive with a greater ratio of invested capital per employee," Stoker feels. "But you can do lousy design with a computer or without it. Great buildings are still designed by talented people."

#### More Work, Faster

For its investment, Stoker believes SOM gets more work, faster, from fewer people. "At the same time, quality is enhanced because so many alternatives can be evaluated and so much data processed.

"The computer shortens the turnaround time between concept and design. And it is sometimes a needed credential for some kinds of work, like that for many agencies of government or the big corporate client who wants all his project data to be machine readable?

SOM has bought software, but usually opts to develop its own as needed. Its Structural Generating System (SGS) package and several programs designed to speed the input of data were developed while SOM was working on the Sears Tower in Chicago. SOM CADD systems include graphics, vast underlying data bases, and a wide range of applications.

#### **Training Is Costly**

While the development and enhancement of software and data bases are the most costly parts of SOM's computerization, on-going training runs a close second. And to remain "state-of-the-art" also costs money. Currently Stoker's department is spending 10 per cent of its time on two massive projects designed to make SOM's computerization more efficient and less expensive. One project is a change in computer languages, from VAX Basic to C. The other is a switch from a central time sharing operation to a distributive network.

Cost savings will be significant. The new setup will allow SOM to add a work station at a cost of \$40,000 compared to \$80,000 now.

On the other side of the make-or -buy argument is Houston-based CRS Sirrine, Inc., which has 3,200 people in 20 offices. Unlike SOM, CRS Sirrine prefers to buy software.

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#### CRS: A 'Knowledgeable Consumer'

"We feel we have gotten more bang from the buck by becoming extremely knowledgeable consumers of software," according to Gerald Pfeffer, director of computer services. "We scour the market and have developed software which helps us evaluate outside software," Pfeffer said.

It wasn't always that way. In the early '60s, CRS Sirrine developed much of its own software. "But often, just as we had developed in-house capability, we found that the market had developed a better alternative. So now, we look to see if what we want is available before developing software in-house."

Pfeffer feels that the computer has forever changed the way services will be rendered and has created a continuing demand for new services.

#### Revolution in the 'Back Room'

Automation is converting the 'back room' operations of service businesses like banks into factories inhabited by a new kind of 'gray collar' worker. So well has CRS learned to automate its own service operations that it has set up a new business—helping other businesses automate their own offices and train their gray collar workers.

"Services are becoming products," Pfeffer says. "We will be developing new 'service products' in the same way that consumer and industrial products are developed. We will start with an idea, research the market, market test, sell the product, refine it, and finally end up with a mature product.

"We will have several such service products in the pipeline at any one time, in various stages, from inception to maturation."

#### Don't Make If You Can Buy

Don't make waves or your own software is the motto at Gensler & Associates, San Francisco, one of the country's largest architectural firms, with 500 employees in 11 offices. Tony Mirante, Gensler's director of computer services, brings in each computer function slowly with a minimum of expense, fuss, and disruption...and absolutely no downtime.

"We always start at the shallow end

of the pool, and by the time we get to the deep end, we are prepared to swim."

Typical of this pragmatic approach is the firm's five-year plan to bring all accounting functions in-house. "First the service bureau did it all. Then we installed micros and began inputting the data for the service bureau processing. Shortly we will bring the processing in-house."

Mirante, who worked at SOM with Stoker in developing SOM's in-house CADD system, bought outside for Gensler. "We opted for an Intergraph 751 system because it is less costly to work with a vendor who has developed hundreds of architectural programs."

#### Don't Build a Bureaucracy!

A big firm can, and should, computerize without building a computer bureaucracy and without hiring people who do nothing but program, Mirante feels.

"If you build a computer department, you end up with programmers seeking too many elegant and costly solutions." Even Mirante spends 90 per cent of his time on client projects.

To get maximum use out of its CADD system, architects and interior designers use it for design work during the day. At night, architectural students from nearby colleges off-load project work done during the day and do "grunt work like making base drawings or red mark pick up."

One of the last of the big firms to automate was Hellmuth, Obata & Kassabaum, Inc., St. Louis. In September, 1981, the 850-person firm hired Charles Atwood, an SOM alumnus, and gave him a management mandate and the cash needed to get the job done fast.

#### **HOK Investment: \$4 million**

In the three years since, Atwood, HOK's vice president and director of computer services, has invested about \$2.5 million in hardware and \$1.5 million in software. Atwood's department of 30 people are hard at work, developing or buying the software and data bases which will give HOK 83 new system capabilities—all in accordance with HOK's master plan.

HOK is even eying the possibility of setting up two new divisions or sub-

sidiaries, one to license HOK-developed architecture and engineering software and the other to do facilities management.

#### **Outside Time-Sharing Clients**

Henningson Durham & Richardson, Inc., Omaha, has been profitably serving as a time-sharing bureau for a wide range of clients throughout the U.S. for 13 years. These clients are linked to HDR's Cybernet 730/173 by terminals. HDR's 22 offices are linked to the Cybernet by means of Datapoint terminals.

While HDR prefers to buy software outside, it has developed a great deal of its own, according to Herman Schmidt, vice president. HDR developed NOAH, a hardware and software package utilized for management and marketing and is offered to time-sharing customers. The firm also co-developed an HVAC program which is called MDP (Mechanical Ductwork Package) with California Computer Products Inc. (CALCOMP), Anaheim, California.

HDR has two CALCOMP systems, a one-station system devoted entirely to research and development and a five-station system for design production. HDR also has a 12-station CDC 2000 CADD system which is used by its engineering group.

Two shifts work the CADD stations, "We tried three shifts, but the odd working hours had a psychological affect on people, so we dropped it," Schmidt said.

Frank P. Gagarin, vice president of marketing for Schmidt Garden and Erikson, Chicago, said his firm experimented with a turnkey CADD system for a few months and decided it was not cost-efficient.

#### **Wants Ball-Point Pen Price**

Gagarin said his firm will get into CADD "with both feet when a capable system is designed and marketed at a ballpoint pen price."

Whether you look upon it as a tool or as an engine which will spawn new services for new markets, the computer seems to have changed big architecture—swiftly, decisively, and forever.







# Creative Financing Makes CADD Work for One Firm

by Rhea Dawson

After three years of investigating CADD systems and the financial implications of acquiring one, one engineering firm has decided creative financing—for now—is the only way to make the system affordable.

For Matrix Technologies, Inc., there were marketing and image issues at stake as well. "If we went with a lesser-name system, our big clients wouldn't be impressed, and a big part of consulting is image. A small firm could use a small CADD system, but it's not the image we need," explains president Roger Radeloff, P.E. His Toledo-based consulting engineering firm employs 50, with a branch office in Clinton, IA.

Radeloff determined there were four possibilities.

- Form a service bureau with three or four other related firms. Ultimately, he wants CADD in-house, so this alternative was not attractive.
- Use a service bureau, at a cost of about \$50,000. The negatives he saw: Their software can't be customized to your needs. And because it has many clients, the bureau lacks flexibility.
- Contract with clients who are committed to using the CADD system sufficiently so that it pays for itself. This eliminates the need for principals to spend their time selling the CADD system's time!
- Establish a joint venture with a local technical college to provide the computer time needed and also to train Matrix employees to use a CADD system.
- "I decided to enter the agreement with Owens Technical College in Toledo for the simple reason that I couldn't afford to buy into an IBM, Computervision or Intergraph system for my long-term needs," Radeloff notes.

#### **Cost-effective Choice**

There are other reasons the financial implications of the Owens venture make sense. "The system we eventually buy must be able to 'talk' to our clients' computers," he adds.

The monthly cost of acquiring and maintaining a CADD system to meet all of Matrix's needs would be about

\$10,000. Radeloff uses this rationale to tally individual costs that comprise the monthly expenses:

- System has a life of three-to-five years. To warrant the capital outlay, productivity gains four to five times over the manual drafting and project management systems must be maintained.
- Hardware from a major manufacturer of sophisticated CADD systems would cost about \$300,000.
- Operating software costs run about \$60,000. This cost doesn't include application software, which must be custom written.
- Monthly maintenance fees average \$2,000.
- Full-time data processing manager to make adaptations to the software and to train operators. Six months' time is the minimum for operators to work up to adequate speed on a CADD system, Radeloff estimates.
- Other costs to consider: Additional equipment, such as a better plotter, digitizer, more memory, modem interface and added software-and required changes that would become evident after a firm had worked with the system.
- Upgrade of the office HVAC system and other modifications needed to house a computer.
- One-year's experimental time to determine which applications of the computer are cost-effective and logical.

#### **Work as Partners**

The joint venture between Owens Technical College and Matrix Technologies is the best of both worlds, for now. A big plus is that the Computervision system already was

in operation at the college before the agreement between the two organizations was reached.

This summer, as partners, Matrix and Owens are applying for a grant from the Thomas Alva Edison Foundation, since they are working together as academia and industry.

The partnership works like this: Matrix rents time from the college. Right now, Matrix employees use the system between midnight and 4 a.m. daily. The schedule is more flexible in summer, when Owens has a lower demand for the system. "We could put a remote station in our office if we wanted to, but our people go right to the college to use one of the terminals," Radeloff explains.

Employees interested in becoming proficient on a CADD system are willing to work the late hours...and in

some cases even prefer it.

But the bottom line is that this arrangement is cheaper for Matrix, and Radeloff believes the firm is learning more about CADD than it would if a service bureau were employed.

"We rent time from the college. But this is more than using the college as a service bureau. A bureau wouldn't teach us anything. The college has trained six of our employees how to use the system," Radeloff says. The college staff also maintains the system and makes recommendations on applications.

#### Marketing, Training Tool

"This is less expensive for us than a service bureau because the college wants to work with us in this pilot program. The cost recoupment for us comes from selling time on the system to our clients," he adds.

Matrix uses CADD to produce process and instrument diagrams, loop diagram, electrical wiring diagrams, conduit schedules, junction box and electrical interconnect drawings, instrument and equipment schedules, and materials lists and foundation plans and details.

"Tying in with the college's CADD system is a marketing and sales tool and also keeps us up to date to see what type of system we'll go with long term," he says.

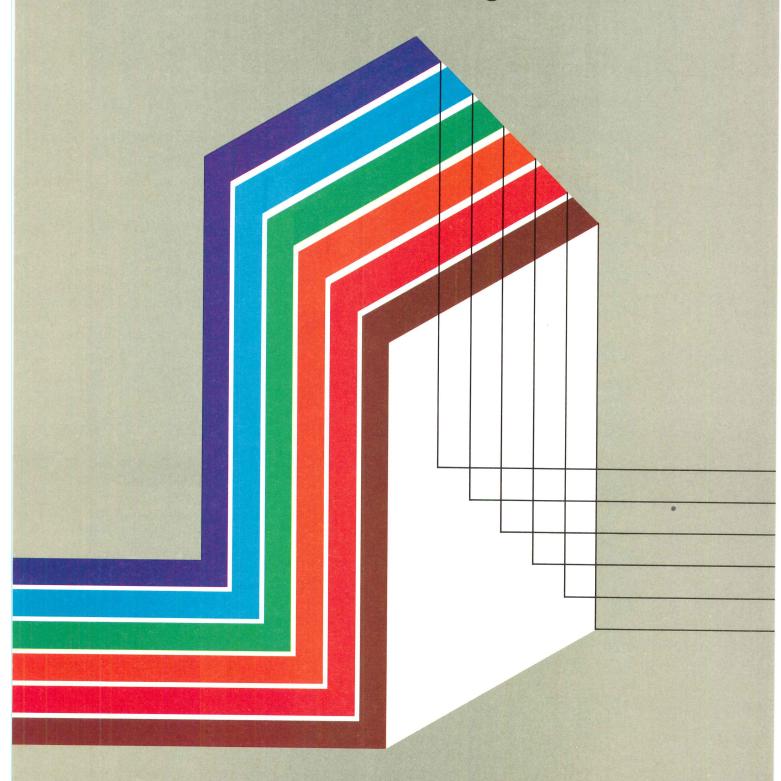
"When I buy a system, I will base the decision on one or two clients who provide sufficient business to us to

support the system.

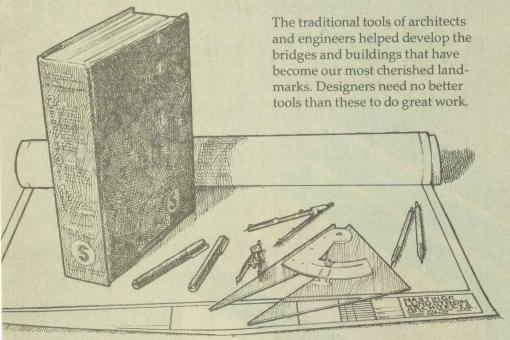
But I would like flexibility, which means that if I buy an Intergraph system it must be able to link up to our client's Computervision system." That's not possible now, but Radeloff believes it will be in another two or three years. "The suppliers could make their computers interactive, but they haven't wanted to up till now."

### CalComp Presents

Tools for Today: The System 25 and The Integrated Design Series



#### An Interactive Design System for Architects and Engineers



But today's competitive environment requires you to consider more than aesthetics; it requires you to save time, money and space as well. Designers now need to control and automate every phase of project planning, design and construction.

CalComp's new interactive design system, comprising Integrated Design software and System 25 hardware, provides the designer with the ability to command the entire process without losing the creativity symbolized by the more traditional tools of the trade.

The System 25 brings you a new concept in computer-aided design; you can select one stand-alone Interactive Design Center or you can configure as large a system as you like by linking Interactive Design Centers together over a Local Area Network.

CalComp's exclusive Picture Processor Technology and 32 bit, dual processor CPU provide unparalleled performance. You can create, produce and edit plans, drawings and bills of materials at speeds that reduce production time by weeks. Increased design and drafting productivity means more creative time (and more profits) for you.

The new, modular software programs of the Integrated Design Series help manage most phases of building design and construction, including:

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- Interiors Planning
- Architectural Design
- Architectural Production
- Construction Costing
- Heating, Ventilating and Air Conditioning
- Facilities Management

Drawings and data from all design disciplines are integrated throughout the Integrated Design process. The construction costing package, for instance, can accept information created during heating, ventilating and air conditioning design.

Each module can operate alone; the real benefits begin, however, when all packages interact. When used in concert, these packages assemble and share access to a common library of information, thus eliminating tedious cross checking and repetition and leaving more time to review and make decisions.

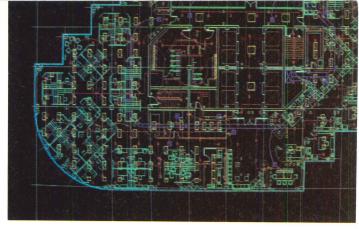
CalComp's Integrated Design Series provides:

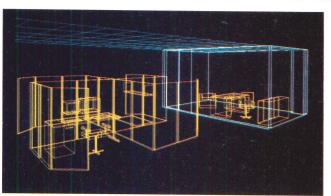
- Simplified revisions and updates
- Standardized drawing elements
- Accurate and coordinated drawings and reports
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Together these features give you, the designer, complete control over a project. At any stage, you can select from a series of choices and automatically update all previous input.

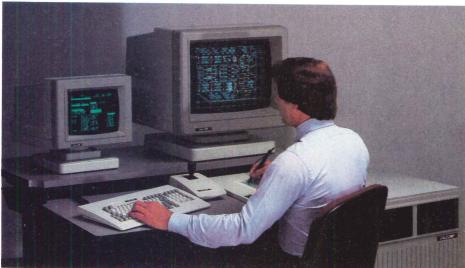
You make the decisions, the system makes the drawings.

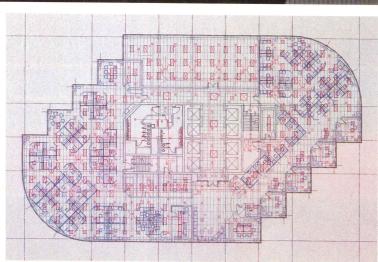


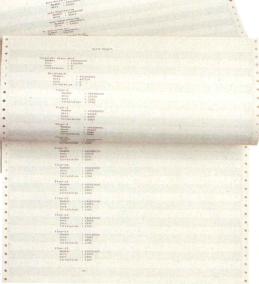


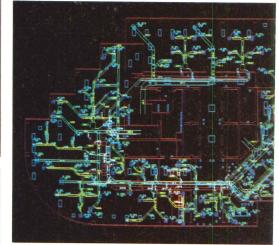


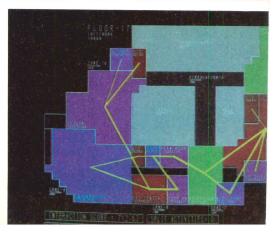












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### FOUNDATIONS

Bruce D. Sanders, Ph.D.

So you've decided to get a computer for your office? Or you already have a computer, and you find that it isn't as useful as you'd hoped? In both cases, you learn from experience.

The common mistake made by businesses acquiring computers: Failing to keep your focus on what you do for a living. Too many people in too many organizations buy or lease a computer the way they might buy a record player. You find a nice stereo system, and then you look for some good records to play on the system.

But because of different industry standards, you can't do that sort of thing with computers. You might find a goodlooking piece of equipment, but sometimes you can't find the software the set of instructions—to perform the jobs you want to complete.

If you already have a system that doesn't do as much as you'd hoped it would, beware so you don't repeat that mistake when you make your next purchase!

Begin by pairing what computers do best with what you want your organization to do. List the ways that you can use computers. Then locate the software to do those jobs. Then, and only then, carefully select your hardware. Next comes installation of the system, followed by integration into your work routines, and upgrading or revision of the system over time. Throughout the process, keep your focus on what you do for a living. Automation is the answer, not the question.

Targets of Opportunity

The pairing of what computers do best with what you want your organization to do has been called spotting the targets of opportunity. So many of the fundamentals of automation change so quickly that it's reassuring to know that the signs of targets of opportunity have remained much the same years.

• Large volume. If you do a great deal of any one type of task, consider automating it. Computers are at their best performing routine, repetitive chores, doing the same thing a million times in a row. People, on the other hand, enjoy changes in routine. By giving the routine work to the computer, you increase accuracy and worker satisfaction. And you save money.

In many offices, preparing letters and keeping financial records are largevolume tasks. Rather than having an



office worker type similar paragraphs in different letters, have standard paragraphs stored in the computer's memory and trot out these paragraphs to be customized for each letter. When keeping financial records, use software that places each entry in all the right ledgers.

- Fancy math. Computers can add, subtract, multiply, and divide with great precision. They also can make logical comparisons, seeing if one number is greater than another, for example. Automate tasks that involve manipulations of numbers. Examples of such tasks include scheduling and job cost estimating.
- Time pressure. Computers operate at superhuman speeds, but computers do cost money. Identify tasks where the machines will earn their keep by saving money or making money through quick action. One example of such a task in many organizations is cash management. The best cash managers are those with the least cash, for the money is out earning more money through investments. However, the death of many organizations begins with limited liquidity, so skilled cash management involves quickly moving money from one pot to another.
- Common source document. A source document is the paper that you write on or type on that contains information to be entered into the computer. An order form is often a source document, as is a list of item

costs. If the information on one source document can be used in many different ways, it is a natural for automation. Often the information from one form sets off project scheduling, cost accounting, materials management, and subcontracting or delegating. Good computer systems have integrated software, which means that once the information from a source document is entered, it can be used in a wide variety of ways.

• Willing employees. Automate in places where people are willing to have the computers come. Look for people excited about working with a desktop computer. Look for employees who want to learn about office automation because they hear it will make their jobs easier or because their children are learning about computers.

There are times when you must deal with employee resistances as part of the automation process. This is especially true in small organizations because you don't have enough employees to simply work around the resisters. Then the challenge becomes finding the sorts of tasks employees

are more interested in automating.

Finding the Software

After you've identified your organization's targets of opportunity, find the software to do those jobs. Select software before you select hardware because the software that handles the targets of opportunity in your firm may work best on certain kinds of

Software—that set of instructions that tells the equipment what to do-comes in two flavors, custom and packaged. In large organizations, custom software might be written by programmers who work for that organization. Often contract programmers working independently or in a service bureau are hired to do custom programming. Good custom software fits the strengths and limitations of your organization and your organization's computers.

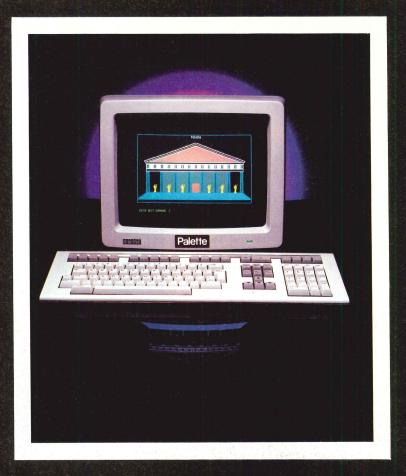
Good packaged software, also called canned software or off-the-shelf software, does a group of jobs well for many different users. The disadvantage of packaged software is that it is not customized to your needs. However, the cost advantages of packages are so great that it makes sense to look first for a workable package to see if one exists...or if an existing package can be customized to meet your needs.

But how do you find the packages to meet your needs? Actually, there are three problems:

 How do I find out what packages exist? Many hardware vendors are pleased to give you directories of software that will operate well on their machines. Software vendors provide

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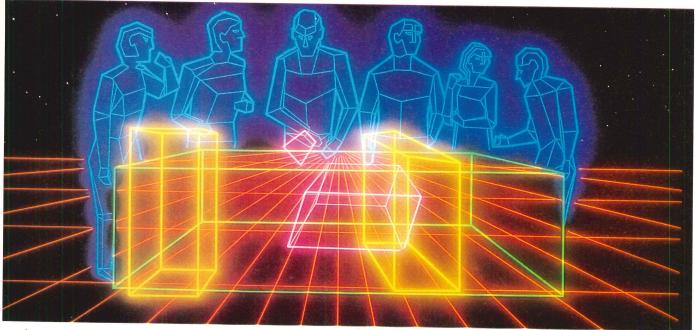
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catalogues of their respective offerings. Most microcomputer periodicals regularly review software packages. There are organizations that publish both comprehensive directories and directories of software for particular applications. Among these organizations are Datapro Research Corp., in Delran, NJ, and International Computer Programs, Inc., in Indianapolis, IN.

Don't select a package based just upon its listing in a directory. The directories are useful in finding out what is in the marketplace. You'll want to follow up by contacting the vendor, perhaps talking with data processing professionals, and also judging the quality of the software, which leads to the next problem.

 How do I judge software quality? Directories aside from those published by software vendors frequently include quality ratings. Look for tests of quality that involve giving the package to a group of business people like you and asking them to try it and report on it. An alternative is a survey of users of that package. Conclusions from these sorts of tests are more directly related to your needs than surveys that present a package to a few data processing professionals to ask them what they think of it.

A related method for judging software quality is to talk with members of user groups. A user group is, as you would expect, a group of people who use a particular hardware system or a particular software package or use computers in a particular way.

Ask the software vendors you're shopping with if a user group exists and, if so, how to contact the group. Then ask some of the members what they think of the software package. At first glance, it would seem that members of a

user group are a biased population. After all, these are people who have decided to stay with the software. But if a software product is inferior, the user group may be applying pressure on the vendor to make changes. If that's the case, members will no doubt be pleased to provide you a stirring narrative of their tribulations.

And don't forget another nice way to judge quality-try out the software, which leads to the third issue.

• How can I try it out? In reality, you won't really be trying out your software until you use it for a while in your office. But keeping this in mind, you can get some ideas about how the software works.

If you are making a large purchase, the vendor may be willing to arrange a site visit to another installation. Trade shows can provide you an opportunity to at least fool with the software. User group members may enjoy showing off a package and letting you try it out. A number of retailers hold classes in the use of popular software packages. Don't be surprised if there is a fee for the class, but ask to have your fee credited towards a subsequent purchase of the software.

#### Finally, the Hardware

When you find some promising software packages, the decisions about hardware are easier. As you look in the software directories, most listings will say what engines are best for driving each package. As you talk with members of user groups, you'll hear software and hardware discussed as parts of a system, not in isolation. As you try out the software, you'll be trying it out with a certain hardware configuration.

Encourage the people who will use the system day after day to participate fully in deciding what comes into the office.

Realize, however, that the unfamiliar is frightening, so you may want to ask employees to stretch their muscles and give a new system a fair trial. The IBM Personal Computer keyboard has the keys arranged differently, spaced differently, and at a different angle than on the keyboard of an IBM Selectric. But after using the IBM PC keyboard for a brief time, as on a site visit, and talking with others who use the new keyboard, the secretary may decide that the key arrangement, spacing, and angle are the products of a genius.

Although you make your final decisions regarding software before your final decisions regarding hardware, the decision-making process overlaps. In addition, there is one perfectly acceptable blatant violation of the rule, "Software before Hardware". You may be wise to place your order and place a deposit on hardware before placing your order for software. Packaged software usually can be delivered quickly, but there is a much longer delivery time for many hardware systems. Having your fresh new software diskette and manual with no hardware to use it on is as frustrating as having a brand new record with no record player.

In at least this way, acquiring a computer system is, after all, like acquiring a stereo system.

Bruce D. Sanders, Ph.D., is the author of Computer Confidence: A Human Approach to Computers, published by Springer-Verlag. He is the director of Sanders Seminars, based in Vacaville, CA. Dr. Sanders produces and presents seminars throughout the U.S. about computer systems and office automation.

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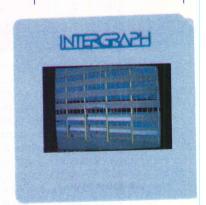
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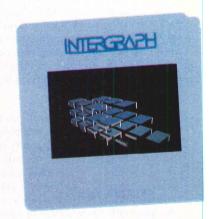
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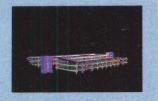
Construction **Documents** 

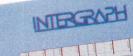
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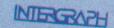
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# The Financial Implications of the Computer for Architects

by Dennis O'Brien

Architecture is being transformed from a labor-intensive into a capital-intensive business.

That is the feeling of many architects, both large and small, as they ponder how the computer—and the large investment it requires—will affect the business of architecture.

Some are even convinced that architectural firms with large computer outlays will, like big auto manufacturers, operate in shifts to get full utilization from the equipment.

Others feel the big firms, better able to make substantial capital outlays, will have an almost insurmountable competitive advantage over the smaller firm. The more automated of the smaller architects say the smaller, nimbler organization can better integrate computers into its operations.

Another scenario: More architectural firms will be pushed into engineering and construction so that more functions can be handed over to the computer, thus maximizing its efficiency.

Still others think the cyclical nature of architecture will be made less so by automation. Architects will tie themselves to long-term clients with such computerized services as facilities management or subspecialities like communications planning.

Whether large or small, architects who have successfully integrated the computer into their practice say that it reduces manpower requirements, adds new capabilities, makes them stronger competitors, and more closely involves the client in the planning and decision-making process. Most feel computers improve the bottom line, but are hesitant about quantifying dollar benefits.

Lawrence D. Boozer, director of computer operations for Zimmer-Gunsul-Frasca Partners, a 70-person firm in Portland, OR, uses the computer for word processing, job tracking, specifications, and financial management. "Without the computer we would need to triple our accounting staff to handle all of our projects."

The computer, according to those who have tried it, also:

 makes the bidding process more precise. • allows better decisions to be made earlier in the design process, because more data can be processed and evaluated.

gives a better handle on architecture as a business by more precisely controlling projects, billings and payroll

The computer confers many nonfinancial benefits which can attract new and repeat business. There's undisputed razzle dazzle in using a computer-aided design and drafting (CADD) system to "spin" a building graphically, in 3-D and full color, while the client watches the screen.

Getting into computerization at the word processing and spreadsheet levels can cost as little as \$3,000 for a complete work station, such as an Apple IIe, CRT monitor, disc drives, and software. In fact that's where the smaller firm without any computer capability probably should start. "While you are trying to make up your mind about computers, get an IBM PC or an Apple and just put it in the office," suggests David Thompson, an associate of RTKL Associates, Inc., Baltimore. "Play with it. See what it can do."

Howard Kessler: Economic overkill.



From word processing, a natural progression is financial management, including general ledger, project correspondence, mailing lists, accounts payable and receivable, payroll, billings, contracts, proposals—and finally CADD.

But make haste slowly counsels Charles Davis, founder of Davis Associates, a 13-person firm in Chicago that is perhaps the world's most automated. "Implementation must be made in a methodical manner, step by step."

#### Some Say CADD Too Costly

The long leap into CADD requires a substantial investment. A turnkey system from Computervision which includes hardware as well as a number of software packages—mechanical design, architecture, piping, plant design, cartography, wiring diagrams, and many others—sells for \$100,000 to \$350,000 and beyond.

More modest stand-alone CADD systems range in price from \$45,000 to \$60,000. Typical of these is the Graph/Net system offered by Graphic Horizons, Inc., Boston. It includes a CRT, drafting desk with tilting top, and a "puck" which the operator moves over the desk to "draw." Software is also provided, including programs for layout optimization and perspective analysis as well as symbol libraries. The price includes installation, and training in the architect's office.

Howard Kessler of Kessler, Merci, and Associates, Inc., a 10-man, Chicagobased firm, sums it up for many. "CADD systems just aren't there yet in terms of pay back. Drafting is the easiest application to automate, but also one of the least expensive services a firm can buy. At today's prices, a CADD system, for the smaller firm, is economic overkill."

#### **Time Sharing**

Some firms introduce themselves to CADD through time-sharing arrangements. Zimmer-Gunsul-Frasca is working with an engineering firm on a \$45 million, 90,000 square-foot research facility for Oregon Health Sciences University, using CADD for design and engineering drawings. Zimmer-Gunsul pays up to a maximum of \$5,000 a month to CADI, Inc., a Seattle service bureau. "On the basis of our experience on this major project, we will decide how and how fast we will be moving into CADD," says

Larry Kasser of Lawrence Kasser Associates, Saxtons River, VT, with only two full-time employees, managed to plunge into CADD with a lease outlay of only \$1,200 a month for five years for a \$60,000 Graphic Horizon System, including a \$5,000 plotter to make hard copies of drawings. Kasser skipped spreadsheet and financial

management applications entirely, going right into CADD. His assistant, an architect from Bangladesh who had never even seen a computer, "produced a full set of project drawings within three days after we sat him in front of the screen."

One economy offered is storage: "The drawings are on disc."

Time consumed in drawing, design, and production of documents has been reduced about two-thirds. Kasser also is building a data base of details of projects already done including listings of typical kinds of spaces, and components of those spaces like doors, wall finishes, carpeting, floor finishes, and furniture.

"Whenever we can re-use those spaces, we will be getting another payoff on our investment."

Kasser feels his system pays for itself by enhancing his ability to meet his clients' requirements and aesthetic expectations.

"We figure that the CADD unit is an employee that costs \$7.50 an hour, about what a clerical employee would

#### Leasing Arrangements

At the end of the lease period, Kasser can buy the equipment for about 10 percent of its value. His lease arrangement "passes through" the 10 percent investment tax credit.

Most equipment is leased for periods of three to five years or else purchased outright. Typically, leases provide for the buy-back of the equipment by the lessee at the end of the lease for a nominal amount.

Many firms lease major hardware and software from the partners. That is how RTKL recently acquired an Intergraph system costing \$750,000. The partners obtained a bank loan, bought the equipment, then leased it to RTKL.

The benefits in such a case are that partners qualify for investment tax



Larry Kasser: Enhances performance.

credit, the first-year expensing privilege, and depreciation over the five-year lease. The payments are deductible business expenses for a company which at the end of the lease period may buy the equipment outright for a nominal sum. If it does so, a firm can depreciate the equipment again, using the purchase price as the depreciable basis.

"We liked Intergraph because it is based on the VAX, an industry standard, because of its data base capacity, and because we felt the company had the largest commitment to the AE market,"

#### Fast Tax Write-Off

Hardware and software can be written off on an ACRS (Accelerated Cost Recovery System) basis over a period of five years, provided the equipment went into service after 1981. If ACRS is chosen, the depreciation is spelled out in IRS tables: 15 percent for the first year, 22 percent for the second, and 21 percent for the third, fourth and fifth years.

There is also a one-shot deduction of up to \$7,500 which may be taken in 1984. The law allows this amount to be expensed in the year of purchase rather than depreciated. The 10 percent

investment tax credit can be taken only for the amount remaining after the first-year expensing amount is deducted.

So on an investment of \$65,000 for a stand-alone CADD unit and plotter, \$7,500 of the cost may simply be expensed for the first year. The \$7,500 must be subtracted from the \$65,000 to arrive at the amount which is eligible for the 10 percent investment tax credit.

How to best handle the first year one-shot expensing deduction (which will rise to \$10,000 in 1986) and the investment credit should be left to a firm's tax expert.

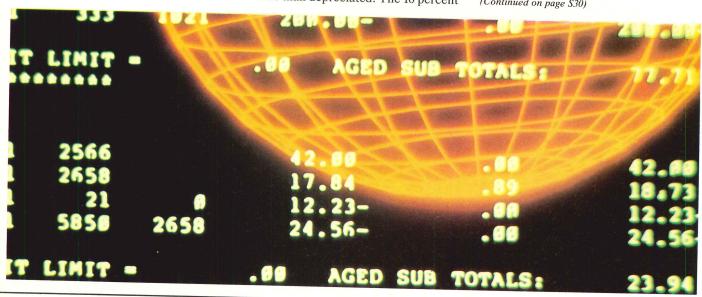
#### Capital-Intensive

Davis Associates does nearly all of its work on computers and has \$300,000 invested in them, for a per employee investment of nearly \$25,000. Davis who was director of computer operations of Skidmore, Owings and Merrill before founding his firm, has written nearly 1,300 software packages. These include a program which calculates the energy effects of the sum as it travels around a building.

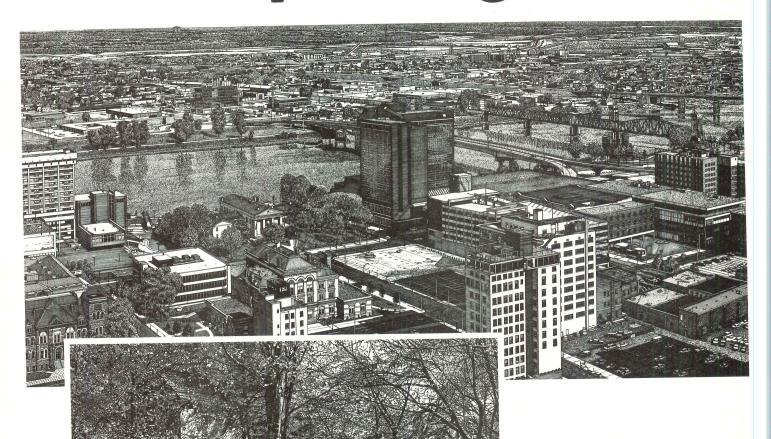
For Davis, the computer "adds a new dimension of service." He recently used it to compare how well 11 existing buildings and a proposed new building would suit a client's needs. The computer-generated analysis included what the impact of each alternative structure would be on the client's earnings per share projected for the next 15-years.

Computers may well exacerbate difficulties caused by architecture's cyclical nature. People trained in both architecture and use of the computer are valuable and hard to replace. "On the down cycle you can't afford to get rid of the equipment and you can even less afford getting rid of people," Davis says. Therefore, architects will increasingly pursue less cyclical,

(Continued on page \$30)

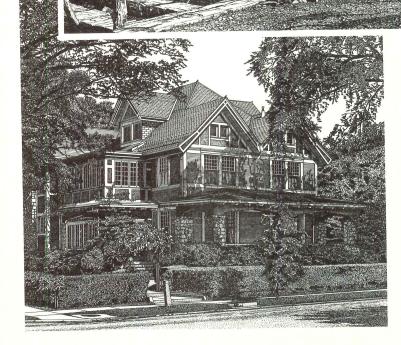


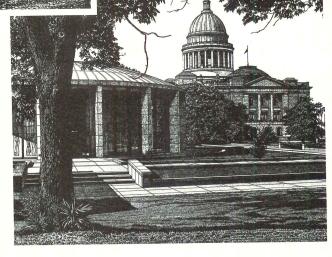
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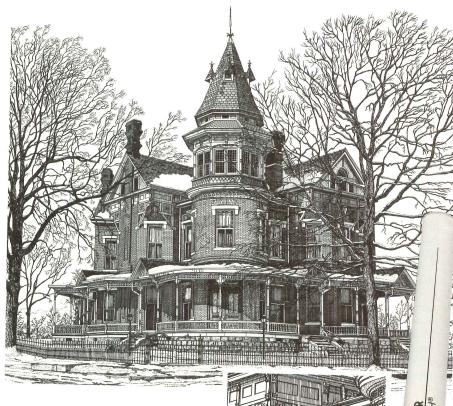
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### **Product Reviews**



#### Competes with Low-Cost CADD

Graphics software, developed by Martinet Corporation, competes with low-cost CADD programs. The software program produces high-quality detailed color graphics on high-resolution desktop terminals. Program is \$3,000, available for purchase in-house or through time-sharing bureaus. Software features user-friendly command prompts, flexibility to create lines, curves, polygons, circles, etc., from a palette of 64 colors, capability to view four perspectives at once, ability to fence off areas for drawing changes, and zoom in and out features. Program includes grid command so accurate pinpointing can be made, vendor claims.



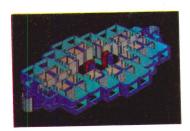
#### Streamlines with Universal Parts

Harter Corporation introduces the Harter I/F system of integrated computer support furniture. Key benefit, claims manufacturer, is the universality of parts; there are neither rights nor lefts. Other benefits of the freestanding work stations within the line are efficient power/communications distribution, ample overhead storage and infinite linkable arrangements, which saves floor space and increases efficiency. Line includes adjustable, semi-adjustable and non-adjustable VDT stands and is available in 12 finishes and 9 laminates.



#### New for DEC Pro 350

Palette CADD software, by Palette Systems, Inc., is now available on the DEC Professional 350 personal CADD station, in addition to remaining available on the DEC VAX and PDP 11 computers. Palette on the Pro 350 provides the same functionality and performance normally found in larger computers, company claims. It has the capacity and speed to draw full-size working drawings with detail. All Palette files are compatible over a wide range of Digital computers, so low-end CADD can be introduced and upgraded to a larger system without re-creating the data base. Palette provides costing on 25,000 construction items; basic drawing capabilities include arcs, ellipses, polygons, parallel lines, French curves, cross-hatching, shading, line thicknesses, line textures, layering, and various sheet sizes.



#### **Skok Introduces Artech**

SKOK Systems introduces a new high-performance, low-cost CADD system-Artech-for architects and engineers. The work station includes a powerful 32-bit Hewlett-Packard computer and can be connected in a network, displays two- and threedimensional images on a 19-inch color screen, and enables users to enter operational commands via a graphics tablet. The tablet contains more than 300 directly accessible instructions. Artech can also be upgraded. The Artech DesignStation is priced at \$27,000. A fully configured systemincluding all hardware and software for a functional entry-level system-is priced at \$59,500. It includes a complete work station, a dual disk drive, a D-size plotter, and SKOK's Arplan™ two-dimensional design and drafting software.



#### **Autodesk Updates**

Autodesk Inc. has introduced another revision of its AutoCAD software. The software is intended for professional and precision drawing applications including schematics, space planning, mechanical drafting, architectural drafting, graphics design, and free-hand sketching.

The new release adds these features to AutoCAD: a "break" command permitting partial delete of drawing elements, "cross-hatch" command to permit the use of user-defined hatch patterns along with a library of 38 pre-defined patterns, a free-hand sketch mode, fillets, automatic polygon close, alternate arc/circle specifications, circular/radial arrays, alternate text fonts, and units in scientific, engineering, decimal, or feet and inches.

AutoCAD is written in "C" and operates on 15 microcomputer systems.



#### Features Ergonomic Design

Systemate line of moderately priced, fully adjustable ergonomic furnishings has been introduced by the Magnuson Group. Work stations are offered in split-top styles with tandem or individual height adjustment of keyboard and CRT surfaces. They are fully heightand tilt-adjustable under heaviest computer hardware loads, including CADD, supplier claims. Products feature twin bevel-gear drives with anti-friction thrust bearings for effortless, positive height and tilt adjustment by operator from seated position, manufacturer says. Mobile storage cubes and ergonomically adjustable seating are included in the line, which has work surfaces from 36 in. to 72 in. long and connectable at angles of 90, 120 and 135 degrees.



#### CAD with 32-Bit CPU

System 25, a new computer-aided design (CAD) system from CalComp features a 32-bit central processing unit, distributed processing, and a modular building approach that enables system expansion. It combines microcomputer technology with Cal-Comp's high-speed graphics display subsystem. It generates bills of material, creates or edits drawings and plans, generates ancillary information from electronically stores drawings, and provides control of design information. Features include VAX™ compatibility, Ethernet™ local area networking ability a UNIX™ operating system and Multibus™ interface technology. The system consists of two displays—a 12-inch alphanumeric screen and a high resolution (20-inch monochrome or 19-inch color) graphic screen-and keyboard.



#### **Scans Drawings into CAD**

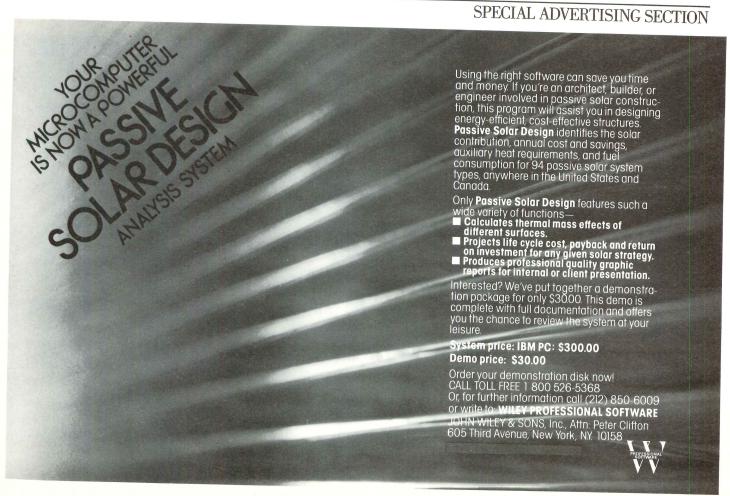
Formative Technologies, Inc., (FORMTEK) produces CAD systems that mix raster and vector images and eliminates manual copying. Called FORM:SCAN, the automatic raster scanning software allows users to incorporate any existing drawings into CAD—from size "A" to "E," bypassing tedious hand copying or digitizing, supplier says. After the image is in the system, FORM:SCAN can scale, pan, zoom, rectify, or resize it to produce accurate size-corrected raster drawings. To convert the raster to a vector drawing, one uses a transparent overlay window in FORM:DRAW, the drafting system. The output is then available from the plotter. It is also possible to combine raster images with scaled vector drawings without redoing an entire drawing. For example, a user may take a scanned floor plan image

as background, and using FORM:DRAW replace only the necessary area with an intelligent vector drawing.



#### **Automates Project Management, Billing**

Timberline Systems Inc. introduces a package called AEPEX and designed for architects and engineers. It allows architects and engineers to automate their project management and billing. AEPEX is priced at \$4,900 and includes four modules: architect/engineer, general ledger, payroll, and accounts payable. The package runs on personal computers manufactured by IBM, Texas Instruments, DEC, and SAGE.



(Continued from page S25)

long-term businesses like facilities management.

Davis is quick to quantify benefits of the computer. "Without automation, we would need 35 to 40 people to produce the amount of work we turn out now with a staff of 13." He estimates that about half of his firm's work is done on the computer, representing a third of all billables.

Jana Davis, who oversees financial management and administration, says she would need three or four additional people to do all that she now does with a computer.

Another change the computer has wrought: "It is cutting out lower-level positions," Davis says. "Getting experienced people who are familiar with our computerized operation is difficult. Training for us is a major problem which impacts our growth."

#### **Charging for Computer**

How should clients be charged for computer use? Larger firms, particularly those with elaborate CADD systems, charge wall clock rates for some functions like data entry and a special per second rate when the computer is being put to its highest and most intensive use in a number crunching application like structural analysis.

Davis and Thompson feel that a firm should try to get back three times the annual costs capitalized of the hardware and software costs, plus overhead which is assignable to computer use. Both admit that they don't always reach this goal.

Some firms bill computer time directly to the client when the client agreement permits this. On a lump sum contract, computer time is billed internally to the department using the time.

Kasser's two-man firm in Vermont charges clients for computer usage on an hourly rate which includes prorated overhead plus a gross mark-up. Where the contact is for a lump sum, Kasser includes an estimated amount of computer time.

#### The Real Advantage

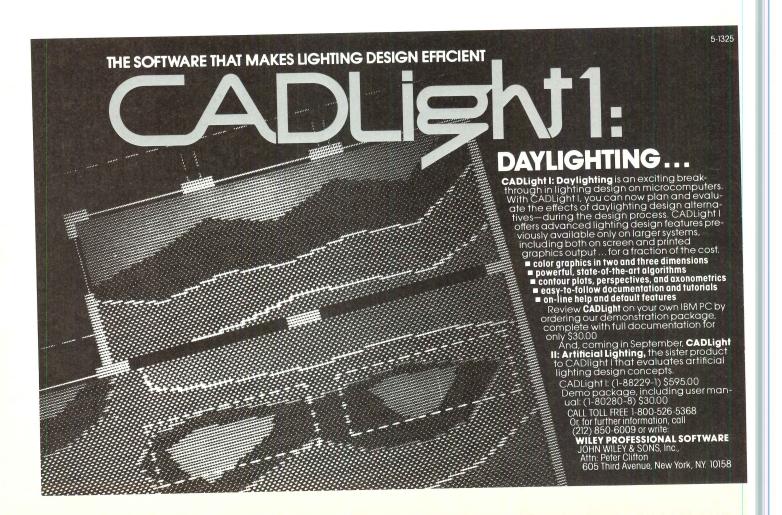
But every architect interviewed by DP/ARCHITECTURE stressed that the objective in adding computer capability is not primarily to make architecture more profitable, but to

make the staff more productive, add capabilities and products, or simply to come up with better architectural solutions.

Davis disagrees that capital investments by the larger firms are making the business capital intensive. "The big firm with several million dollars, in hardware and software, is still investing less than \$5,000 per employee. That level really doesn't qualify as capital intensive."

Davis is apparently delighted with his own computer investment. "Any firm, large or small, which doesn't automate to the hilt is missing a great opportunity. They are forcing themselves to manage with less information, design with less information about the clients needs, and produce work of less quality. It won't be long before the marketplace either denies them a place or forces them to automate."

SPECIAL ADVERTISING SECTION



Zoom to change scale and pan over full "E" size drawings

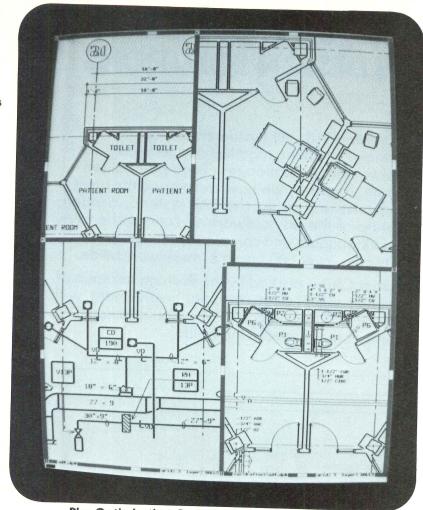
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his or her own acts. An employee is liable for illegal, negligent, malicious or tortious acts, even if they receive no benefit and all of the proceeds go to the employer. If the employee acted within his or her authority and within the ordinary course of the business, the employee may under certain conditions recover reimbursement for losses from the employer. If both are liable, each may try to recover losses from the other. An employee may also be criminally liable under state licensing statutes if the conduct in question was sufficiently egregious.

There are other areas in which the interests of staff and owners may not coincide. Where there have been promises of bonuses or partnership or corporate participation, disputes may arise because of the vagueness of the promises. Disputes about overtime are becoming more frequent, according to Weisbach. Federal and state laws dictate that non-professional, non-managerial employees must get time-and-a-half for more than 40 hours of work a week, and it has to be paid in the first pay period following the work. It is illegal for employers to offer compensatory time to non-professionals for overtime. Historically, most A/E firms have classified all their employees as professionals and/or managers, thereby making them exempt from the legal requirements for overtime pay. This practice is now more frequently questioned. Because of the severe penalties for the employer who mis-classifies—large fines and double compensation-Weisbach says he "gets on it very fast" if his clients are involved in an overtime dispute.

Other disputes arise over professional credit for design work, which can cause ambitious employees to leave the firm and can reduce a firm's ability to recruit if it develops a reputation for denying staff recognition.

#### Owning the business and other good news

With the decline of some industries, such as steel, there is a national trend toward employee ownership, which may have an impact on the way architectural firms are organized in the future.

A major Texas-based firm, Caudell Rowlett Scott, has developed a plan in which 60 percent of the company's stock is employee-owned. The company is presently introducing a 401(k) savings and investment plan, to which CRS contributes a matching 12½ percent in company stock. The employee can invest up to 6 percent of total annual income in this tax-deferred income plan each month. With new tax laws, says Ed Agostini of CRS, "any company can do it."

John Myer, head of M.I.T's architecture program, applied employee ownership in a small Boston architectural practice.

"I got to a point 15 years ago," Myer says, "with a limited partnership of three, where I began to feel that there was really a need . . . for everybody in the office to have a sense of self-value and position, and a place that they could invest in and contribute to as fully as possible."

They started a collaborative system, where the number of stock-holders was increased and the new stockholders were brought into a decision-making process, "a kind of forum." They found that this was creative and energetic and "a way to work in an expanding market." But they also found that this form of organization brings difficulties in a falling market, because of the need to make decisons about reducing staff when the work load drops.

"The constant up and down ever since has become one of our major preoccupations," Myer admits. His firm has arrived at a compromise: while maintaining the number of stockholders, they have limited participation to 25 percent of the staff.

"This seems to provide strength and energy to the firm, and fewer differences and difficulties with employees compared to a smaller proprietorship."

The firm maintains a sort of mentorship in which young employees are tracked in a caring way, so that they know that there is someone in management who is aware of their abilities and can help when they are being blocked.

"They are putting their license on the line for the convenience of the firm," Weisbach says. "It's only fair that the firm picks up the liability."

Another trend in improving the working environment is a return to the studio or workshop concept common to European firms, in which people are grouped and not lost in a large organization.

"This," says Myer, "breaks up a monolith into smaller working groups of 15 or 20, setting off the scale of jobs, and gives people something they can identify with."

#### TECHNOLOGY A POSITIVE

The expanding use of computer technology may change the role of the staff architect from "hired hand" to "highly paid technocrat," according to Paul Lurie, a management consultant to design firms and principal in the Chicago law firm of Fohrman, Lurie, Sklar & Simon. Architectural firms are making a substantial financial investment in computers and in the people operating them; there is an increasing motivation for holding on to staff with this specialized training, Lurie observes. He also predicts that the growing tendency of architects to acquire more business training will increase their ability as employers to perceive the direct relationship between their employment policies and the profitability and managerial efficiency of their firm.

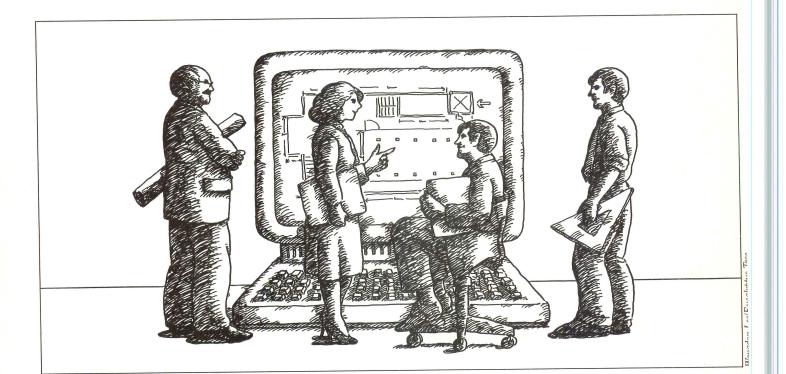
Architects beginning careers today have opportunities to contribute to the built environment not only as traditional designers, but as real estate developers, as business and sales executives, as architectural researchers, or as facilities managers for corporations large and small. There is a trend among students to acquire double degrees—in architecture and business, or architecture and engineering. The broadening role of architects is changing the classic model of the architectural firm as well.

The more sophisticated, multi-disciplinary, business-oriented staff architect is concerned with participation, with job security, with getting new business, and with the operations of the firm, and is better able to contribute on these levels. As the roles for young architects proliferate, the young architect has greater opportunities for autonomous management of his or her career, in corporations as well as in consulting firms. And all of this bodes well for the young architect who prepares for it.  $\square$ 

Ann Nydele is a New York-based market communications consultant and writer who has worked as a business development director for well-known design firms.

## Affordable CAD

By Oliver R. Witte



OW THAT COMPUTER-AIDED DESIGN has moved within the financial grasp of most architects, the issue becomes whether it is worth the investment.

The need for an affirmative answer is great. A small but growing number of design clients, led by some agencies of the federal government, are insisting on CAD capability. Other clients don't care how the design is produced as long as costs, including the designer's own fee, are cut to the bone. To prosper, or even survive, in this competitive environment requires that small firms have access to much the same kind of productive technology available to large firms.

To find out whether low-cost CAD is a tool or a toy, eight months ago we launched a comprehensive investigation of computer application.

Six programs were identified as potentially suitable for professional use and 14 architects, mostly in the Chicago and Milwaukee areas, were invited to put them to use in

their offices. The standard was whether it appeared that they were at least as productive as conventional methods on routine drawings.

The evaluators were organized into teams, each working with one program. The programs reviewed include AutoCAD by Autodesk; CADPlan by PersonalCAD Systems; Drawing Processor by BG Graphics; MicroCAD by Computer Aided Design; RoboCAD2 by Robo Systems; and VersaCAD by T & W Systems.

The climax of the evaluation was a "shootout" at which each team reported its experiences with its program to the other teams. The presentations included drawing a series of compulsory figures, followed by a freestyle event at which the teams were encouraged to show the unique capabilities of their programs. Then, at a round-table, three questions were posed to the evaluators. The questions and their answers:

■ *Is low-cost CAD ready for professional use?* Yes. Are you ready?

- What should I expect? Rough going with the hardware, but generally smooth sailing with the software.
- which is the best program? You can't go wrong with any of the six. They are intensely competitive, with each new release usually leap-frogging the pack. The best program may be the newest. The evaluators generally supported the programs they worked on. A chart showing how they ranked each program appears on a following page. The right choice for you depends mostly on you. But read on.

#### THE COST OF CAD

"Affordable" for this evaluation means under \$15,000, everything included. The nearby table shows how it might be spent.

Computers used in the evaluation were the IBM PC/XT, Compaq and Apple II. The IBM and Apple were selected because they and their compatibles support the broadest range of software for CAD, word processing

ARCHITECTURAL TECHNOLOGY

and financial management—the applications most often needed by architects.

Beware of false economies. With an IBM or compatible, buy at least 512K RAM, a hard disk, two serial ports and one parallel port. Budget for installation and training. Get a good digitizer and plotter. Sure, the programs will run with less RAM and dual floppy disk drives. But if \$2,000 or so is make or break, consider waiting. The cost in lost time and suffering will be too high.

Justify the computer purchase for word processing, specifications and financial management. Consider the cost of CAD only as the increment for the extra RAM, plotter, digitizer, software, co-processor and mouse, or about half the total. And consider spending more, perhaps \$17,000, for a  $36'' \times 48''$  plotter.

The programs evaluated here were selected because they fit within the \$15,000 system price and because they seem to offer architects the opportunity for greater productivity than conventional design methods.

#### CAVEATS

As an indication of how fast CAD is moving, the last architecture licensing examination contained a CAD question (orchids!) but neglected to offer the best answer (onions!). The question:

For what phase of architecture would CAD be best used?

- a. Programming.
- b. Design.
- c. Construction documents.
- d. Specifications.

The third choice was true a year ago. Today, the right answer is all of the above or whatever the architect needs at the moment.

It's hard to write accurately about CAD for anything published less frequently than a newspaper.

During the course of the evaluation, every one of the six cooperating software vendors produced a new version that made the previous version look like a toy. Between the copy deadline for this issue and its publication, we expect at least three vendors will update their programs, with similar impact.

Our choice was whether to write about history or promises. We chose history because we have learned a new word: "Vaporware." It's software that's "on the truck." Trusting schedules by the computer industry is risky, so we write what we see.

What we offer is a report of our experiences as working professionals, not a

## CAD SHOPPING GUIDE

Computer, 256K RAM, 1 Floppy, 1 Hard Disk	\$4,400
Extra 320K RAM Memory	500
Disk Operating System	. 75
Multifunction Card, 64K.	450
8087 Co-processor Chip.	250
Monitor and Graphics Card	925
Plotter, 24 by 36 Inches.	
Digitizer, 11 by 17 Inches	3,000
Mouse	1,125
Installation Training	300
Installation, Training.	1,400
CAD Software, Maximum	2,500
TOTAL	Φ1.4.00E

Includes 640K RAM memory, 10 megabytes of permanent data storage, all cabling and connections, built-in clock, two serial ports (one for digitizer, one for plotter), one parallel port (for printer), color, and warranty and software updates for one year. Excludes printer and tax. Prices, quoted at list and rounded up to nearest \$25, are allowances and are not intended to imply brand recommendations.

technical analysis by computer specialists. When we say a program wouldn't do something, we mean it wouldn't do it for us, at least not smoothly enough to suit us.

Just when we were getting comfortable with one version, the next one—vastly superior—would come our way. Comparative judgments apply only to the six programs under evaluation.

#### THE CUTTING EDGE

We write CAD with one D and call it "design" because drafting is only one capability of CAD software as it is evolving today. The best programs help the architect solve his information, cost and analytical problems as well.

The hottest new features in affordable CAD are 3-D and data base extraction, including bill of materials. The ability to generate perspectives automatically and to extract and manipulate data from the drawing makes CAD a powerful design tool.

Vendors also are scrambling to make it possible to download their data files to programs like Lotus 1-2-3 and to exchange drawings with other microcomputers as well as with minis and mainframes. For example, an architect with one combination of computer and program should be able to send drawings back and forth via phone lines to an engineer with a different combination. A CAD program that doesn't soon meet the

Initial Graphic Exchange Specification (IGES) standard, published by the National Bureau of Standards, may soon be in trouble, because it may become impossible for users to exchange data with other computer users.

Other hot features include symbol libraries, the ability to customize menus, efficient text handling, high resolution color (approaching 1,024 by 1,024 pixels) and speed.

Speed is the Achilles' heel of current generation micros. Functions that seemed lightning fast to us when we started now drag interminably. Programs that refresh the screen quickly and that permit drawings to be created and edited quickly have an edge.

#### THE ISSUE IS PRODUCTIVITY

The question of productivity can be slippery. Our standard for judging whether to include a program in this evaluation or not was based solely on whether an architect could draw more productively with it than without it. A closely related question is how long it is likely to take to reach that point.

For some tasks, a computer is obviously inappropriate.

Creating or tracing basic shapes probably can't be done much faster and cheaper on a computer—any computer—than by hand.

#### How the evaluators rank the programs

Of the 14 evaluators, nine reported having reached 1:1 productivity. Getting to that point took them an average of 74 hours, with a range of 20 to 120 hours. Those who said they cannot draw as fast with a computer as with a pencil have worked with the program for an average of 80 hours, ranging from 26 to 160 hours.

Previous computer experience among the evaluators ran the gamut from extensive to none. Four evaluators have years of CAD experience; five never used a computer until this year; the rest have been using computers for purposes other than CAD.

The evaluators who have passed the 1:1 hurdle generally agree that real gains in drawing productivity did not come until the time came to revise and extend the drawing. The next big gain will come when they become thoroughly familiar with the fine points of the program. But the big leap forward will be in ways they never anticipated. It's already happening.

Evaluator John Voosen puts it this way: "Although we started out intending to use our CAD program just for technical draw-

#### REPRINTS AND VIDEOTAPES

Reprints of this 26-page Affordable CAD article are available from AIA Bookstore for \$3.50 prepaid, or \$2.25 for 25 or more (includes shipping and handling). Order #M-691.

Videotapes of the seven-hour evaluation session at Triton College cost \$260 to buy or \$150 to rent. Separate tapes are available showing the presentation on each system and the roundtable conclusion. Separately, the tapes cost \$50 to buy or \$30 to rent. VHS format will be sent unless Beta is specified. To order, send a check payable to Architectural Technology, CAD Video, 1040A W. Webster Ave., Chicago, Ill. 60614. Readers are encouraged to include comments on the article with their reprint or videotape orders.

ings, we are now using it for design explorations and presentation work of a kind we never would have attempted several months ago."

Voosen's experience is similar to that of every evaluator, even those who still aren't at 1:1 for routine drawings. It's all these unanticipated capabilities that makes it unlikely that the computer will put anyone out of work. It will just make the firm more competitive.

#### NOBODY KNOWS THE TROUBLE . . .

It would not be useful to present our experiences of the past months with CAD as an uninterrupted series of joyful discoveries. Learning CAD has brought its share of pain and frustration.

Perhaps the first hurdle was fear that the computer would inhibit creativity or pervert the design process—that the medium would become the message with mindlessly repeated patterns. But the computer is no more "foreign" a tool than any other. The drawing device, if fully expressive, is irrelevant to the art of architecture, although it can be highly relevant to the business of architecture.

Still, it takes some getting used to.
Evaluators Bill Wenzler and Dwight
DeLattre both used the word "overwhelmed" to describe their initial reaction.
The thinking process was a "total revolution"
to Chuck Millmann. Said Paul Berger, "To an
architect used to Bumwad and felt tip pens,
the use of a computer to create or draw is
extraordinary, to say the least."

Chuck Pedersen advises: "The system can be implemented only by re-orienting our thinking regarding the process by which drawings are created. A drawing is made up of a number of repetitive items that can be drawn once and copied. Offices, apartments, even entire floors are just as easy to copy and edit as simple objects. We suddenly find that many buildings are made up of four identical corners, only one of which needs to be created. The other three can be copied and edited."

The problems fall into four categories: the computer, its disk operating system, the peripherals and the software. Getting them all to play in tune is a real challenge. The

evaluators do not agree whether it's better to buy à la carte or turnkey. À la carte is cheaper; turnkey is faster. The buyer must decide what's more precious, his money or his time.

It might be necessary to work with two kinds of dealers. The computer stores generally don't carry CAD software and peripherals because they don't generate enough volume. And CAD specialists don't like to sell computers because they don't generate enough profit.

There's a cliché about choosing the software first and then the hardware. CAD is a bit more complex. It works better to think in terms of buying an integrated system in which the costs and capabilities of the components are balanced, as in a good stereo system.

#### How to buy a CAD system

The ideal way to proceed would be to get a demonstration of at least two complete systems. Try each one yourself, from turning on the computer to input to plot. When you decide, take that very system home with you, with as many cables left attached as possible. Don't even put it back in the boxes.

When you're trying a system yourself, take along a hammer. Any time the sales agent reaches for the keyboard or any piece of equipment to "help" you, threaten to bust him across the knuckles. Accept advice—and write it down—but do it yourself. Dealers who can demonstrate but can't explain won't be much good to you later over the phone.

While you're doing it yourself:

- Consider the trade-offs among color, black and white, screen resolution and price. Do the jagged circles and diagonals on the monitor bother you enough to make you spend more money?
- Can you direct the system conveniently? Does the operation seem intuitive, or do you keep getting stuck? Are the commands in English or computerese? How much bouncing back and forth between the keyboard and other input devices is required? What input devices seem most natural and accurate?

### How the evaluators rank the 6 programs

Program	Evaluator	AutoCAD	CADPlan	Drawing Processor	MicroCAD	RoboCAD	VersaCAD & E-2000 Jr.
AutoCAD:	Allsopp Kowoll Voosen	2 1 1	1 3 4	5 6 6*	3 4 2	6 5 6*	4 2 3
CADPlan:	Millmann Welliver Wenzler	4 2 4	1 1 1	6 5 6	3 4 2	5 6 5	2 3 3
Drawing Processor:	Fallon Robicsek	5 3*	4	1 2	3 5	6	2 3*
MicroCAD:	Berger DeLattre Engelke	4 4	Unable 1 3	to attend the Sh 5 5	oot-Out	6 6	3 2
RoboCAD:	Winitzky	3	1	6	5	4**	2
VersaCAD:	Newman Pedersen	3 3	2 2	6 6	4	5 5	1

#### NOTES

Rankings based on evaluators' own standards, applications and perceptions. Shaded boxes indicate evaluators' rankings of programs they tested.

Other rankings based primarily on presentations by other evaluators at the Shoot-Out.

\* Tie

- \*\* Based on RoboCAD2. Ranking of RoboCAD by other evaluators based on RoboCAD1.
  - How big a drawing area do you prefer? Do you prefer one screen or two?
  - Draw a three-circle. Does it look like a circle or an egg? If it looks like an egg, can you adjust the monitor to fix it?
  - Draw a room in feet, inches and fractions. Put in a door and window. Hatch it, scale it, dimension it, put a couple lines of text near it, put a window in, pan, zoom, move the text and drawing separately, save it, recall it, alter the text and drawing and plot it to scale.
  - Do you like the drawing? Did you get good help from the dealer? You know the three most important influences on the value of real estate, but do you know the three most important considerations in the purchase of a computer?

- (Hint: The first one is technical support.)
- Buy software, not "vaporware."
- Ask for references.
- Finally, beware of analysis paralysis. Don't get so bogged down comparing small features that you can't make a decision.

#### **BIBLIOGRAPHY**

Three magazine articles on affordable CAD make interesting reading.

- "Getting the Picture with CAD." *PC Magazine*, July 24, 1984.
- "Computer-aided Design." Byte Magazine, January 1984.
- "Computer-Aided Design on the IBM Personal Computer." PC World Magazine, October 1983.

ARCHITECTURAL TECHNOLOGY

#### GUIDE TO THE ARTICLES

The following pages contain:

- A features chart reflecting a consensus of evaluators' perceptions of the programs.
- Articles on each of the six CAD programs. They reflect the opinions of the authors, except as others are quoted.
- A discussion of computer hardware and CAD peripherals. The most vexing problems experienced by the evaluators were in this area.
- A wrap-up article analyzing the future role of affordable CAD in both large and small architectural offices. The article also compares microcomputers with minis and mainframes.
- A glossary.

## CHART COMPARES CAD SOFTWARE FEATURES

	AutoCAD	CADPlan	Drawing Processor	MicroCAD	RoboCAD	VersaCAD & E 2000 Jr.
Di O. 1	1/83	11/83	7/83	6/82	5/82	1/81
First Sale	5,000	2,000	200	1,800	2,600	2,200
Sales (Licenses)	\$1,500a	\$1,975b	\$495c	\$1,000d	\$1,495e	\$2,490f
Price	φ1,500a 1.4	1.4 +	1.2	3.32 +	2	3.0
Version Charted	Fall 1984	Fall 1984	Summer 1984	Fall 1984		Summer 1984
Next Release	0	90 Days	Indef.	None	90 Days	90 Days
Warranty	0	0 Days	\$100	No Charge	\$250	\$750
Updates for 1 Year	\$2 <b>4</b> 0	No Charge	\$120	No Charge	Price Diff.	\$500
Next Update, No Contract	φ240 	No Charge	Ψ120	110 01111-81		
VENDOR FRIENDLINESS			*	***	**	***
Technical Support	**	***	***	**	***	**
Ease of Learning	**	***		**	***	***
Ease of Use	**	***	*	*	**	***
Manual	**	**	**			
Tutorial (Lessons)	0			Brief		0
Demo Program on Disk		0			0	0
Videotape	0	***	0	0	0	
On-Line Help Menus			0		0	0
Toll Free Number	0		0	0	0	***
Training Program	0		0	0	0	
Newsletter	Bimonthly	0	0	0	0	Bimonthly
Copy Protected	0	0				0
Use Protected With Hardware	0	-	0	0	•	•
HARDWARE						
Sells Hardware	0		0	0		
Supports Color			0	0		
Supports Color Supports High Resolution Color			0	0	0	0
Monitors Supported	1 or 2	1	1 or 2	1 or 2	1	2
			0		0	0
Mouse Supported Digitizer Supported						
				0	0	0
Large Digitizers Supported	**	**	*	**	**	**
Digitizer Moves Cursor	0	0	0		0	0
Light Pen Supported	0	ŏ	0	0		
Joystick Supported						
DISPLAY	_	0	0	0	0	0
Macros	107	65	One	999	960	250
Layers (Levels) With 640K RAM	127	0	one	555	0	0
Menu on Tablet, Not on Screen	0	0	0			0
Aspect Ratio Fixed by Program		•	0			
Pan		5	0	0	0	19
Save Multiple Pan Windows	0	5 ***	**	*	***	**
Redraw Time	T .			60 sq in	51 sq in	71 sq in
Screen Drawing Area	51 sq in	54 sq in	58 sq in 0	00 sq m	0	0
Vary Line Width on Screen		_		•		
Rubberbanding of Lines		_	0	0	-	
Different X, Y Grid Spacings	0	•	-	•	0	0
Grid in X, Y and Z Axes	0	0	0			0
Grid Can Be Rotated	0	0	0	•		V

This chart compares features of the six CAD programs in the AIA evaluation. It reflects the consensus of the evaluators.

The chart includes only functions that are likely to be important to most architects and that are handled differently by the programs. Functions that all programs perform equally well, or do not perform at all, are omitted. Also omitted are some functions that are too

complex to compare with symbols.

Discretion is advised in interpreting the chart. Selecting a program by totaling the black boxes and stars is not recommended. For example, a black box in some cases may be bad, not good, as in copy protection. Further, ease of learning and use must be considered in the context of the program's overall power and the user's special needs.

The chart keys to definitions on a previous page. Two programs have version numbers suffixed with a plus sign, indicating either that the vendor provided us with features intended for the next release or that features have been added without changing the version number. Articles on the programs explain.

#### MANAGEMENT

	AutoCAD	CADPlan	Drawing Processor	MicroCAD	RoboCAD	VersaCAD E 2000 Jr.
DRAWING CREATION					ROBOCTED	L 2000 JI.
Format: Floating Point = FP	FP	T				
Arch. Symbol Library Supplied		Integer	FP	FP	Integer	FP
Dynamic Tracking	0		0	0	0	***
Mirror Imaging Directions	0	0	0	0	**	***
Create Rectangle and Ellipse	In Manual	In Menu	In Manual	0	In Menu	In Manual
Orthogonal Mode	Neither	Both	Ellipse	Neither	Neither	Both
Dianter Object Att 3			Ô	0	0	Don
Display Object Attributes			0		ő	-
Crosshatch	***		0	0	0	
Fill Polygon		0	0	Õ	0	***
Draw Parallel Lines, Fix Ts	0		0	0	0	
Auto-Insert Windows and Doors	0		Ö	0	0	0
B-D:	0	0	0	***	0	0
—Perspective or Isometric	0	0	0		0	*
—Wire Frame or Solid	Õ	0	0	Both	0	Perspective
-Report CG, Moment of Inertia	ő	0	-	Wire Frame	0	Solid
		0	0	•	0	0
EDITING						
Editing Convenience	**	**	**	*	**	**
Erase Object	**	***	**	*	***	***
Erase Contents of a Window				0		
Save Part of the Drawing		-		•	0	0
Search/Replace Symbols			0		0	*
Vertex Snap	0		0	0		0
Move Objects Between Layers			0			0
Scale Objects		-	0		0	***
Scale X, Y Axes Independently		0				
Scale Text Height and Width	-	•	•	0		0
Bill of Materials	0	0				
	U		0	0	0	
DIMENSIONING						
Automatically Dimension Lines			0	0		
—Diagonal Lines	0	*	0	0	0	
—Angles	0	0	9	0	0	
rea Calculation		0	0	0	0	
intries in Feet and Inches	- :	-			0	***
Changes Units of Measure			0			0
bsolute Coordinates	-	0				
elative Coordinates					0	
Polar Coordinates			0	0		
olar Coordinates	0	0	0			
CURVE HANDLING						
illets	_	_				
Complex (Bezier) Curves	*	*	0			
Create Circles	***	**	***	*	**	***
LOTTING				2.2	TP.	**
pecify Size of Plot Area		0	_		•	
pecify Start Point on Paper		0	•			
, cont aper	_	0		100	*	

Notes:

—CHART CURRENT AS OF JUNE 29, 1984

SYMBOLS: ■ = Available; 0 = Not Available; \*\*\* = Above Average; \*\* = Average; \* = Below Average.

a Includes Advanced Drafting Extension (\$500)

b Includes Automatic Dimensioning (\$250), Data Base Extraction (\$350) and Arch. Symbol Library (\$75)

c Drawing Processor II will sell for \$995 d Includes Layering (\$250), Rotatable Character Set (\$150) and Hidden Line Removal (\$100)

e Includes Controller (joystick)

f Includes Bill of Materials (\$495) and 3-D (upon request)

## VERSACAD EXCELLS IN NITTY-GRITTY FUNCTIONS

By Charles Newman, AIA and Charles Grant Pedersen, AIA

VersaCAD and its twin, the E-2000 Jr., combine most of the best features of the other five programs in the evaluation. For precise, high quality, production drawings with lots of detail, they are the CADillacs.

The two are sold by different vendors—VersaCAD by T & W Systems and E-2000 Jr. by Carrier Corp. as a licensee of T & W—but the programs are identical. The differences are primarily in ancillary areas, such as the manual and symbols library. For this evaluation, we generally will refer to VersaCAD but we include the E-2000 Jr.

VersaCAD's power tends to be in the "back end," nitty-gritty functions rather than in front-end flash. We think the merits of the program are not likely to be fully appreciated until the architect has several months experience and starts demanding real productivity.

No other program handles its symbols so well. No other program has such powerful

editing functions. No other vendor has so much experience in the low-cost CAD market. And no other vendor appears to be so well positioned for the future.

In some specific features, it may be outdone by a rival. CADPlan refreshes its screen faster. MicroCAD's 3-D is better. RoboCAD's sketching routine is easier. But VersaCAD is at least competitive in all important areas, superior in most and likely to improve.

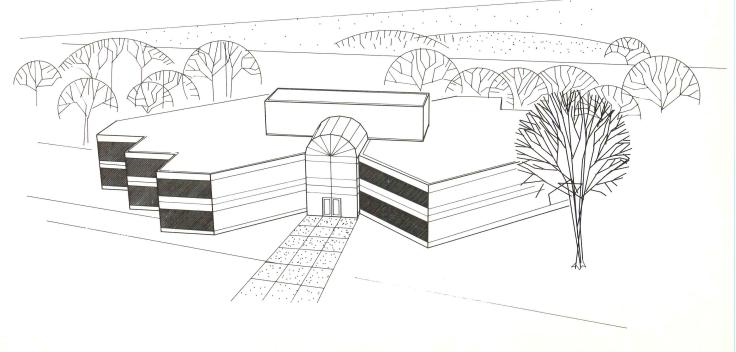
How a program handles symbols has a big effect on productivity. The idea is the same as word processing, only in drafting we think of it as object processing: do a repetitious process only once and copy it. The typical construction drawing uses a substantial number of symbols and objects that can be drawn once, stored in a library, retrieved and inserted as is or modified as necessary.

VersaCAD organizes its library into pages of 100 symbols in a 10 by 10 matrix. A picture of a symbol is stored in each space. The

page then is plotted out at a size specified by the user, placed on the digitizer and registered as an overlay.

The number of symbols is virtually unlimited, but there's no need to keep track of their names because the selection can be made visually.

Newman is president of Charles Newman and Associates, architects, engineers, planners and construction managers in Naperville, Ill. The firm has three members. Pedersen is principal of Charles Grant Pedersen and Associates, Architects, Hillside, Ill. The firm has five members. They both bought word processors two years ago. Pedersen said adding CAD peripherals took 12 hours; reaching 1:1 productivity took 100 hours; total CAD experience is 200 hours. Newman spent more time on hardware, primarily because of problems configuring plotters, and less time on the program, 120 hours, which has brought him to 1:1 productivity for typical applications.



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When a symbol is required, the user activates the correct page, touches the desired symbol with the stylus or puck and presses the enter command. Picking a symbol is like flipping through a volume of *Architectural Graphic Standards*.

Moreover, once the symbol is on the screen, it can be moved, scaled, rotated and placed. Until the symbol is placed, it blinks as it is moved on the screen so you can see exactly where it will fit into the drawing. The process, called dynamic tracking, is unique among the systems evaluated and quite helpful.

Symbols can be custom-drawn or obtained from vendors. Carrier currently supplies a library of 5,000 symbols to its customers and is working to assemble a complete list of all symbols commonly used in construction documents.

Because the ability to revise a drawing is such an important reason for CAD, the architect should examine carefully the editing capability of the program being considered.

VersaCAD facilitates editing by assigning graphic attributes to symbols and objects rather than to levels (overlays). For example, a symbol's line type, color and pen number can go with it if it must be moved from one layer to another.

Some programs require all objects on a layer to have the same color or pen type. We found VersaCAD's ability to put objects in the same group on several layers, and to put objects from different groups, with their own colors or properties, on the same layer particularly useful.

The program permits up to 250 levels that can be activated or deactivated in any combination to produce varieties of composite drawings. But the walls in each drawing are the same walls that were drawn once, as in overlay drafting.

This feature should be studied so each level contains the same type of information from project to project.

Charles Grant Pedersen found it easy to experiment with different line weights when he used VersaCAD to generate this perspective of a proposed medical office building in suburban Chicago. Revisions took just 15 minutes. To produce the floor plan on the next page, he drew the left side, copied it, rotated it 180°, and joined the two drawings.

Further, by standardizing the settings for the various levels, the user can prevent forgetting to include a level with only a few objects, which could create a costly problem if found after construction has begun.

Plot specifications, window specifications and level switches can be merged into the workfile. This allows the user to merge a file set up specifically for, say, a structural drawing, plot it and merge the settings for electrical drawings.

Networking several workstations would enable one person to work on structural drawings while others work on mechanical, electrical, interiors etc., using the same floor plan. To check coordination among disciplines, merely turn on the levels where those disciplines reside and they can be seen superimposed over each other.

We feel we need a minimum of 100 levels for efficient maneuvering among disciplines overlaid on a single floor plan. Splitting up levels according to the 16-division format of the Construction Specifications Institute, as recommended in the VersaCAD manual, makes no sense at all in working drawing production.

One of the most powerful commands in VersaCAD is called "inquire." It enables the user to get quick information about an object, such as its length, coordinates, angle, area and perimeter. We have found this option incredibly helpful in ways that probably were never intended.

For example, when we enter an existing drawing or even a free-hand sketch, we don't worry about getting the dimensions just right. When we're through entering, we inquire about the length of a line in the drawing. Since we know what the length should be, we simply tell the computer to scale the drawing to make it the size we want.

"Inquire" also is the way to obtain area calculations. VersaCAD appears to offer the most capabilities. Consider a large circle with two small circles inside. VersaCAD can calculate the net area of the large circle.

VersaCAD is unusual in being able to recover the workfile in case of power failure or a similar disaster.

Independently, the user can recover all objects deleted from the drawing since the last time the file was crunched. Other pro-

grams can recover only the last object deleted.

Mirror imaging and copying in VersaCAD are strong with one exception.

Individual objects or groups can be image copied (maintaining the original), copied in two directions with copies equally spaced, or copied along an arc with the spacing set by the user.

The exception: If the object includes text, it, too, will be mirror imaged, making it unreadable on the monitor. But we found that our Hewlett Packard plotter corrects the text automatically.

Overall, VersaCAD is chock full of good ideas.

To speed the operation, the user can temporarily switch text displays to parallel lines. When the screen is redrawn, text can take a long time, especially when the drawing begins to fill up with notes. The parallel lines act like a marker showing the location of the text and they are a lot faster to redraw.

Polygons are created merely by stating the number of sides and the radius. Bezier curves are used to form irregular curved shapes. The hatch function works automatically within any bordered area. Diagonal lines can be dimensioned semi-automatically. Drawings may be created with both relative and polar coordinates. All those functions are unusual or unique among current versions of the six programs in the evaluation, and we have found that they improve our productivity enough that we would not want to do without them.

The accuracy of VersaCAD is taken for granted. Both the program and our Hewlett Packard plotter are accurate to a thousandth of an inch with demonstrated repeatability. We have plotted the same drawing twice and the lines only got darker, not wider.

VersaCAD is the only one of the six programs in the evaluation that requires two screens. That's an advantage because the second screen is dedicated strictly to drawing, thus providing the largest drawing area. But the cost of the second monitor and the extra shelf space it requires could be seen as disadvantages.

Bill of materials and 3-D are not unique to VersaCAD, but it is among the leaders.

In two respects VersaCAD tops CADPlan's bill of materials.

#### T&W has been in low-cost CAD the longest

Because VersaCAD's routine comes with some pre-programming, the report can be created in less time. It's still too time-consuming and complicated, but the potential for development is in place. More pre-programming would make the routine even friendlier.

Second, the program doesn't hang up when it is told to look for a symbol that was left out of the drawing. It simply goes on and reports finding none.

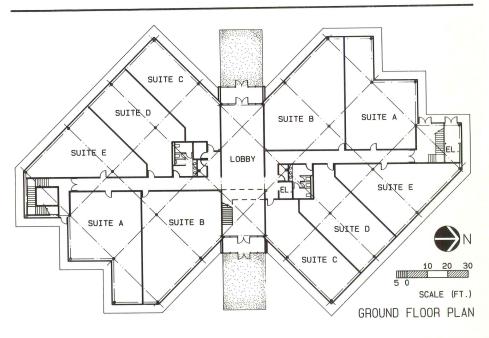
VersaCAD's present method of 3-D data entry also is excessively cumbersome, although again we think T & W is off on the right foot with this preliminary version. The routine is limited to straight lines and has some trouble with hidden lines. But it deals with solids, which is probably the future of 3-D, and it allows the user to transfer the 3-D drawing to the 2-D workfile for easy editing including addition of text. And, of course, the routine is free—at least until it matures.

All in all, getting to the point where you're ready to start learning VersaCAD probably is more difficult than with the other programs.

At the time we started learning VersaCAD, we had been using our IBM personal computers for about 16 months and were familiar with their disk operating system (PC-DOS). This proved to be of only minimal help, however, since VersaCAD uses UCSD p-System. Except for RoboCAD, which uses Apple-DOS, all other programs in the evaluation use PC-DOS. Running VersaCAD means learning some commands that are very different from PC-DOS, resulting in some initial confusion.

Those who use an IBM XT will have to partition their fixed (hard) disk—and maybe re-partition it a couple of times as the size of their drawing files increases. The process takes time to research, plan and perform. The problem can be eliminated by using an Iomega disk drive instead of the IBM fixed disk, which is what we did.

Moreover, T & W guards against unauthorized use of the program with a card that goes into an empty slot in the computer, or with a key that plugs into the keyboard. We chose the key because we didn't have any empty slots in our computers, but we found that it occasionally generates unintended characters in other programs.



Important missing features include automatic double line entry for walls, automatic trim of lines extending beyond intersections, a continuous read-out of the length of a line being rubberbanded, and object snap (so a symbol can be entered to intersect a point on the drawing without windowing in or depending on other, less accurate snap functions).

We also wish dimensions could be entered in feet and inches. Because we can't, we enter all dimensions in inches. If we were to make the entries in feet, inches would have to be shown as decimals of feet, which is unacceptable.

T & W has been in the low-cost CAD business longer than its principal competitors. We think it is positioned best for growth.

VersaCAD is the only program among the six with both bill of materials and 3-D, rudimentary though they may be. Both are important for the future.

The Carrier connection is already influential. Carrier's manual is better than T & W's—more clearly written, better illustrated and typeset for easier reading. And its symbols library is big, growing and free to its buyers. But neither manual adequately explains how to use level settings or techniques for efficiently using group names.

Carrier has also written engineering programs independent of T & W for microcomputers and is working to enable them to interact with its E-2000 Jr.

Networking was mentioned previously. As our practices grow, we anticipate that one computer won't be sufficient. VersaCAD is already selling and supporting networks. We think we can grow with the program, rather than having to buy a minicomputer and learn a new system.

The next generation of microcomputers will probably include a 32 bit processor. T & W already supports a 32 bit Hewlett Packard micro. It's better than the IBM for graphics, but it's also a lot more expensive and less flexible in running other programs. We're content with what we have for the moment.  $\square$ 

VersaCAD T & W Systems Suite 106 7372 Prince Drive Huntington Beach, Calif. 92647 (714) 847-9960

E-2000 Jr. Carrier Corp. Box 4808 Syracuse, N.Y. 13221 (315) 432-6838

## AUTOCAD IS BEST SELLER

BY PHILIP D. ALLSOPP, RIBA KENNETH R. KOWALL, AIA AND JOHN C. VOOSEN, AIA

AutoCAD is the most popular of the six computer aided design programs in the AIA evaluation. With 5,000 licensed programs in the field, it has become the de facto standard for affordable CAD. It supports more computers and peripherals, and is supported by more equipment, than the other programs, thus offering architects the widest range of choice when configuring their systems.

Field support for AutoCAD may be the most extensive, too. Some 600 dealers throughout the United States provide local sales and service.

The program is among the most aggressively updated, with three major revisions last year and the second revision this year nearing release at press time.

The vendor, Autodesk, has been so confident of the value of its forthcoming releases that it has not taken steps to prevent unauthorized copying of its program. The theory has been that the next release will be so

Allsopp, who has extensive computer background, is director of health planning for Perkins & Will, architects, engineers, planners and interior and graphic designers. The Chicago-based firm has 330 members. Although Allsopp has put in 80 hours on AutoCAD and CADPlan, he has not reached 1:1 productivity for his purposes, although another 50 hours with CADPlan probably would do it, he said. Kowall is an architect for the Consulting Engineers Group, Glenview, Ill., and San Antonio, Texas. Its 22 members specialize in precast concrete. The firm purchased its first computer 2½ years ago and has invested 15 hours on peripheral hardware and 35 hours learning AutoCAD. Kowall estimates another 85 hours to reach 1:1 productivity. Voosen is president of John C. Voosen, Architects, Chicago. The firm has four members. He has used computers since 1978. So far, he has spent 150 hours learning CAD plus 12 hours installing the peripherals. He reached 1:1 productivity in 40 hours but estimated that computer neophytes might require about 80 hours.

much more valuable than the last release that anyone who knows the program will be unable to resist buying the latest version.

An investment in AutoCAD is well protected against obsolescence. The progam is written in the C language, which is easily recompiled on new computers and is designed to be transportable to the next generation of 32-bit processors.

All this success has its down side. The Autodesk technical staff, although excellent, sometimes gets stretched a bit thin.

AutoCAD is exceptionally easy to get up and running.

The program supports one or two screens, making good use of both. Messages and lists are displayed on one, and drawings, menus and status on the other.

Drawings may be displayed in color with, again, good use being made of high resolution color equipment. Line types, which are not distinguished on low resolution screens, are shown as properly dashed or whatever in high resolution. Similarly good use is made of the higher resolution black-and-white screens, such as with Compaq computers.

Documentation for hardware installation is excellent, well formatted, clear and—more to the point—correct. Don't depend on directions from the hardware manufacturers; the information is too general and sometimes wrong.

The manual is framed by an excellent table of contents and index. The best guide to the interior—the command summary—is mysteriously buried in the middle of Chapter 2.

The text is terse, formal and technical. It didn't become good reading until after we knew something about the program. All the information is there, once you know what you're looking for.

Most people in our offices began without the manual and almost all promptly ran afoul of the "drawing limits." The program will not accept commands outside specified limits. Despite this fault, most of us were able to draw anything we wanted very quickly. A few commands are worth mentioning because they caused a great deal of frustration. All were more or less resolved by reference to the manual.

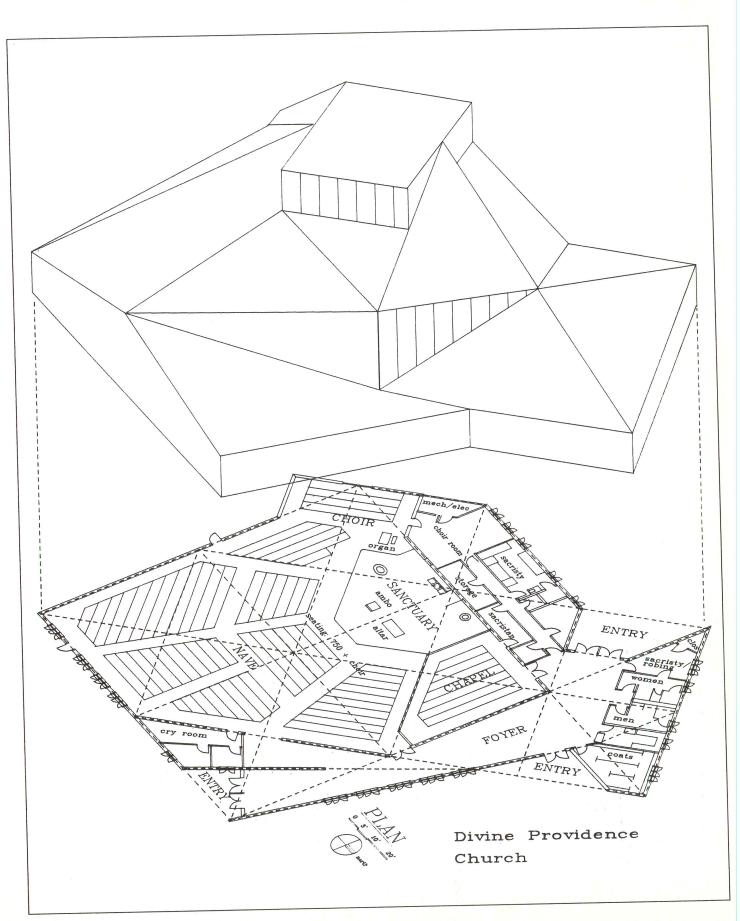
- "Arc" was tried initially when guesswork sufficed for joining two lines with a curve. Its lack of clarity surfaced when drawing bathroom symbols. Arc just doesn't work the way one would expect.
- "Fillet" generated surprise in some cases when apparently random curves were attached to the end of straight lines.
- Switching layers on and off also required study and practice.

Perhaps AutoCAD's most valuable feature is buried in the manual under "Miscellaneous Features." It is the ability to customize menus by using a word processing program. None of the other six programs offers this flexibility to customize a program to make it uniquely one's own.

The importance and utility of this control over the menu and other commands may not be obvious to a beginner. CAD commands are so diverse that no program can present all its options to the user at one time. Most programs guide the user through a series of subordinate menus until you finally reach the item you want.

With AutoCAD, you can rename commands to your liking, rearrange their order and link a long series of frequently used commands to be executed immediately at a single keystroke (sequence called a macro). Text is limited to 80 characters per series of instructions, with the space bar interpreted as a carriage return.

Macros enable menus to be customized for a firm, a project or a single drawing. They enable the experienced professional to turn AutoCAD into a CAD language. The results are fast and really dramatic. We keep WordStar on our AutoCAD directory for easy customizing "on the run."



### Perkins & Will explores management applications

The ability to rename commands is helpful for those who have a digitizer with a 16-button cursor. Preceding menu options with a button number makes the selection of commands more convenient.

AutoCAD has the most extensive library of hatch symbols of any system evaluated here. Users are supplied with 36 choices, including 12 recognized by the American National Standards Institute.

Any enclosed shape may be hatched automatically at a specified scale and rotation. The rub is that the shape must be completely enclosed and self-contained. To prevent peculiar results, the zoom window should be used to check that all lines meet. And don't ask the program to hatch the part of a rectangle that is inset into a circle, for example. It can be done, of course, but the shape must be redrawn.

Sketching is effective with AutoCAD but, as with any vector-based system that stores everything as points to be connected by straight lines, it eats up file space quickly.

AutoCAD is the only one of the six programs that permits a circle to be created three ways: center and radius, two points (diameter) and three points.

Blocks may be treated as entities, with full editing and nesting options. Drawings may be inserted as blocks or as individual entities. Rectangular and circular repeats of entities or blocks into arrays also are permitted.

Four standard text fonts are supplied in the program. If they don't suffice, the user may create his own. Text entry would be faster if a function more like word-processing were used to write the text block, followed by a block command to move the text.

We found AutoCAD particularly slow in redrawing the screen, apparently due to its habit of scanning entities on nonactive layers. The pan command, for example, requires that the drawing be regenerated. For a complex drawing, this can take more than a minute.

A glaring weakness is the way AutoCAD handles a drawing that has become too large to fit on a disk. The program turns off the graphics screen and asks whether to keep the drawing or abandon it. Either answer brings the startling message, "AutoCAD gives up." A hard disk would avoid the problem, or at least postpone it.

The problem can sneak up on an unwary user, especially one using a computer with dual floppy disks and a data disk with other files on it. AutoCAD uses three files for each drawing: the original, a backup and a phantom work file. All editing occurs in the work file, which is abandoned when editing is completed and which doesn't show up in the directory. Thus only about a third of the disk space is available for the drawing file.

There are advantages to this file arrangement, including an automatic backup in case a drawing is hopelessly messed up during editing. The drawing can be restored to its original condition simply by quitting the editing session.

But we have learned that after spending more than \$10,000 on hardware and software, it's foolish to save \$5 on a disk. Each drawing deserves its own disk, frequently backed up.

#### ALLSOPP ADDS:

AutoCAD gave several people in Perkins & Will a friendly first glimpse of CAD.

We were not particularly interested, though, in AutoCAD's ability to draw. Drafting for P&W is merely the by-product of a much larger information management problem.

The focus of our evaluation was to determine whether it could assist us in regaining key markets that have been lost to specialists. The advent of microcomputers places in the hands of architects, possibly for the first

time, a means to reverse the flow of planning and programming.

The hospital industry, one of P&W's most important markets, has changed rapidly over the past 10 years. Gone are the days when planning meant facility planning and design, and the most important information was construction documents.

Today, planning means determining the most cost-effective allocation of very limited capital resources with quantitative techniques. At the very beginning of the design process, we need to test five or six options to determine cost sensitivity and help us determine which one to develop further.

AutoCAD comes with the ability to extract data from objects in the form of Data Interchange Files (DXF). The utility of this feature remains unclear. We were unable to transfer DXF files to Lotus or dBase II.

We have used the program on only one project, an aircraft refueling complex at O'Hare Airport. Object menus were constructed for valves, pumps and pipe junctions.

AutoCAD's apparently limitless zoom feature enabled the main terminal buildings to be located on the same sheet as the details of the pumping and fuel distribution bases.

It was during this project that the lack of attribute data for calculation purposes was most acute. We were dealing with a network spread over thousands of yards. It would have been useful to calculate flow rates based on pump, pipe and valve attribute data as the design was being undertaken on the screen. The data had to be taken off manually and re-entered into Lotus 1-2-3 for processing.

A common characteristic of our architectural and engineering disciplines is the use of room or zone data sheets. Since interdisciplinary work is commonplace at P&W, we wanted AutoCAD to provide a base for generating room data sheets from design drawings. This feature is not available yet but would be extremely useful. 

AutoCAD

AutoCAD

AutoCAD

Autodesk Inc. Building B 150 Shoreline Highway Mill Valley, Calif. 94941 (415) 331-0356

John Voosen produced this isometric plan view for Divine Providence Church in Westchester, Ill. by storing a standard plan view as an entity, recalling it rotated clockwise  $30^\circ$ , making that an entity, and recalling it again with a diminished Y value (x=1, Y=.65). The plot, made on a Houston Instruments DMP-42, is shown without reduction.

## CADPLAN MAKES TEDIOUS TASKS AUTOMATIC

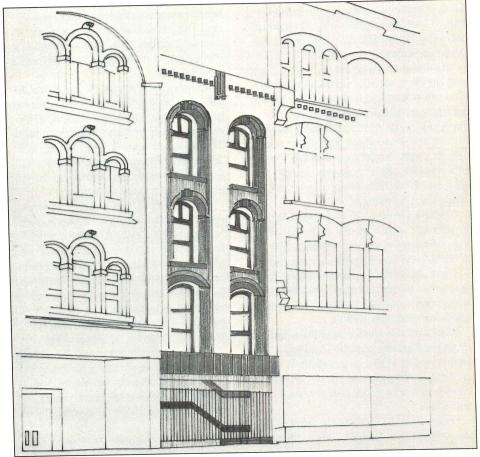
By Charles E. Millmann, AIA David K. Welliver and William P. Wenzler, FAIA

CADPlan has the kind of features that made us—and most other evaluators—like it immediately. Call it slick or call it flashy: there's a chemistry working here that many architects will find irresistible.

The program is the fastest of the six evaluated. Not only does it redraw quickly on the screen, but it has been designed to do nasty little jobs automatically—like open a wall, insert a window or door, and tidy up the intersections. With some programs, inserting windows must be done tediously, one step at a time.

Just creating four walls is a breeze with CADPlan. It draws parallel lines at a user-specified width as easily as other programs draw single lines. But the best part is that where walls meet, the parallel lines are automatically adjusted so the wall lines join each other precisely. Ditto with interior wall intersections. These are features all other CAD vendors are sure to copy for their new releases.

CADPlan also was the first to do a bill of materials: It counts the number of symbols (furniture, etc.) in a drawing and prints out a summary showing the number of each symbol, vendor, order number, item cost and



William Wenzler and Associates did these drawings for 514 Water Street, a condominium project in Minneapolis that is currently in pre-construction sales.

Millmann is director of design for Py-Vavra, architects and engineers in Milwaukee. The firm has 24 members. With no previous computer experience, he attained 1:1 productivity after 163 hours on the program. Welliver is technical coordinator for ISD Inc., interior designers. The firm has 125 members in Chicago, New York City and Houston. Welliver, of Chicago, who claims "some" computer experience, has put in 150 hours on the program, but estimates that he reached 1:1 productivity for the typical drawing after 80 hours. Hardware problems cost him another 38 hours. Wenzler is president of William Wenzler and Associates, Architects, of Milwaukee. The 10-member firm bought its IBM in May and spent 38 hours solving hardware problems and 26 learning the progam. Wenzler expected to reach 1:1 productivity in another 40 hours.

total cost. The procedure is cumbersome, but it works. The potential uses for a good data base extraction procedure are exciting and CADPlan has the inside track. Look for every CAD program to have this one, too, before long.

Another nifty feature enables the digitizer to work in a relative mode, like a mouse. Usually, digitizers work in an absolute mode: a point on the digitizer refers to a specific point on the screen. With a mouse, wher-

ever you put it down on its pad is where you start on the screen. CADPlan lets you use the digitizer in either mode, although the mouse seems to move the cursor faster. In any case, we recommend buying both.

CADPlan also might be called a snappy program. The user can snap to a grid point, vertex or, unique to CADPlan, a node. This is simply a point selected by the user, not necessarily a vertex or grid point.

Most of the controversy around CADPlan concerns another unique feature, the integer system it uses to keep track of where objects are located. This is how it is able to redraw the screen so quickly even without the Intel 8087 co-processing chip. Four of the other five programs use the floating point format.

CADPlan may be less precise, but based on our still-limited use of the program, we doubt that the difference is significant enough—for our applications—to persuade us to give up the re-imaging speed.

How much less precise is it? Well, draw a rectangle 10′ 5¾″ long and rotate it 30 degrees. It will "grow" about a quarter inch due to rounding. Or take a rectangle and rotate it several times. It will deform.

Of more interest to us is the limitation that the integer system places on the size of what we are drawing and on our ability to change data base units.

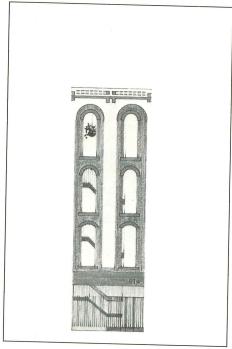
Each drawing must have a "unit." It can be any measurement, but once set it cannot be changed later in the drawing.

The "integers" result from the 16 bit processor used by the computer. Since each "gate" in the processor has two possibilities—either open or closed (on or off)—the capacity as used by CADPlan is two to the power of the number of bits, minus one. With 16 bits, that works out to 65,535, which is the maximum number of increments CADPlan allows.

This means that if the unit you selected is inches, your longest line may not exceed 65,535 inches, which is about one mile, and you may draw only to the nearest inch. If your data base unit were a quarter inch, the longest line in your drawing could not exceed 65,535 quarter inches, which is about a quarter of a mile, and your tolerances could not be tighter than a quarter inch.

You know your practice best, but we don't design many buildings or interiors longer than a quarter mile to accuracies of less than a quarter inch. Nor do we rotate objects several times about a point. What we do much more often is sit and watch the screen regenerate.

If we were involved in planning large sites or tracts with relatively small buildings, such as subdivisions for houses, we might feel differently. Site plans and houses typically are drawn in different units. The area of a site planned to an accuracy of a hundredth of a foot would have to be rather small with CADPlan. And it would not be possible to



Wenzler used CADPlan with an IBM xT computer, a Kurta digitizer and a Houston Instrument plotter.

put it on one layer and a house plan, drawn perhaps in half-inch units, on another layer with the same drawing file name.

Note that "data base units" and "scale" are not the same. The scale at which the drawing eventually is plotted does not depend on the units in which it was drawn.

Eventually, screen speeds might become less significant as CAD vendors become adept at compensating for the slowness inherent in the current generation of microcomputers. For example, to pan across a large drawing takes a long time on a micro, even for CADPlan. To reduce the time, this program (among others) enables the user to specify windows for immediate recall. With CADPlan, the number is five, which is quite useful if you can remember which window is which. A graphic cue to the windows would help.

Some critics point out that CADPlan is "RAM-bound," meaning that the size of the drawing is limited by the amount of RAM in your computer. If you have 320K, your drawing cannot contain more than 320,000 vertices, minus the 64K that the program occupies. Our computers have 512K (less than the maximum 640K that an IBM will accept) and we have not reached the limit.

The strength of CADPlan is the ease with which the program is learned and used. In fact, it appears to be the easiest of the more powerful CAD programs.

The entire program resembles the familiar process of drawing with a pencil. Less keyboard work is required with CADPlan than most of the other programs. We use the mouse almost exclusively to select menu options and to draw.

CADPlan's videotape is particularly helpful and so is the on-screen help menu. Simply typing a question mark will provide a description of the current command.

The program also seems exceptionally easy to configure or reconfigure.

The last item on the main menu is "info," which takes the user to a single screenful of commands that set scale, grid size, text size, layer information, peripherals and much more. When the drawing is saved, the info page is saved with it. As a supplement, a layer information page enables the user to review at a glance all layer presets, such as line type, color, pen type, etc.

The symbol file is probably the second most powerful element of the program. Personal CAD Systems has developed and is continuing to expand a library of architectural symbols. They save drawing time and space on layers.

This leads to the third powerful element, data base extraction, which uses attributes assigned by the user to each symbol. With it, the user can develop reports tailored to the information required. This can help in estimating, inventory or description.

Note that the version evaluated here is 1.4+—that is, 1.4 enhanced with features intended for the next release of the program. These enhancements include irregular area calculation, mirror image copy and some automatic shapes such as polygons and an ellipse. The most significant "bug" in the enhanced version is its inability to insert door swings near intersections.  $\square$ 

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## Drawing Processor is easy to learn

By Kristine K. Fallon, AIA and Robert C. Robicsek, AIA

Drawing Processor, at \$495, is the lowest priced software in this evaluation and is among the easiest to learn. Accuracy, flexibility and curve generation are among its principal virtues. The manual contains the best tutorial section, patiently explaining and showing each step in the creation of a drawing.

Unlike the other CAD programs, which place the menu on the screen, Drawing Processor offers these options:

- A strip showing the most common commands can be laid above the keyboard for those who prefer keyboard entry.
- The strip can be placed on the digitizer and the commands selected by touching the blocks in which they reside with the digitizer's stylus or puck. The disadvantage is that the 12 sq. inches taken up by the menu reduces the space available for drawing on the digitizer. Further, many of the commands are not on the strip, requiring the user to go back and forth between the digitizer and keyboard.

Perhaps the key limitation is that Drawing Processor was designed as a general purpose graphics program not written specifically for architects. It therefore does

not provide some of the features that enhance productivity in architectural drafting: an architectural symbols library, infill patterns to indicate materials, multiple layers and semiautomatic dimensioning. Nor does the manual address the issue of how to apply the program to specific architectural tasks.

Technical support is excellent, but limited to two or three people. Calls are not always returned and the phone is often busy. In addition, BG Graphics is slow in sending promised materials. Both program disks we received were defective. Although the company promised to send new disks on Feb. 6, they did not arrive until Feb. 21.

Hardware problems plagued us throughout the evaluation, due to unclear technical support and non-standard interfacing. One of our most amazing discoveries was that, although we were told on separate occasions that two monitors were required, we discovered in May that we may be the only two people in the country using two screens. The manual is ambiguous but seems to suggest that two screens are required.

Overall, we believe that Drawing Processor has proven itself to be a useful design and production tool. Further, it has proved immensely useful in other, less expected areas. We found that the program:

- Permitted timely production of organization charts and project schedules for proposals.
- Allowed the designer to sit down with a client and, calling on a predefined component library, undertake a series of elevation studies. The process ended in agreement on the best solution.
- Quickly generated an attractive graphic as a cover for client's promotional literature.
- Helped with space planning studies. Once the basic plan is entered, many options can be studied quickly and drawn with precision.
- Promoted the marketing of design services to facilities managers and developers. They are impressed by

their ability to participate in keyboard design sessions and pleased with the speed and results.

As a production tool, Drawing Processor executes quickly and with a high degree of mathematical accuracy. It would be helpful if this inherent computational power would permit the user to display the exact X and Y coordinates of a previously defined point, to intersect two lines and to make multiple copies of a component simply by specifying the X, Y distance from one copy to the next.

An annoyance is the inability to create an on-screen menu of stored components. It is not even possible to get a listing of components without "quitting" the program.

On the other hand, Drawing Processor permits any graphic data previously filed to be incorporated directly as a component in any other drawing. The flexibility Drawing Processor offers in the definition, manipulation and placement of components is one of its strongest features.

Another strength is curve generation. In addition to circles, arcs and ellipses, it permits free-form curves defined by a series of control points. This feature is great for doodling as well as drawing furnishings and fixtures. The wood trim on the Pullman dormers (see illustration) was defined as free-form curves.

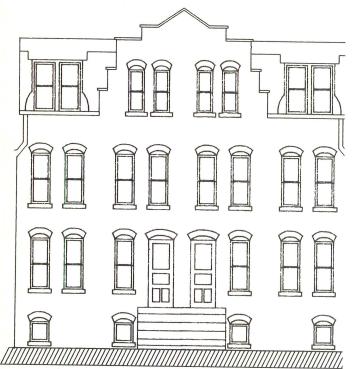
Text is easily placed by size, angle of rotation, slant and line type, but the program only offers one type face. It is clear and easy to read, but its style probably won't satisfy all architects.

#### FALLON ADDS:

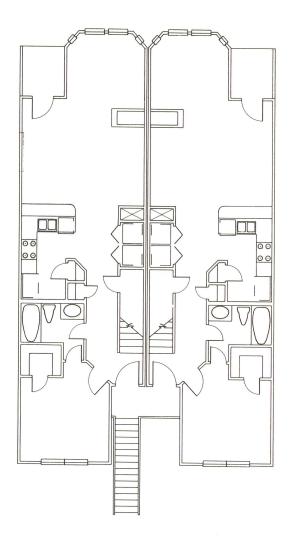
Verifying how the performance of any CAD package compares to a manual method is difficult without first doing the job by hand and then repeating it on the computer. The opportunity to do exactly that came soon after I completed my initial experimentation.

Charles R. Traylor Jr., AIA, Dallas, was searching for an affordable CAD system and BG Graphics referred him to me. He asked me to produce a set of drawings and document my time so he could compare it to his

Fallon has more CAD experience than the other evaluators. She is director of computer graphics for the A. Epstein Companies, Chicago. Their 400 employees provide architecture, interior design and six engineering services. She reached 1:1 productivity with Drawing Processor in 20 hours and has 55 hours on the program plus 15 hours dealing with hardware problems. Robicsek is a principal with Environ, architects, interior designers and planners in Chicago. The 12member firm has had a computer for a year. He spent 40 hours to configure the CAD peripherals and is approaching 1:1 productivity after 100 hours on the program. Fallon drew exclusively with keyboard entry, which she prefers to other forms of input; Robicsek learned on the keyboard and then switched to a Kurta digitizer, which he prefers for entering existing drawings.



Kristine Fallon found it easy to draw the wood trim on the dormers of the townhouse above by defining them as free-form curves. Fallon did the floor plans from a set of typical drawings submitted to her by Dallas architect Charles R. Traylor Jr.



normal production process. I agreed.

The test involved drawing 11 apartment floor plans, all variations of a basic plan. Normally, Traylor would produce them at quarter-inch scale, reduce them to eighthinch scale, reproduce them and assemble them into apartment complex plans with 13 individual units combined on each level. The final products of my test were three levels of these composite plans. (See illustration.)

Using the manual method, the process took 37.5 hours of labor and cost \$192.80 for reduction and reproduction. I was able to produce a comparable product in 22.75 hours with no outside costs. Although I had worked with the program for less than 30 hours when the test began, I was able to achieve better than 1.6:1 productivity.

#### ROBICSEK ADDS:

Although Drawing Processor supports keyboard entry for lines, arcs and data, the company makes clear that the digitizer is the preferred method of data entry. I tried both. The digitizer is faster, but manual entry is more accurate. In sum, I prefer the digitizer, but it's close.

Actually, there's no excuse for it being close, but Drawing Processor is missing three critical features. It doesn't have rubberbanding of lines or an orthogonal mode, and the cursor on the screen doesn't follow the stylus as it moves across the digitizer.

Further, the program handles "pen up" commands awkwardly. If I am entering connected lines and I want to stop and move to another part of the drawing, I must remember to move the cursor to the "pen up" box of the menu strip on my digitizer and press the stylus button to it. Otherwise, I find myself drawing unintended lines—a problem virtually unknown with the other systems.

Keyboard entry is done in two ways: by typing coordinates or by using the arrow keys to move the cursor. Both are cumbersome. The digitizer I used was a Kurta with a stylus. With the menu strip in place, I mount a drawing on the tablet, align it and define its scale. The drawing can be either a freehand sketch on graph paper or a hard line drawing. By pressing the stylus down at intersecting points, the drawing can be input conveniently. To obtain greater accuracy, I zoom in on various parts of the drawing.

Digitizing is limited by the size of the tablet. Unlike keyboard entry, drawings larger than the tablet must be entered in parts and pieced together on the screen. The accuracy of the tablet may also at times hinder data entry, especially if the operator cannot use the grid or tolerance functions as he enters data. With the Kurta, which is accurate to a thousandth of an inch, it becomes almost impossible to digitize two points in a parallel line, even with graph paper.

Drawing Processor BG Graphics 824 Stetson Ave. Kent, Wash. 98031 (206) 852-2736

### MICROCAD OFFERS VERSATILITY

By Paul B. Berger, AIA Dwight D. DeLattre, AIA and David J. Engelke, AIA

MicroCAD is unique. It's the only one of the six programs that does a professional job of drawing in 3-D. With a supplementary 2-D capability also available, MicroCAD has an unequaled versatility.

The beauty of the system, though, is its ability to analyze and study space or objects in three dimensions. Drawings are created using X, Y and Z coordinates. Objects drawn in plan and elevation can be rotated, moved, joined and viewed in isometric or perspective.

The cursor represents the observer's eye, enabling the designer to study an object from any vantage point. We can move around the building, through the building and over the building, or any part of it. The cursor is moved quickly and accurately, and new perspectives can be generated at the push of a button. We thought this feature was great.

In fact, it appears that MicroCAD is easier to use and more powerful for architectural purposes than some 3-D programs we have seen on minis and mainframes. MicroCAD is for architects; the software for the bigger systems seems intended more for engineers.

Berger is president of Paul B. Berger & Associates, Chicago. The firm, with seven members, specializes in corporate interiors and architecture. His IBM machine and CAD program arrived about the same time early this year. He spent 60 hours on hardware problems and 160 hours on the program, with 1:1 productivity still more than 100 hours away. DeLattre is president of New Horizons, an eight-member architectural firm in Arlington Heights, Ill. His IBM arrived in January. Reaching 1:1 productivity took 100 hours on the program but twice the time resolving hardware problems. Engelke is project architect for Potter, Lawson & Pawlowsky, Madison, Wis. The firm's 23 members specialize in architecture, interior design and planning. The firm's IBM arrived with the program in February. He spent 20 hours dealing with hardware problems and has attained 1:1 productivity after 80 hours learning the program.

The program allows us to look at the building more thoroughly, earlier in the design process and in less time than previous manual options. We intend to use the program to study both building interiors and exteriors, to plan groups of buildings and to determine the most appropriate view for renderings.

Of equal, if not greater importance, are the marketing implications. The ability to provide demonstrations for owners who cannot visualize floor plans is an invaluable time saver. Especially in dealing with home owners, we can show alternatives, make changes and get approvals quickly.

The program has significant operational strengths. Grids of any increment can be established in X, Y and Z axes, in any scale and with any unit of measure—and all are capable of being changed midway through the drawing. Straight lines would be easier to enter if the program had an orthogonal mode, which permits only horizontal or vertical lines.

An option to remove hidden lines from the 3-D wire frame drawing has been added recently. It appears to work well, although it is usually limited to one object at a time. Because hidden line removal works in planes, two overlapping objects will not be treated. If one building obstructs the view of another, the program will not block out the overlapping portion.

Also, to use the hidden line program, the drawing must be created in a counter-clockwise direction. Lines that connect planes must be drawn twice so they will not disappear in some perspectives.

The 2-D program did everything required in the compulsory section of the Shoot-Out. It will draw lines and arcs, insert text, edit drawings, reverse (mirror) plans, store symbols that can be recalled and inserted, and dimension lines and areas. But it won't do them as well as the other programs. We would never recommend buying MicroCAD as a drafting program. Evaluator John Voosen, among others, observed that he

wished he had both MicroCAD and the program he was using.

Although MicroCAD lacks such useful 2-D functions as the ability to poché, semi-automatic dimensioning, and a symbols library, some of these features are easily created. On the other hand, moving a door, deleting a portion of a line or moving a wall ought to be easier. The chart unfairly casts MicroCAD in an unfavorable light because the rated features are mostly 2-D applications, for which MicroCAD does not excel. But just having a basic 2-D capability is a significant bonus.

The primary weakness of MicroCAD is the time it takes for redrawing on the screen. With all computer-aided drawing, the screen must be cleared and replaced rather often, and one becomes quite conscious of waiting as one's proficiency with the system grows.

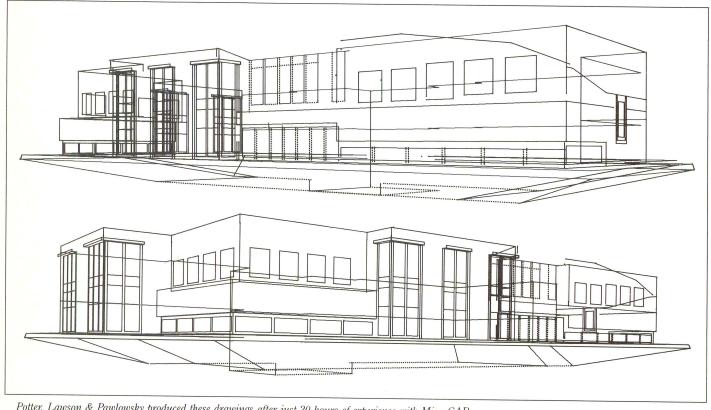
When a MicroCAD drawing becomes large or complex, the redrawing process becomes very slow. Arcs, circles and text, although easily added, are particularly time-consuming to redraw.

Another weakness, in which MicroCAD is not alone, is the inability to display color and line types on the screen. Although we can plot six different line types and eight different colors, the screen remains black and white with all solid lines.

An annoyance is the lack of a tutorial. Although the manual does an adequate job of explaining the functions, a step-by-step guide to creating a typical drawing would reduce frustration and save time. Further, the program would be easier to use if the manual assumed less expertise on the part of the buyer. Compensating for this is the accessibility and architectural background of the creator of MicroCAD, Nelson Johnson, AIA.

When buying MicroCAD from a dealer, make sure he has the most recent version. Enhancements such as layers have been added without changing the version number.

As our learning time with the total system



Potter, Lawson & Pawlowsky produced these drawings after just 20 hours of experience with MicroCAD. They are early perspectives for an office building currently under construction in suburban Madison, Wis.

passed about 80 hours, we all noticed that the results we were able to obtain from the program became increasingly dramatic. Various members of our team are now using the program for a wide range of applications, from designing custom furniture to preliminary design to master planning to marketing. About the only things we're not using the program for are production drawings and construction documents.

We are quite impressed with MicroCAD as a 3-D program. Although it has not solved all our CAD requirements, it seems that it will become more and more helpful as our facility with the program grows and as the program itself continues to be improved. It's a good investment.

#### COMMENT BY MICROCAD:

Hidden line removal is grossly misunderstood. We use a form of hidden line removal called Surface Orientation Method. In the fall, we will have the Surface Priority Method.

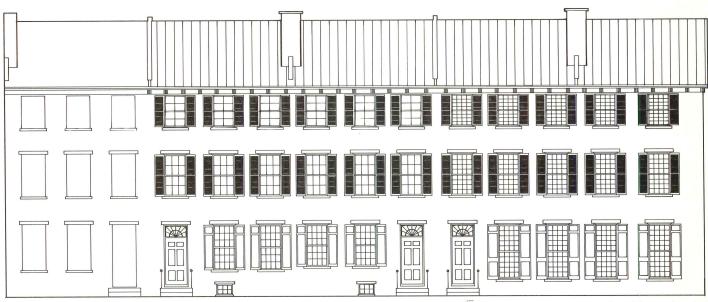
The orientation method takes very little time for the computer to process, but requires considerably more data preparation. Overlapping objects will not be treated. This is the form promoted in most software sold to the public.

The second method requires much less data preparation on input, but is limited by the enormous amount of time to sort planes by distance from the viewer and even more time to test for intersections. The result is that it can take 20 minutes for a microcomputer to treat 16 lines.

My theory is that it is much more efficient to remove hidden lines manually. Using a digitizer to trace the perspective projection is much faster than any other method of removing hidden lines from wire frame models.

A third form of hidden line removal is associated with solids modeling. It works best when the system has enough colors. The entire surface is made up of points of color. A broad pallette is required to differentiate planes and simulate light sources. The computer sorts each point of light by distance from the observer and displays it in order, from background to foreground, so the last points to be displayed will overlap earlier, farther away, points. Because only points are treated, no prioritizing of planes or computation of intersections is required. Solids modeling will prevail as the speed, color and resolution of micros increase.

MicroCAD Computer Aided Design 7650 Geary Blvd. San Francisco, Calif. 94121 (415) 387-0263

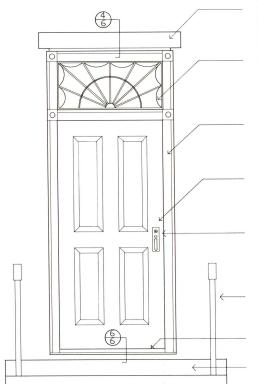


David Winitzky used RoboCAD to produce these drawings for the Lloyd's Row project, a restoration of four brick townhouses built in Alexandria, Va. in 1812. The four units are shown in the elevation

60

drawing above, with a fifth, previously restored unit that is not part of the project. Working details for restoration of the entrances are shown below. Each of the door and hardware details shown keys to a

separate, more detailed drawing of that section. At right below is a portion of a ground floor space planning study. The project is scheduled for completion this fall.



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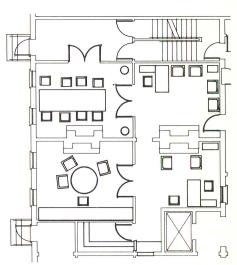
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W. David Winitzky is president of Cascade East Corp., an architecture and engineering firm with 12 employees in Alexandria, Va. He bought his first Apple in 1978 and now has eight micros networked from a hard disk. He has worked with the Robo programs for 60 hours and now, with CAD2, has reached 1:1 productivity for most drawings.

## ROBOCAD SYSTEM COST IS LOWEST

By W. DAVID WINITZKY, AIA

RoboCAD2 is the least expensive of the professional CAD systems. Its total system cost comes to little more than half that of the other five systems in the evaluation.

The special appeal of RoboCAD2 is to the design instincts of the architect. It's really comfortable to draw with. We use RoboCAD to sketch free-hand, study details, draw building elevations and floor plans, and do space planning studies. The program has the advantage of combining both speed and accuracy.

Very little keyboard input is required. Virtually all entry can be done with a proprietary device called a controller. It has a joystick to move the cursor, a dial to rotate and manipulate objects and three buttons with which to make menu selections and control functions.

Evaluator Charles Newman called the program "screen oriented" and evaluator Charles Pedersen said he liked being able to keep his attention focused on the single screen, rather than dividing it among screens, the keyboard and the input device.

Unlike the other programs in the evaluation, the symbol library is displayed pictorially on the screen. Selections are made by pointing at a picture rather than by typing a file name as with CADPlan.

The program is easy to learn and use, although somewhat less powerful than the top-rated CAD programs in terms of available, editable objects. Through the use of the program's library, complex drawings can be developed.

Robo Systems sells both CAD2, which I recommend, and an earlier version, CAD1, which I do not. CAD2 is an effective aid to architects, but the data entry process in CAD1 is too cumbersome. This article is based on CAD2, which was released after the Shoot-Out but before the deadline for this magazine. The other evaluators based their rankings on the version they saw, CAD1.

After following the step-by-step installation instructions in the manual and experimenting with the controller, we began immediately exploring the capabilities of the system.

The screen displays a counter showing the remaining memory for drawing and should be carefully observed. Memory limitations complicate file management and editing.

The number of editable lines and points in one drawing is limited to about 10K of data point information. Our floor plan for a 6,000 sq. ft. restoration project, including only walls, doors, windows and columns, used 97 percent of memory available. To continue, the drawing had to be saved as a single object and reloaded. This freed all but 1 percent of available memory, but meant we could no longer edit conveniently.

By saving to and loading from the symbol library, the size of the drawing is limited only by the disk storage capacity, which is 140K per disk on the Apple. Practically, we have never approached the limits and cannot imagine an architectural application that would.

Retrieved drawings can be stretched, squeezed, rotated, flipped about either axis and reduced in size. But individual elements within the unit cannot be modified.

To edit a previously created part of the drawing, the designer must keep track of the level on which that part of a drawing resides. Then, to find a line somewhere in a group, one must step through the lines one at a time to find the right one. To locate a point on a drawing that fills the available memory can take nearly two or three minutes. We would prefer to be able to point close to a screen data point and have the computer snap to the nearest screen point.

With the addition of an accelerator card, which we did not use, the search routine would operate three or four times faster.

Lessons learned

- Don't use all the available memory for any portion of a drawing before it is saved. Leave a margin for text and details that require reference to the points in that section of the drawing.
- Rehearse the points in a drawing that you will need for future line work and indicate those on a base drawing. Load this base using the utility command so you have complete access to all of the reference points you require.

We use the program's scale drawing mode for 90 percent of our drawings. The computer prompts for the page view size and the units (km, m, mm, ft. and in.) of the scaled view. Any picture unit saved in scale will be rescaled when brought into the work page. This is a powerful feature when placing furniture, drawn in U.S. units, in metric floor plans for overseas clients.

The dimensioning mode calculates line lengths but we found the text default mode unsatisfactory for U.S. units. The system uses decimal inches rather than fractions, so that 5', 6 1/2" would appear as 5'6.5625". And the dimension line, reference marks and arrows would need to be drawn individually.

Text blocks are limited to 40 characters wide, but they can be rotated.

The program runs only on the Apple IIe or Apple II+ computers (or compatibles) with floppy disk drives. A hard disk is not an option. Screen resolution on the Apple is 256  $\times$  193 pixels, somewhat less than 640  $\times$  200 for IBM's color monitor, which is considered low resolution today.

Here's a breakdown of system costs for RoboCAD2:

Essential system component	ts	
Apple IIe with one drive	\$	995
Extra drive		329
Monitor		179
128K RAM board		300
Software and controller	1	,495
BASIC SYSTEM SUBTOTAL . Enhancements	\$3	,298
Accelerator card		600
Warranty/Updates		250
Digitizer		,195
Library disks, each 10	00 to	250
TOTAL		,593

RoboCAD2 Robo Systems Chessell-Robocom Corp. 111 Pheasant Run Newtown, Pa. 18940 215-968-4422

## ADVICE ABOUT HARDWARE AND PERIPHERALS

By OLIVER R. WITTE

The most serious problems have not been in learning or running the CAD programs. They have been in getting all the paraphernalia—the computer, chips, boards, graphics cards, security devices, disk drives, ports, mice, digitizers, light pens, plotters, etc.—to play in tune. A list of the equipment we used, with varying degrees of success, appears on page 66.

If the most important advice in software is to buy training, the most important advice in hardware is to buy installation. If you can't buy installation, at least insist on seeing it all work first. We have lost track of how many times we were promised—incorrectly—that two pieces of equipment would work together, or that the software would support a piece of hardware.

Wishful thinking is one of the real scandals of business ethics in the computer industry. Some hardware vendors are just as guilty as software vendors. They're hungry and they're overcommitted. They probably sincerely believe that by the time you lose patience, they'll be ready to make good on their premature assurances.

The effect is that you might have to get at the back of your computer rather often to add, move, tighten, replace. When you think you're finished, you're just getting started. Count on including in the price of your system a socket bank and maybe a remote switch so you can turn on half a dozen or more pieces of equipment with one switch.

An exception to the refrain of constant hardware frustration comes from evaluator Dave Engelke.

"Our experience with installing, cabling and configuring hardware was positive," he said. "We strongly recommend that one local source be found for all hardware needs."

Wire management is a serious problem. Cords, cables, power supplies and transformers seem to run wild.

Why don't the software vendors prevent the confusion by just supporting a couple of the best computers, digitizers and plotters? The answer has to do with how retail sales are generated. The key to software volume



is having a lot of dealers. And the key to getting a lot of dealers is to support the peripherals that the dealer carries, because that's where most of his profit comes.

#### CRITICAL COMBINATIONS

Coordination of purchases is especially important in three areas:

High resolution graphics card and monitor. Buy them only as a matched pair. The risk in buying from a catalog is a flickering screen. The Hercules monochrome graphics card comes the closest to universal support and is an excellent value as a substitute for the standard IBM mono card. The only high resolution color combination tested was the Vectrix system, supported by AutoCAD. Said evaluator John Voosen, "We wish we could justify its \$7,000 price. Unfortunately, the software needs only one of this beauty's 12 cylinders." Engelke reported lower performance than expected from the Conographic card with MicroCAD.

Digitizer and program. Most digitizer vendors don't supply the cable that connects to a communications port on the computer. They say they can't supply the cable because each program has its own quirks about how to receive data. Buying a digitizer without a cable that works is risky unless you really enjoy building cables. Few digitizer vendors have as wide a dealer network as Summagraphics or as helpful a technical support staff as Kurta. The worst problem was with Drawing Processor, where no digitizer could

be made to work. After dozens of hours, the reason turned out to be that both evaluators had purchased only one communications port and the program uniquely assumes that if only one port is installed, it never will be used for anything but plotting.

Plotter and program. One manufacturer told us that his plotter will work with all programs that support Hewlett Packard. It took several hours for us to discover what he should have known: it won't. In fact, it wouldn't work with most of the programs under evaluation. We also discovered that a plot that took 37 minutes with one model of a plotter took 1 hour and 20 minutes with another model. OK, it was a bug in the program, but who wants to be a test pilot?

#### COMPUTER ISSUES

Compatibility also is an issue with computers. Evaluator Voosen found that a combination that works with an IBM doesn't always work with his Compaq. He tried a graphics board that is supported by AutoCAD and promised to double his screen resolution.

"I found that the mixture caused the Compaq to lose track of the hard disk and blow up the graphic screens," he said. "If Compaq fixes its bugs, I'll buy it again. CAD systems should have the higher resolution this board offers."

Nevertheless, Voosen likes his Compaq. He said he was amazed to discover how much slower the IBM is.

If the software supports the Intel 8087 arithmetic chip, buy it, advises Voosen. "It dramatically improves the speed of programs designed to use it. In a benchmark drawing, we found that it improved screen regeneration time by  $3\frac{1}{2}$  times."

#### DISK STORAGE

The evaluators are unanimous in recommending some form of hard disk, rather than dual floppy disk drives.

"With the floppy disk," says evaluator Chuck Millmann, "many times there is a half minute or longer wait while changing menu options. With the hard disk, there is no wait-

## Hard facts about hard disks

To moderate the system price, all of the affordable CAD packages use general-purpose business microcomputers such as the Apple, IBM and equivalents. These machines are all designed to be expanded in order to work effectively. Since the expansion products come from different vendors, the complete configuration should be tested in advance.

All CAD systems can benefit from the addition of a hard disk drive. These marvels of technology can put 5 to 140 megabytes of data in the same space as a  $5\frac{1}{4}$ " floppy disk.

Hard disk drives provide four major benefits in the CAD environment—faster processing, elimination of the floppy shuffle, larger symbol libraries and safer storage. Many hard disks also allow multiple CAD work stations to access a common set of drawings and symbol libraries.

Because the hard disk spins ten times faster (3,000 rpm vs. 300 rpm) than a floppy, the average access time for a piece of information is greatly reduced. The large capacity of the disk means that all files are instantly available. Large symbol libraries can be kept accessible. This encourages users to always use the correct symbol and not create a new one because it seems easier than finding the right symbol library diskette.

A hard disk drive is more reliable than a floppy disk because it is in a sealed environment. While drives of 10Mb or less can be backed up on floppy disks, this is time-consuming.

Hard disk technology has blossomed in recent years. Look for smaller sizes and larger capacity. The catch is that as disks get bigger, access speed must also drop.

Any computer that has a hard disk of greater than 10Mb needs an easy back-up system. Back-ups are even more important for the drawings because exact duplicates are impossible. It is particularly hard if the drawing is old, has been archived and the original operator is no longer available.

The best system is a tape cartridge that still allows access to individual files. This means that one lost drawing can be restored, without eliminating all drawings since the date of the back-up.

If possible, the tape drive should be at least half as large as the hard disk, i.e., two tapes make a complete copy. Some back-up devices are based on the disk cartridge—a single hard disk platter, which, when inserted, acts as a hard disk.

The copy process is very fast and if the hard disk fails, this unit is a smaller, but acceptable substitute. The drawbacks are that the capacity is low—5 or 10Mb—and the cartridges are very expensive (over \$60 each). This means that the cost of back-up is significant enough that the procedure may be skipped.

Back-up devices are usually sold through the same sources as hard disks and are often packaged together.

#### —DONALD B. VITZ

Vitz is president of TT Systems, Washington, D.C. He is a computer consultant specializing in affordable CAD.

ing and most operations also are faster, including redrawing."

Ten megabytes, the typical storage capacity of a hard disk, might sound like an infinite closet, but Voosen claims that without scrupulous file management, he'd need 30 megabytes by now.

Evaluators Newman and Pedersen, also concerned that a single drawing can use some 300K and by the problems of backing up the hard disk to floppy disks, recommend the Iomega Bernoulli box. It has dual removable cartridges, each holding 10 megabytes and costing about \$55 each. Cartridges can

be backed up in minutes.

"If a floppy disk were being used for drawing storage," Pedersen said, "it would be possible for some systems to create a work file in RAM larger than the storage space available on the floppy. There would be no way to save the drawing."

#### MONITORING THE DRAWING

How the drawing looks on the screen is almost as important as how it looks on the plot. Resolution and flicker are not the only issues. Consider the size of the drawing area, glare, lighting, desk space, whether two screens are worth the money, and the screen aspect ratio. If the program doesn't correct the aspect ratio, which has to do with pixels and screen dimension, the monitor must. But not all monitors have adjusting knobs. And if you skew the ratio to suit an uncorrected CAD program, you'll have to skew it again to run graphics on, say, Lotus 1-2-3.

Example: In AutoCAD, the software ensures that a circle looks like a circle. In some other programs, a three-inch circle is three inches in the X direction and four inches in the Y direction. The egg will plot as the circle you intended. It's just disconcerting.

#### INPUT DEVICES

An attempt to reach consensus on the best input device—numerical input from the keyboard, cursor keys, mouse, light pen or digitizer—generated lively debate and much variation in individual preference.

Evaluators Kristine Fallon and Dave Winitzky tout the merits of keyboard entry. Fallon likes its accuracy and Winitzky feels comfortable at the keyboard.

Nonsense, says Voosen. It's really inaccurate and slow for anyone with less than perfect typing skills. He and evaluators Bill Wenzler and Dave Welliver prefer the mouse. Says Voosen, "The pad it runs on is small (9" by 12") and can be placed anywhere, even on a lap, making even the most outrageous drawing positions comfortable." Welliver contends that for CADPlan, at least, it's faster than the digitizer.

Voosen compared Optomouse with Mouse Systems, and concedes that he might like the former better if he were left-handed.

"The Optomouse has two horizontal rocker switches that allow for four selections from the menu: digitize, line, circle and trace," Voosen said. "No matter how we worked Three words of wisdom: "See it run"

with it, we couldn't hit the right button automatically."

Digitizers are recommended strongly by Newman and Pedersen precisely because of their speed and accuracy. Their favorite was the Summagraphics Bit Pad Two.

"The cursor on the screen, as controlled by the Houston Instrument HiPad, was unstable," said Newman. "It would not maintain a constant coordinate even when motionless, except at a fairly large increment snap."

Engelke, Voosen and evaluator Dwight DeLattre agreed with Newman's assessment of the two digitizers. All dismissed the HiPad as an unsuitable choice.

Evaluator Paul Berger, working with the Summagraphics MM 1201, praised its easy installation and responsiveness. He called it a "necessity."

Digitizers, like plotters, come in sizes from 11" by 11" to 36" by 48". Voosen, who tried them all, finally decided he prefers something in the 12" by 17" range. He liked the E size Calcomp because he could digitize whole drawings without having to copy and cut them. But the cost of a large digitizer, about \$6,500, and the range of motion required to select menu items and trace, were disadvantages.

Evaluators also could not agree on whether the stylus or puck was the better input device to use with a digitizer. Voosen thought they both needed more design work.

"With a stylus, digitizing a point is an adventure because the stylus covers the point you're trying to find," he said. "The cord rises from the back end and loops awkwardly to the table, catching everything in sight."

Voosen likes GTCO's idea of offering pucks with 5 and 16 buttons. AutoCAD links the buttons to the first 15 screen menu items. The buttons are fully accessible and can become powerful macros. But they are not well shaped and don't fit the fingers well, he said.

Light pens were generally rejected as suitable input devices. Engelke called them awkward and nearly impossible to use when not calibrated properly to the screen.

"Totally useless," was DeLattre's assessment of light pens.

## CAD'S GREATEST PROMISE IS AS A CREATIVE, INTERACTIVE TOOL

Our tools not only shape our products; they shape our lives. Technology can be felt in the everyday events of life. It also affects the very structure of our society.

Architecture is an information-intensive profession. And throughout America information-intensive activities are being changed by technology.

How long will it be before architecture is routinely produced on a CAD system? There appear to be three issues: cost, time and quality. The adjoining chart compares the cost of three computer systems.

Compare also the cost of CAD to the cost of people.

First, the billing rate of a senior architect is about \$85 per hour—the cost of a microcomputer for an entire month. The micro CAD station is only a little more. Any measurable improvement in quality or productivity makes it worth the investment.

The cost issue boils down to simply this: We can no longer afford to ignore this technology. For many, micro CAD is a logical beginning.

Today an architect can still raise the eyebrows of his colleagues by dropping the news that he spent a million dollars on a CAD system. Yet when one considers that cost is roughly equivalent to the cost of hiring eight people, it is a ho-hum expenditure.

There are significant differences between the micro CAD and the mainframe CAD equipment: resolution, speed, versatility, three dimensions, color graphics, and so on. But it is not a question of which to choose. We will use both, and in networks.

#### TIME

We are knowledge workers, but our collective body of knowledge is filed in the minds of people who were trained with T-squares and triangles. Most of us like the tools of our trade. We like to draw. Most architects are intimidated by microcomputer technology. Others simply don't want to change.

Acceptance of CAD will be slowed as long as these essential people control the process and resist change. The application of CAD to architecture is more constrained by the number of computer-literate people who can be hired or retrained from existing staff, than by cost or the development of new technology.

Timing is the crucial issue. The smart firms are moving, but cautiously. To move too fast will squander money, produce operational inefficiencies, and will not be cost-effective. But a firm that does not train a generation of computer literate people will become outdated.

#### QUALITY

How many times have you looked at something you have just finished and thought, "If only I had time to do that again, I could sure do it better."

With CAD, you can.

The profession has viewed CAD as a production tool—it is a misconception. Computer applications classically follow two phases:

■ First, a process is identified to be automated based on a simple, one-to-one concept. Anticipated savings are not realized, but the process hints at new opportunities.

■ Second, the process is adapted to the new technology. Quantum leaps in productivity and quality emerge. Performance is achieved that couldn't be replicated manually at any cost.

Architects are hired to solve problems: to design buildings. But our big cost is not the cost of design. It is the production of working drawings. We spend our money not on solving the problem, but in documenting the solution.

With word processing and number crunching on microcomputers, there is no documentation problem. The problem is worked out on the screen. When the creator is through, he simply pushes "Print."

Surely the same will be true of design. When CAD becomes a creative interactive tool, we will begin our design work on the screen. Work will continue in increasing levels of detail, and when we are through with design, we will be through.

By far the greatest promise is that CAD will improve concepts. Our buildings will be better. We can view more designs from more perspectives in changing light. We can link creative, intuitive thinking with rigorous analysis. We will test more alternatives. We will investigate our thoughts more thoroughly.

We will be better architects and our profession will be more satisfying. But the big winners will be our clients. And that is as it should be.

#### —Charles B. Thomsen, AIA

Thomsen is president of 3D/International, Houston. The firm has pioneered in computer applications for architecture.

#### Comparative costs for CAD

A STATE OF THE STA	CARL SAN BOOK CO.		
	Microcomputer	Micro CAD	Mainframe CAD
Hardware and Software Number of Stations Work Station Cost	\$5,000 1 5,000	\$12,000 1 12,000	\$900,000 8 112,500
Monthly Amortization <sup>1</sup> Monthly Maintenance <sup>2</sup> Total Monthly Cost	83 2 85	$   \begin{array}{r}     200 \\     \hline     10 \\     \hline     210   \end{array} $	$ \begin{array}{r} 1,875 \\ \phantom{00000000000000000000000000000000000$
Cost Per Hour <sup>3</sup> 1. Assumes 5-year straight-line d	\$0.50	\$1.22	\$16

1. Assumes 5-year straight-line depreciation. Does not consider the cost of money, investment tax credits, accelerated cost recovery, depreciation, salvage value etc.

2. Based on 3D/I records. Includes software and upgrading.

3. Assumes one eight-hour shift. Costs can be further reduced with two and three shifts.

"Rather ineffective for an exacting application," said Berger, who learned data input with a light pen. Resolution was poor, he found, and using the pen was uncomfortable, slow and laborious.

Evaluator Ken Kowall summed it up when he said, "We believe a mouse, digitizer and even the light pen each have certain advantages that would warrant buying more than one input device."

#### PLOTTING OUT

The plotter offers an opportunity to really bust the \$15,000 budget. The Hewlett Packard 7585B costs \$16,900 all by itself. But then plotters for CAD systems are like speakers for stereo systems: you can spend a little or a lot, depending on how much importance is attached to the quality of the final product.

In fact, if a drawing size larger than 24" by 36" is required, it's difficult to find less expensive options.

At the D size, which the evaluators agree is the minimum acceptable for professional drawings, the options are Houston Instrument's DMP-52, for \$4,500; HI's DMP-42 for \$3,000; and Hewlett Packard's 7580B for \$13,900. The DMP-52 matches the HP for speed, acceleration, resolution, accuracy and repeatability. It has one pen versus eight for

Which is better? Again the evaluators could not agree. Fiddling around with changing pens is a pain, but price is a consideration. Some of the evaluators bought HI and others bought HP. Both are satisfied. Newman and Pedersen, who bought the E size HP, contend that claims of equal specifications notwithstanding, their drawings look better and their productivity is higher enough to justify the price.

Voosen bought both—the DMP-42 for working drawings and HP 7475 (B size) as a personal plotter and for presentation purposes.

A small plotter sold by IBM Instruments, the XY-749, was highly admired for the smoothness of its arcs. It's an A size (81/2 by 11) with eight pens. IBM Instruments also offers a B size, but nothing larger. Both were used with CADPlan and MicroCAD.

In CAD, the three little words that mean so much are, "See it run."

## **FACILITATORS**

Support for this evaluation was furnished by the following persons and organizations. The equipment was used for input and output with the programs, as cited below.

High Resolution Monitor and Card: AutoCAD

Vectrix 384A, \$7,000\* Vectrix Corp. 2606 Branchwood Drive Greensboro, N.C. 27408 (800) 334-8181

Monitor:

All programs
MicroVitec 1486/L Cub, \$1,290
Techland Systems
25 Waterside Plaza
New York, N.Y. 10010
(212) 684-7788

Permanent Storage:

VersaCAD Bernoulli

Bernoulli Box Iomega Corp. 4646 South 1500 West Ogden, Utah 84405 (801) 399-2171

High resolution Graphics Cards:

All programs

Monochrome GB101, \$500 Hercules Technology Suite 210 2550 Ninth St. Berkeley, Calif. 94710 (415) 540-6000

MicroCAD

Cono-Color Model 40, \$1,000 Conographic Corp. 17841 Fitch Irvine, Calif. 92714 (714) 474-1180 Digitizers:

MicroCAD

MM 1201, 11.7 × 11.7, \$782\* VersaCAD and AutoCAD Bit Pad Two, 11 × 11, \$830\* Summagraphics Corp. 777 State St. Extension Fairfield, Conn. 06430 (203) 384-1344

AutoCAD and Drawing Processor Digi-Pad 5, 11 × 11, \$1,720\* GTCO Corp. 1055 First St. Rockville, Md. 20850 (301) 279-9550

CADPlan and Drawing Processor Series 2, 12 × 17, \$1,000 Kurta Corp. 4610 S. 35th St. Phoenix, Ariz. 85040 (602) 276-5533

AutoCAD, MicroCAD, RoboCAD, VersaCAD HiPad DT-114, \$920\* Houston Instrument 8500 Cameron Road Austin, Tex. 78753 (800) 531-5479

Mouse:

AutoCAD USI Optomouse, \$300 71 Park Lane Brisbane, Calif. 94005 (415) 468-4900

Light Pen:
MicroCAD
FT-156, \$195
FTG Data Systems
10801 Dale St.
Box 615
Stanton, Calif. 90680
(714) 995-4787

Plotters:

AutoCAD, CADPlan, Drawing Processor, VersaCAD 7470A — 8½ × 11, \$1,100\*

7470A — 8½ × 11, \$1,100\* 7475A — 11 × 17, \$1,900\* 7585B — 36 × 48, \$16,900\* Hewlett Packard 16399 W. Bernardo Drive San Diego, Calif. 92127 (619) 487-4100

AutoCAD, CADPlan, MicroCAD, RoboCAD, VersaCAD

DMP-51 — 22 × 34, \$4,500\*

DMP-42 — 24 × 36, \$3,000\*

Houston Instrument

8500 Cameron Road

Austin, Tex. 78753

(800) 531-5479

CADPlan, MicroCAD XY-749 — 8½ × 11, \$2,000 IBM Instruments Box 332, Orchard Park Danbury, Conn. 06810 (800) 243-7054

Technical Support:
Don Vitz
4611 River Road, N.W.
Washington, D.C. 20016

(202) 244-5584

Tom Math 701 S. Lincoln Ave. Park Ridge, Ill. 60068 (312) 692-7320

Institutional Support:
Chicago Chapter, AIA
Northeast Illinois Chapter, AIA
Wisconsin Society, AIA
Triton College, River Grove, Ill.

\*Plus extras, such as cables

## GLOSSARY

"A" Size Sheet—8½" by 11"

Aspect Ratio—Ratio of screen height to width. The aspect ratio of a monitor may affect the way in which a geometric shape appears when plotted on the screen. In some cases, a circle may appear as an ellipse. This effect can often be eliminated if the software is "tailored" to correct for distortions.

"B" Size Sheet—11" by 17"
Block—Symbol or group made of entities.

"C" Size Sheet—The architectural size is 24" by 36". The engineering size is 22" by 34".

Coordinate Dial—Displays the position of the cursor, usually in X, Y coordinates.

Coordinates—Locations on the screen, expressed as X, Y and, in 3-D systems, Z points. Entry of data in absolute coordinates sends the cursor to a specific location on the screen. Relative coordinates move the cursor specific distances in screen measurements from its present point in the X, Y and Z directions. Polar coordinates also move the cursor from its present position, but the directions are expressed as an angle and real-world distance (feet, inches, etc.).

**Cursor**—1. The rectangle of light (usually blinking) on the computer screen. 2. Synonym for the puck used with a digitizer.

Digitizer—Input device that uses a drawing surface and a pointing device, such as a puck or stylus, to control the cursor on the screen. Variously referred to as pads, tablets and tables, usually depending on their size. Used primarily to trace existing drawings or sketches.

**Dynamic Tracking**—The location of an object is previewed by flashing it as it is moved into position. When the right position is reached, the object is placed. Works well with simple symbols but the response slows for complex objects.

**Entities**—Also called primitives. The basic drawing elements, such as line and arc, that are provided in the program's database.

**Explode**—Break apart a symbol or object into its basic components so the symbol may be changed.

Floating Point System—The more common format for the way a program keeps track of where objects are located. It's

a bit more accurate but slower than its alternative, the integer system. Floating point and integer refer to the type of numbers the program uses to store coordinates.

**Group**—Cluster of primitives that can be modified individually.

Handle Point—Where the cursor grabs on to an object or group to move it.

Integer System—The less common way a CAD program keeps track of where objects are located. See Floating Point.

Layers—Also called levels. Think of them as a set of transparent overlays that can be superimposed on the screen or plotter. Layers may be turned on and off. All programs except Drawing Processor permit multiple layers.

Library—Collection of symbols.

Light Pen—Input device that moves the cursor on the screen and sets points when the end of the pen is touched against the screen.

**Macro**—A user-defined, linked series of commands executed with a single keystroke. Permits a menu to be customized to perform a complex, but frequently used function efficiently.

**Monitor**—The TV-like screen that displays the drawing.

**Mouse**—An input device that moves the cursor on the screen and makes menu selections. Used primarily to create new drawings.

**Nesting**—Making an object part of one or more groups.

**Object**—Any element of a drawing. Synonym for primitive and entity.

Pan—Movement across the X or Y grid, usually by a screen-full at a time, without changing the magnification. Lets you see details of a drawing that were off the screen.

Pixels—Points of light on the computer screen. The smallest elements that can be used to display your design on the screen. The more pixels the monitor and graphics card can display, the crisper the image will appear.

**Plotter**—Computer-controlled output device that draws with pens on paper. Contrast with printer, an output device that types on paper.

**Primitives**—Also called entities. The basic design elements, such as a line or arc,

that are joined to make symbols or groups.

**Puck**—Input device, usually used with a digitizer, to move the cursor on the screen and make menu selections. Also called a cursor.

Rubberbanding—1. A preview technique to show a tentative location on the screen. It creates a moveable line, fixed at one end, that contracts and expands to follow cursor movements until its location is correct. All the while it is blinking, dashed or otherwise shown dynamically. Some systems also rubberband circles, arcs or objects. 2. When an object is moved, all lines connected to it are stretched to remain attached.

**Snap**—A convenience that permits the cursor to go directly and precisely to the nearest grid point, vertex, user-defined increment between grid points or user-defined node.

**Stairstepping**—The jagged lines on a low resolution monitor trying to display a diagonal line or curve. Term "jaggies" is used as a synonym.

**Stylus**—Pencil-like input device to move the cursor on the screen. Pressing the point of the stylus to the tablet or drawing stops and starts a function.

**Symbol**—Cluster of objects or primitives that some programs treat as an entity, rather than a collection of entities.

**Toggle**—Pressing a command key repeatedly turns the function on and off.

Vertex—The coordinate points that the program uses to keep track of objects. The function of a mouse or digitizer actually is to create vertex points. We see them as lines and shapes, but the program knows them only as vertices. Drawing a rectangle, for example, requires the setting of five vertex points. One corner will be both a start and end point to draw the lines.

**Window**—A portion of a drawing created by zooming in. Often used as a verb to indicate the displayed result of zooming either in or out.

**Zoom**—Magnify or shrink the visible image of the drawing. Changes only the screen display, not the length or location of lines or points.

#### PRODUCTS

## PRACTICALITY WITH PIZAZZ—GLASS BLOCK IS BACK

BY M. STEPHANIE STUBBS AND MAUREEN CUNNINGHAM

A MATERIAL THAT ONCE WAS RELEGATED TO FACTORIES, FILLING stations and small commercial structures better forgotten, glass block has moved into stylish and expensive office space, residences, commercial and institutional buildings. In its renaissance it has added, to its valid utilitarian image, aesthetics and pizazz.

In essence, what glass block does so well is enhance the play of light. Canadian architect Arthur Erickson summed it up well when he wrote, "Light can be hard and flaring, or ineffably soft and luminous. Night light provides another kind of illusion, giving the forms of the day different presence at night—for it is the source of magic in architecture."

The International Telecommunications Satellite Organization (INTELSAT) building currently under construction in Washington, D.C. is a classic glass block success story. John Andrews International Pty. Ltd., an Australian firm, emerged victorious over five other invited firms in INTELSAT's 1980 international design competition with a 300,000 sq. ft. design built around individual 4 or 5-story office pod/atriums serviced by 12 circular, glass blockskinned stair towers. Anderson Notter Finegold Inc. (Washington, D.C.) is associate architect on the project, scheduled for completion in early 1985.

Aesthetic effect was the major reason for choosing glass block for the stair tower envelope.

"We wanted people to see out of the stair towers as they were moving up the stairs, and then, in the evening, we wanted to be able to see the movement of people on the stairs reflected through the block," explained project architect Geoff Willing, FRAIA, AACA of John Andrews' Washington office. "We wanted the clarity of reflective glass without using sheet glass."

Energy efficiency was another strong argument for glass block. The release of Pittsburgh Corning Corp.'s (PC's) new reflective glass block happily coincided with design of the stair towers. The highly reflective, thermally bonded, oxide surface coating reduces solar heat gain by 70–80 percent and visible light transmittance by 80 to 95 percent. John Andrews chose the  $8'' \times 8'' \times 4''$  VUE TM block, with a warm, bronze-gray coating.

The reflective glass block is one of many energy-efficient features in the INTELSAT building. Mechanical/electrical engineers D.S. Thomas & Partners (Sydney) and The Benham Group East (Washington, D.C.) estimate energy consumption will be 32,000 Btu's/sq. ft./yr., about half the average for Washington office buildings.

#### A PROBLEM SOLVED

The architects were concerned when a few of the top blocks cracked at the heads during an initial installation during the winter. Investiga-

tion showed that before the heads were caulked water had seeped in, frozen, expanded and cracked the block. The cracked blocks were replaced and the caulking job completed, and installation has proceeded smoothly since.

"You won't find major problems with glass block—it's a wonderful material," Willing volunteered. "It's an incredibly simple product to use if one respects the thermal expansion and contraction properties of masonry materials and adheres to standard work procedures such as keeping the work area protected from the weather and above 32°F in freezing weather."

The stair towers and building are almost complete, and already offer a fascinating visual display to passersby. The play of the softly glittering circular elements against the "high-tech" aluminum and glass building pods, fitted with outrigger sunshades, is particularly attractive at night, when the blocks cast a silvery glow.

#### RENAISSANCE

Glass block is popular now, but just five years ago Pittsburgh Corning Corp. (PC), the only domestic manufacturer, planned to phase out production. The sudden increased demand from the design community, and numerous letters of protest from prominent architects, convinced the firm of the commercial viability of the product, and in July 1980 PC announced it would continue production.

To put it mildly, the product took off, appearing regularly in design and building publications.

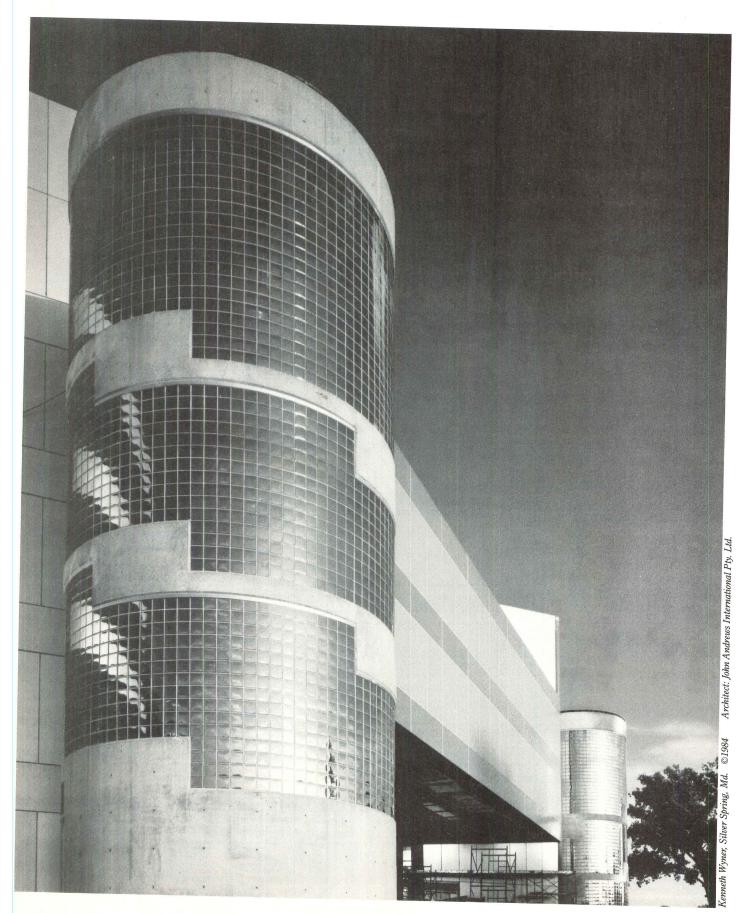
The renewed popularity of glass block in this country has caused an influx of foreign-manufactured blocks, distributed through American dealerships. Two European firms, Westerwald AG of West Germany and Saint Gobain of France, now offer a very wide range of patterns and colors in standard American sizes. Nippon Electric Glass (NEG), a major Japanese manufacturer, offers glass block in this country in 12 patterns, 5 shapes and a rainbow of colors—sky blue, gray, brown, blue, orange, green, yellow and mossy green. NEG also offers a light-reflective block, which bounces light toward the ceiling.

Distributors say most American architects still prefer simple patterns, and demand for the foreign block has not been strong. PC, which produces the lion's share by far of blocks used in this country, reports that its most popular block is the Decora® pattern, plain on the outer face, with a soft swirl on the inner face. Other pattern choices in PC's GlassBlock™ line include clear; one with rounded flutes on the inner faces; a graphic pattern with horizontal and vertical flutes; and a cut diamond pattern. Not all patterns are available in all sizes.

The more flamboyant foreign patterns are used extensively and creatively abroad, resulting in some spectacular designs in Japanese,

M. Stephanie Stubbs is an architect, researcher and writer. Maureen Cunningham is a former publications editor for the Brick Institute of America who is now a sales representative for a brick manufacturer. Both live in the Washington, D.C. area.

Glass block-skinned stair towers at the INTELSAT building under construction in Washington, D.C.



ARCHITECTURAL TECHNOLOGY

### A practical choice for energy, sound and security

European and South American buildings. Willing said his firm has used metric-sized glass block manufactured by Saint Gobain extensively in Australia, with no problems.

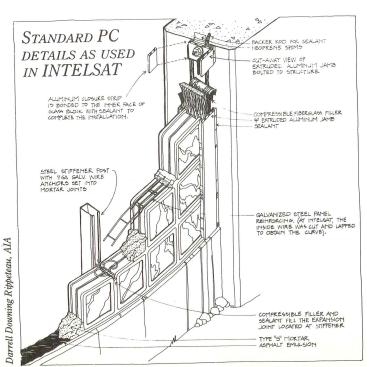
Tanner & VanDine Architects (San Francisco), plans to use NEG clear glass block for the DataMart building currently under construction in San Francisco because of competitive costs, technical assistance offered by the firm's engineers, and most of all, the installation details specifically designed to accommodate seismic movement while eliminating the need for vertical mullions.

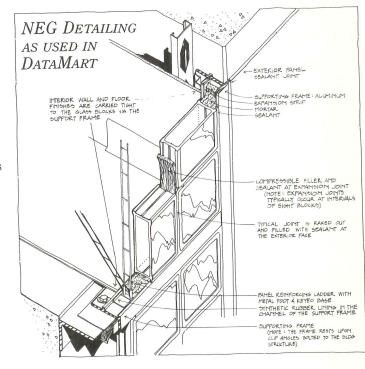
The NEG detailing system has been used successfully in Japan, but is new to U.S. designers, and final approval by local code officials for its installation in DataMart is pending completion of extensive curtain wall tests.

A wholesale and display center for micro-computers and peripheral products, the four-story, triangular DataMart building will have approximately  $18,000\ 12'' \times 12''$  clear glass blocks in its curtain walls. Horizontal louver interior blinds will help reduce solar heat gain.

Stacy explains the differences between the PC and NEG details: "Pittsburgh Corning's standard details typically show edges of glass block panels embedded in metal channels. A portion of the edges of the glass blocks are then hidden. Their alternative is use of panel anchors (thin strips of perforated metal) that are rigidly attached to the supporting frame and embedded into the mortar joints of the glass block.

"NEG's standard details use a metal foot attached to the panel reinforcing ladders which key into a channel in the supporting frame. This channel does not overlap the glass block and can be flush with





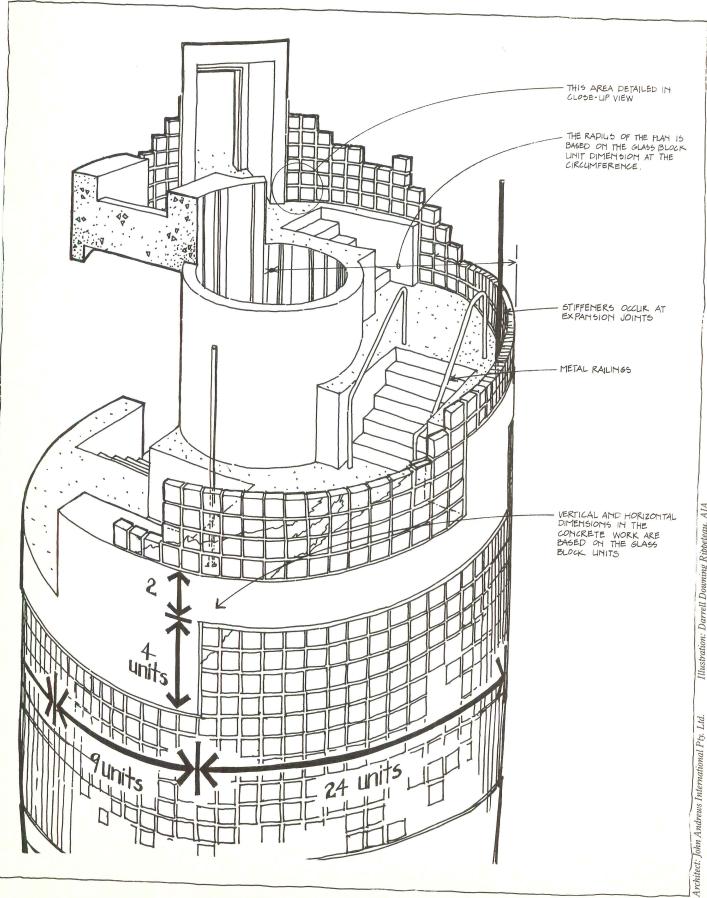
the outer face. The channels are lined with thin sheets of synthetic rubber to prevent any adherence of the mortar or reinforcing to the channels, allowing the panels to expand, contract, and move during earthquakes while remaining securely in place.

"PC typically calls for ladder reinforcing at 2'0" on center, horizontally only. NEG typically calls for ladder reinforcing in one direction and separate paired wires or ladders in the opposite direction. By reinforcing horizontally and vertically, the panels can be supported on their top and bottom edges only, thus spanning vertically. With horizontal reinforcing alone, panels must be supported along their sides, spanning horizontally. This difference has allowed us to eliminate any vertical mullions in DataMart.

"The installation of both horizontal and vertical reinforcing is more difficult for the masonry contractor, but the elimination of vertical mullions offsets some of the cost. After an initial learning period, the masons who constructed the test panels for the DataMart building adjusted well to working around the vertical reinforcing.

"Because NEG's reinforcing is larger than PC's, NEG insists on a minimum mortar joint of \%" (10mm). This results in a spacing of block at 12\%", as compared to the spacing of 12" recommended by PC."

The INTELSAT building was designed using standard PC GlassBlock™ details, including reinforcement specifications. It was the modular sizing of the block and its mortaring and expansion joint needs for placement in the 20' 6" diameter circle of the stair towers that determined the design and cantilever of the concrete stairs. The 4' wide concrete stairs are hung from a 9" thick concrete core, which forms an inner circle with an 8' 4" diameter. Suspension of the stairs from a structural core leaves the glass block free to perform its function as a non-load-bearing envelope.



ARCHITECTURAL TECHNOLOGY

Illustration: Darrell Downing Rippeteau, AIA

#### PC plans to release seismic details soon



Tanner & Van Dine Architects is testing Nippon Electric Glass Co. details for elimination of vertical mullions to enhance seismic safety in the DataMart building under construction in San Francisco. About 18,000 clear glass blocks will be used in the curtain walls.

Stacy said that using the metric-sized blocks has caused no design problems for the firm, because the 300 mm block module is very close to 12", a standard American nominal size. Tanner & VanDine is using a silicone sealant on all the exterior mortar joints instead of the waterproof finishing mortar NEG recommends, based on tests done by Skidmore Owings Merrill (Chicago) on the glass block wall they designed for the Chicago Board of Trade Options Exchange.

Pittsburgh Corning is also testing a system without vertical mullions.

"If tests go as planned, PC's details for eliminating vertical mullions will be in our literature by early 1985," reports Gary Meyer, technical service representative in PC's headquarters office.

"The PC standard detailing system is already seismic safe," Myer said. "Under the worst seismic conditions covered in existing codes, lateral loading against an exterior wall is 9 lbs./sq. ft. Our panels withstand 50 lbs./sq. ft. NEG has taken seismic design further because they're in Japan, where earthquakes are more severe. We've been putting glass block in buildings in the United States since 1938 and have had no major disasters."

San Francisco, with its stringent seismic and energy codes, seems an ideal testing ground for the NEG installation details. The state's strict energy regulations were made more difficult to meet because San Francisco's planning department currently discourages the use of tinted or reflective glass, which prevented consideration of solar reflective glass block. Nevertheless, even with floor-to-ceiling block on three sides, DataMart meets the state energy code.

Structurally, the San Francisco building code calls for the edges of panels to be embedded ½" into channels with a ½" void for expansion, but allows for "equivalent configurations" for attachment. To provide performance information for themselves and code officials, Tanner & VanDine is testing a 22' by 25' mock-up, including a curved section, at Construction Consulting Laboratories, Carrollton, Tex., for water penetration, wind pressure resistance, seismic drift, condensation and thermal cycling, and structural overload to destruction. At the time of this writing the test panel had been constructed.

If the results of the tests are positive, DataMart will be completed in April 1985: an energy-efficient, seismic-resistant glass block showcase of flush paneling, without visible channels and vertical mullions.

#### ENERGY EFFICIENCY

The use of glass block allows the designer to admit light without sacrificing as much energy efficiency as with large expanses of single glazing, making glass block a wise choice for exterior application in buildings where the cooling load is the predominant energy load—as is the case with most non-residential buildings in most areas of the United States. The glass block has a lower U-value than glass, and the mortaring also provides a thermal stop.

Reflective glass block has a solar shading coefficient of 0.25, meaning it admits only one-fourth the amount of solar heat transmitted through clear sheet glass. (The solar shading coefficient is the ratio of solar heat gain through a glass block to the amount of solar heat gain through a ½" sheet of glass.) Clear glass block has a solar shading coefficient of 0.65.

Single-cavity glass block, the most common variety, is manufactured by fusing two molded halves of glass together. The resulting partial vacuum provides thermal insulation ranging in U-value from

0.52–0.60 depending on the size, pattern and color of the block—compared to a U-value of approximately 1 for single-paned glass.

Even better insulating performance can be achieved with double-cavity glass block, which is manufactured with a non-woven fibrous glass insert between the two fused halves, lowering the U-value to approximately 0.44. PC will manufacture by special order double-cavity blocks with a variety of patterns. The cost increase is approximately 10 percent.

Solid glass blocks, sometimes referred to as glass bricks, are manufactured by casting one half of the block directly on top of the bottom half. The resulting U-value is higher (0.87) for an  $8" \times 8"$  block. Solid blocks have the highest percentage of light transmission (80 percent) of any type of block.

Glass block also acts as an excellent sound insulator. A 3%" thick block has a sound transmission loss of 38 decibels. A 3\%" thick block has a 33 decibel sound transmission loss, and solid glass block has a 45 decibel sound transmission loss. This difference can lower the noise level from that of a noisy street (75dB) to that of a quiet office (40dB).

Glass block meets security needs as well. Pittsburgh Corning's VISTABRIK® solid glass block is, according to the company, "virtually indestructible. When a 30.06 rifle was fired at a panel from 25 ft., the bullets were unable to penetrate the glass." VISTABRIK® can also be used for pavers and coverings for light fixtures.

The patterned and reflective blocks provide visual privacy while admitting light, a property that Hartford Design Group (Hartford, Conn.) capitalized on in design of the Training Facility Addition at the New London Naval Submarine Base in Groton, Conn. The building is used for training crew members assigned to submarines, and the Navy had wanted a windowless building for security reasons. Architect Tai Soo Kim, AIA, used bronze reflective glass blocks to allow natural light to illuminate the classrooms, while preventing visibility from the outside.

Glass block works well in areas where condensation is a problem. In instances where the inside temperature is 70°F and the relative humidity is 40 percent, to cause condensation on a panel of block with fibrous inserts, an outside temperature of -23°F would be necessary; and on a single cavity panel, -8°F.

Because of this resistance to condensation, Heinz U.S.A. turned to prefabricated PC GlassBlock™ window panels with inserted ventilators to replace windows in its Pittsburgh plant. The sashes and frames had been damaged by high concentrations of food acids, steam, water, humidity and caustic cleaners. The glass block panels met the company's tough sanitation requirements, and condensation problems associated with humid food-processing areas were minimized.

Block panels are easily maintained. Panels can be hosed down on the exterior, wiped clean on the interior. Thanks to the mortared joints, airborne dust and dirt stay outside, and there is nothing to paint or putty.

Glass block panels have a UL-approved fire rating of 45 minutes. However, their use in fire-rated walls varies from code to code, usually in accordance with the fire protection system used, and in some cases is restricted. The architect is advised to check with local codes and building officials if designing a fire-rated wall assembly.

#### DETAILING AND INSTALLATION

Glass block's unique properties must be taken into account during the design and detailing of buildings, most notably in the areas of attachment to the structural frame, and panel reinforcement.

Because glass block is smooth and non-absorptive, it tends to float in mortar, taking longer to install than ordinary masonry. PC recommends a drier mortar than that used for regular masonry, with standards according to the weight of the block.

The model building codes vary as to the type of mortar permitted. Admixtures such as antifreeze compounds should not be used.

To properly withstand windload conditions, large areas of glass block (greater than 144 sq. ft.) are divided into smaller panel sizes. Panel sizes also determine attachment and reinforcing details.

Particular attention should be given to the head detailing of solar reflective block, as it can be stained by substances sometimes released by concrete surfaces or weathering steel exposed to rainwater. Details should be designed to keep dripwater from these surfaces away from the block.

For small exterior panels, with a maximum of 10 ft. horizontally or vertically (a maximum of 100 sq. ft.), PC shows details in its installation specifications that allow for elimination of channels at the jambs and a panel anchor for anchorage. In installing small exterior panels, panel anchors providing lateral support are restricted only by building code requirements and direction of the architect. Where panel anchors are forbidden, standard channel construction must be used.

Smaller panels of 25 sq. ft. or less, with a maximum width of 5 ft. and maximum height of 7 ft., can have the blocks mortared in solid at the side jambs. Larger panels, usually those over 144 sq. ft., require stiffeners.

PC standard details call for panel reinforcing of galvanized steel double-wire mesh, formed of two parallel 9-gauge wires either 15%" or 2" apart with electrically welded cross wires at regular intervals, to be installed in horizontal joints on 24" centers for their standard block, and on 16" centers for their thin block and solid block. Reinforcing is also placed in joints immediately above and below all openings within panels. The reinforcing runs continuously from end to end of panels and should be lapped not less than 6" whenever it is necessary to use more than one length. Expansion joints are not bridged with reinforcing.

PC GlassBlock  $^{\text{TM}}$  is available in 6", 8" and 12" nominal sizes, and in  $4" \times 8"$  and  $6" \times 8"$  nominal sizes. Its standard size block is 3%" thick; its Thinline  $^{\text{TM}}$  glass block is 3%" thick; its solid glass block 3" thick and 8" nominal square. The interior use of thinner (3%)" glass block has become very popular, and is restricted to individual panel sizes of 150 sq. ft.

In summary, glass block appears once again to have assumed its rightful place as an easy-to-use, easy-to-maintain building material that allows architects to perform one of their most important jobs: control and enhancement of the play of light.  $\square$ 

#### DESIGN

### Daylighting, color emphasized for justice facilities

Architecture for Justice highlights 33 examples of the latest ideas in designing jail, prison, law enforcement, court and juvenile detention facilities.

The 33 designs were displayed in August at the American Correctional Association Congress of Corrections in San Antonio, Tex. They will be shown at the AIA head-quarters in September and will be among the exhibits at the AIA justice committee's Oct. 18–20 conference in Savannah, Ga. Other exhibition sites are also being considered.

The three-person screening jury cited eight of the exhibited projects for outstanding features, including five detention and correction facilities, a justice complex, a juvenile detention facility and a court building.



The screening jury noted that the interior of the Pitkin County Jail in Aspen, Colo. provides abundant natural daylight, attractive, non-institutional furniture, sound-absorbing materials and soft finishes. Architects were Caudill Gustafson & Associates, Aspen.

Most of the jury's comments addressed detention and correction facilities, emphasizing those designs that departed from the traditional telephone-pole configurations, perimeter towers and hard, sterile environments.

A current theory in detention/corrections, and one to which the screening jury adheres,

is that loss of freedom is sufficient punishment to make the threat of imprisonment a deterrent to crime. The less the prison or jail reminds the inmates that they are being confined, the fewer behavioral aberrations inmates will show. Solitary confinement is an effective deterrent to misbehavior within the prison or jail only if the non-solitary confinement contrasts enough to make inmates care to modify their behavior and remain in the general population.

According to this theory a prison that uses extensive daylighting, interesting color schemes and minimal use of security hardware, and which has direct interaction between guards and inmates, is much easier to administer and control than a more traditional jail or prison design.

The jury also emphasized the need for real expansion capability within prison and jail design and noted a commendable increase over past years in the use of energy conservation—primarily through passive and active solar applications.

Other noteworthy characteristics cited by the jury included abundant provisions for program space—such as workshop, education and recreation areas—and good sight lines to all inmate-occupied areas.

A catalogue of the exhibition will be published in September. It includes project descriptions, interior and exterior photos or renderings, some floor plans and elevations, and architect and consultant listings for each facility. Observations by the screening jury are included.

The exhibition is sponsored annually by the American Institute of Architects and the American Correctional Association. The examples were selected from submissions solicited by the AIA Committee on Architecture for Justice.

"For the second year the screening jury put emphasis on compliance with American Correctional Association and National Fire Protection Association standards and supports the goal of such standards to establish an acceptable level of quality in justice architecture," according to the jury statement to be published in the exhibition catalogue.

The jurors were Aaron A. Brown, Prisons Division, National Institute of Corrections; Mary S. Galey, AIA, Office of Facility Development, Federal Bureau of Prisons; and Joseph N. Ladd, AIA, Joseph Ladd & Associates.

—Douglas E. Gordon

### Housing workshop explores development strategies

The AIA Housing Committee sponsored a two-day national housing workshop in St. Louis in late June, where approximately 100 participants were divided into 10 working groups to devise development strategies for in-fill housing on "skipped-over" parcels in urban neighborhoods during an all-day charrette.

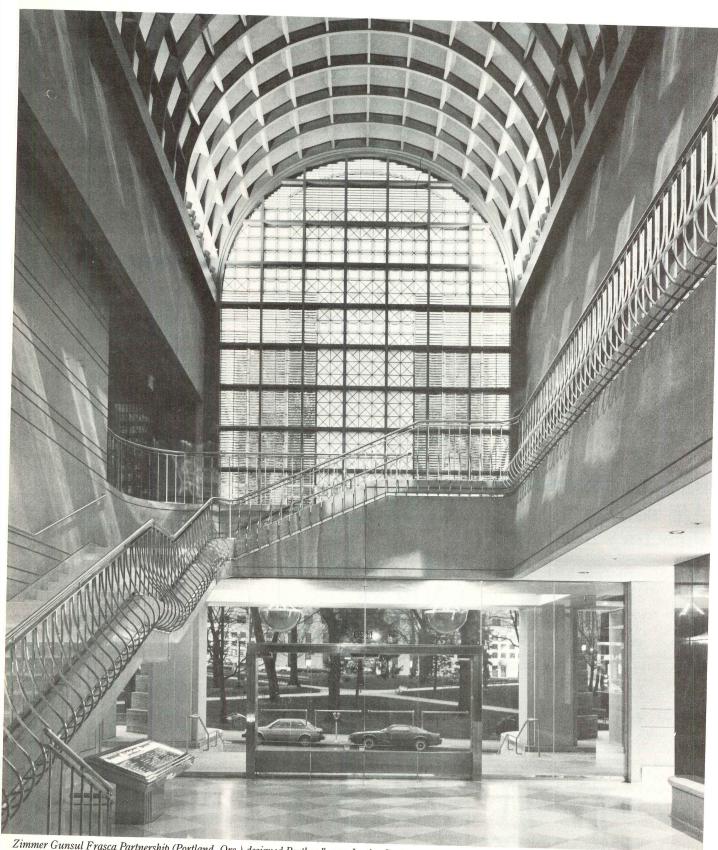
Blake Chambliss, AIA, chairman of the Housing Committee, urged architects to get involved in their community and in the whole development process. "We must look at tax incentives for home ownership, new mortgage sources, and new tax-exempt financing tools," he said. "There is no more cheap energy, no more cheap money, no more cheap land or infrastructure and no more government subsidies."

The workshop featured a number of panel discussions in which real estate brokers, market analysts, mortgage brokers, building and zoning officials, developers, and builders examined residential trends, problems with in-fill housing, financial obstacles and opportunities, and development and construction issues.

Architects were urged to think like developers, builders, realtors and bankers to achieve affordable housing in U.S. communities. "Affordable housing" was defined by a speaker as being two-and-a-half times the median income in a community.

### Indoor pollution symposium slated for Nov. in San Francisco

To address emerging health problems stemming from indoor pollution, AIA and the California Council/AIA will co-sponsor a national symposium Nov. 9–10 in San Francisco, where practitioners will examine implications of pollutants and explore ways to design safer buildings. For more information, contact Vicki Thacker of the California Council (916) 448-9082.



Zimmer Gunsul Frasca Partnership (Portland, Ore.) designed Portland's new Justice Center, a complex that includes commercial retail space as well as service areas for courts, detention, and law enforcement administration. The jury noted the "dramatic arcade entryway," functional courtrooms, and "normalized" detention units.

#### RESEARCH

## Research & Design '85 program set

The Architectural Research Council, meeting in Boston Aug. 26–28, selected speakers and exhibitors for the AIA's Research & Design '85 conference, to be held in Los Angeles Mar. 14–18, 1985.

Research & Design '85 will provide architects and other interested design professionals with practical, state-of-the-art information in five areas: life safety and codes, building redesign, design for specialized populations, energy, and environmental trends that may affect the building industry. These issues were identified by the Council as the most pressing needs in architectural research.

The AIA's *Direction '80's* report underscored the need for transferring practice-oriented research results to the profession. Research & Design '85 is the first of a number of new products and services being developed by the Research Department of the AIA Foundation in response to this mandate.

For further information and registration procedures, contact Kim Leiker, (202) 626-7560.

#### COMPUTERS

## A/E software directory available

N RESPONSE TO THE URGENT NEED FOR A central source of information on architectural and engineering software, the American Consulting Engineers Council (ACEC), in cooperation with the American Institute of Architects (AIA), the Society for Computer Applications in Engineering, Planning and Architecture (CEPA), and Automated Procedures for Engineering Consultants (APEC) has developed DAEDALUS; Database for Engineers and Architects to Locate and Utilize Software.

DAEDALUS is a follow-up to the successful publication "Major Software Sources," also a cooperative effort of the four groups. Five thousand copies of this document were distributed free and several thousand additional copies were sold at a nominal cost. The demand for "Major Software Sources" is indicative of the need for computer software information in the design profession.

DAEDALUS is maintained as a computer database and as such allows a constant flow of new and updated information. It contains hundreds of architectural and engineering

software packages. Individual program listings contain detailed information including: vendor name and address, cost of program, hardware and system requirements for operation and a brief description of program capabilities provided by the vendor. The long-range goal of the project is to make DAEDALUS accessible to architects and engineers through a computer information utility. In the interim, software information is being published in hard copy catalogs.

Each printed DAEDALUS catalog will cover one or a related group of the following topics: Bridge & Highway; CADD/Interactive Graphics; Other Graphics; Electrical/ Electronics; Environmental; Geometry/Surveying; Geotechnical; HVAC/Energy; Mechanical/Plumbing; Project Management; Sani/Hydro/Hydraulics; Structural/Buildings; Traffic/Transit.

The first section available in hardcopy is Accounting and Management Information, which lists over 100 software packages specifically developed for architects and engineers. Each DAEDALUS Catalog will be assembled on 3-hole punched paper for insertion into a 3-ring binder to easily accommodate both the subsequent catalogs and the periodic updates.

The DAEDALUS Accounting and Management Information Software Catalog is available for \$15, including postage, from ACEC Publications Dept., 1015 15th St., NW, Suite 802, Washington, D.C. 20005.

Firms interested in listing their software in DAEDALUS or acting as advertising sponsors should contact Karen Fay at the above address or call 202/347-7474.

## ACEC announces CADD kit

The American Consulting Engineers Council has released a professional development package on Computer-Aided Design and Drafting (CADD). The kit, consisting of a manual and video cassette tape, is an effective teaching tool by designers in all industries. Encompassing all phases of the CADD process, the kit can be used by design professionals who are "just looking" and those interested in expanding current firm capabilities.

The CADD package in VHS or Beta formats is \$250 (\$195 for ACEC members), which includes one copy of the video tape and one copy of the manual. Single copies of the manual are \$15 (\$10 for ACEC members). Orders should be prepaid for No. 56-A (video tape) and/or No. 96 (CADD manual), to ACEC, 1015 15th St., N.W., Washington, D.C. 20005.

## New guide to using public data bases

A new manual from the American Consulting Engineers Council, *Public Data Base Use For Design Firms*, explores every facet of the vast electronic libraries and networks that are accessed through in-house computer terminals, providing design firms with cost-effective ways to command exhaustive commercial resources.

For more information, write the American Consulting Engineers Council, 1015 15th Street, N.W., Washington, D.C. 20005 or call Jim Pierce at (202) 347-7474.

#### STUDENTS

## Students to meet in Ann Arbor

The theme of Forum '84, this year's convention of the Association of Student Chapters of the American Institute of Architects, will be "Expanding Horizons in Architecture."

The convention will be held Nov. 20–24 in Ann Arbor, Mich., and is sponsored by the University of Michigan and the University of Detroit.

Stan C. Lee, co-chairman of Forum '84, said, "People are expecting more from their buildings and the architects who design them, yet many architects seem unwilling to respond to contemporary problems, choosing instead to focus on forms or technology. The traditional approach to architectural education can create a sense of detachment from the needs of the people, he said.

Forum '84, according to Lee, will be an opportunity to assess the responsibility of architecture in society by bringing together students and professionals to debate the future direction of the profession.

"As with any profession, there is a danger of allowing architectural education to become too focused," Lee said. "Much of today's curriculum is based on knowledge and methods that have changed little in recent times. Architectural education needs to become more broadly based by drawing on the knowledge of other disciplines and exposing students to actual problems within our environment."

Program and pre-registration materials for the seminars, lectures, workshops, charrette, tours and social events offered at Forum '84 are available from ASC/AIA Forum '84, University of Michigan, College of Architecture and Urban Planning, 2000 Bonisteel Blvd., Ann Arbor, Mich., 48109



Publilius Syrus knew about excellence.
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Whether you design big projects or small ones, new structures or renovations, your submissions are welcome. The AIA Honor Awards Program honors quality wherever it can be found. Mail the entry blank from the July 26 Memo, or the poster your firm received in August, before October 24.

Publilius Syrus would be pleased.

## AIA Honor Awards

Celebrating Excellence in a Variety of Forms.

#### COMMITTEE NEWS

"Housing the Unhoused" was the topic of a national conference sponsored by the AIA Housing Committee Sept. 16 in St. Paul, Minn. Conference chairman Louis R. Lundgren, FAIA, St. Paul, said the estimated 200,000 to 600,000 homeless persons in the U.S. comprise three groups—those who have lost their homes because of economic situations; those in shelters, such as battered women; and the perennially unhoused, who are often released mental patients and alcoholics who are not receiving treatment.

AIA President George M. Notter Jr., FAIA presented St. Paul mayor George Latimer with an AIA Presidential citation for housing development and rehabilitation in St. Paul under his administration.

C. Murray Smart, AIA, Dean of the School of Architecture at the University of Arkansas, reports that the AIA Architects in Education Committee is conducting a series of panel discussions among architecture teachers, practitioners and teacher-practitioners. The discussions are to determine for committee study the issues of greatest concern identified by teachers and practicing architects. The committee will develop a series of papers from the discussions.

The most recent panel discussion, held in May in San Francisco, focused on the contributions made in architecture education by teacher-practitioners. At that session the panel also tried to identify the "particular educational roles that are intrinsic to the schools and those that are intrinsic to practicing professionals in their role as apprentice mentors," Smart says. A report of the May session and the first panel discussion, held in November 1983 in Boston, will be published in early 1985. The November session focused on how practicing architects have benefited from teaching.

The committee also is analyzing the answers to a questionnaire sent to faculty in a third of the nation's architecture schools. The questionnaire is to identify faculty attitudes toward the AIA and indicate how the faculty and the AIA can serve each other more effectively. The survey will also help the committee determine subject areas for future study.

Linda Bank, AIA, chairman of the Women's Task Group of the AIA Affirmative Action Committee, reports that the group met with women architects from across the country at the Women in Architecture caucus May 5 in Phoenix, Ariz., during the 1984 AIA National Convention. The caucus recog-

nized three women who became AIA Fellows at the convention: former task group member Yvonne Asken, Iris Alex and Audrey Emmons.

This year the Women's Task Group has established a liaison network to encourage women to join the AIA, Bank reports. A liaison in each AIA component will establish personal contact with women who have recently become registered and encourage them to join the AIA. The liaison also will help involve more women in component activities by seeing that they are nominated for chapter offices and committee positions.



The liaisons are to forward to the AIA the names of women qualified for national AIA positions, an effort aimed at broadening the base of women participating in Institute activities.

The task group also has published the 1984 Affirmative Action Plan that, upon its approval by the AIA Board of Directors, will be available through the AIA director of component affairs, and a Roster of Women Critics and Lecturers listing qualified women who are available to act as architectural critics, jurors and lecturers in their areas of expertise.

Ongoing programs of the Women's Task Group include the Outreach Program, in which high school students learn about architecture as a career; the Alumnae Colloquia, which establishes contact with women architecture students; and professional development seminars.

The Architects in Industry
Committee's seventh annual seminar on

"Urban Development and the Corporation"
Oct. 3–5 will examine the influence of corporate architecture on the urban environment.
The seminar will be held in Pittsburgh and

will offer attendees the opportunity to visit several of the city's architectural landmarks, including Frank Lloyd Wright's "Falling Water."

The Committee has been organizing successful seminars every year since 1978 to explore the effects of architecture on the business world and of the corporation on architecture. Those interested in attending the seminar should write Beverly Sanchez, Director, Membership Services, AIA, 1735 New York Avenue, N.W., Washington, D.C. 20006. (202) 626-7434.

The AIA Energy Committee is teaming up with the U.S. Department of Energy and 12 other conference sponsors to host a two-day conference, "Building Redesign and Energy Challenges," Nov. 15–17 at the Boston Park Plaza Hotel. Plenary and concurrent technical sessions will examine three areas of energy-efficient redesign—whole building redesign, component redesign, and building rehabilitation—from the perspectives of the building owner-manager, architect, engineer, interior designer, preservationist and researcher.

AIA President George Notter, FAIA will kick off conference activities Nov. 15 during an evening banquet at the hotel. Other conference activities will include walking tours of three recently completed local redesign projects: the John Hancock Clarendon building, the Transportation building, and the Symphony energy project. The tours will be led by project architects and engineers.

An optional, one-day version of the AIA's advanced level 3C "Energy in Redesign" workshop will be offered to conference participants at a reduced rate of \$165, a saving of \$30 from the \$195 workshop fee.

Workshop faculty members William Bobenhausen, AIA of the Energy Design Collaborative, New York, and Raymond Reed, AIA of Texas A&M University, will teach key elements of the energy-conscious redesign process. Included in the one-day program will be sessions on program audit, schematic audit, design development and energy management.

Participants in the two-day conference who register by Nov. 1 will be eligible for a special, pre-registration fee of \$195 that includes all banquets, tours, receptions and exhibits. After Nov. 1, the registration fee will be \$225.

For information on registration contact Kim Leiker of the AIA at (202) 626-7560.

#### LOWTECH

## HISTORY, THEORY, AND WHAT REALLY HAPPENED

By John F. Hartray Jr., FAIA

A few years ago Christopher Wren was scolded in a *Scientific American* article for not keeping abreast of structural theory. The evidence presented was a sketch of the russes for the Sheldonian Theater at Dxford, which was compared with an earlier lrawing by Palladio of a neatly triangulated imber bridge.

Wren's truss was a statically messy assembly of mortices, tenons, scarfs, rabbets, knee braces and stitch bolts. Its joints and members were subject to rotation and bending. The authors concluded that either Wren "did not appreciate the greater efficiency of the triangulated form, or he did not nake the connection between the structure of bridges and the structure of buildings."

I believe that this conclusion fits in the nainstream of modern architectural theory, since it was derived from pictures rather han a written text. It also appears to be wrong. Palladio's description of the bridge in juestion indicates that it was not a truss. The authors mistook a row of timbers at the side of the roadbed for a lower chord, but hese members were not connected and could not have transmitted tension.

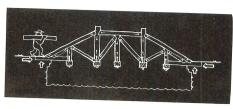
The Palladian detour prevented the article rom discussing some of the serious issues aised by Wren's design, but except for that he incident offers little cause for regret. Wren's reputation won't be hurt, because we lon't read *Scientific American* with any more zare than we read Palladio.

That is worth worrying about.

It is always a mistake to generalize, especially about generalists, but I believe our profession has a language problem. We are so content in the world of visual imagery, hat we consider words to be a kind of excelsior in which to pack our drawings.

This creates an obstacle in dealing with a iterate society, and makes our recurrent complaint of being misunderstood a self-ulfilling prophecy.

How can we hope to be understood when we describe every building we publish as 'contextual, energy efficient and responsive o user needs?" The current fashion in Chicago is to follow Sullivan's dictum and



describe all projects as having a base, middle and top, even if these elements turn out to be a sealant joint at the sidewalk, fifty stories of curtain wall, and a gravel stop.

The non-architect reader who becomes confused by our loose promotional jargon will find little relief in the mixed bag we call architectural history. Many early historians were advocates of specific styles. They were far from objective in their conclusions and the most we have ever hoped for was that they refrained from altering the evidence. In this respect Palladio, and even Ruskin, have always seemed reliable observers. I've never been sure about Serlio.

In our generations Sigfried Giedion, who was charged with proving the inevitability of the modern movement, worked with photographs rather than buildings. As a result both the evidence and the conclusions are suspect. He traced a kind of Darwinian descent from the Windsor chair to the balloon frame, and from thin waisted Aegean maidens to the hinged piers of Malliart's bridges. ". . . Like archaic Greek idols they stand in rows under the platform of the bridge."

It's surprising that it took Tom Wolfe so long to catch us.

With a few exceptions, such as Carl Condit and Reyner Banham, our historians and critics have not been equipped to deal with both technical and formal questions.

Some prefer not to. A writer once asked me to confirm his theory that the long span openings at the base of Harry Weese's Federal Correctional Center, on which I had worked, were derived from the Villa Savoye. When I told him that they had been suggested by the structural engineer as a means of transferring weight to the corners of the building for increased stability, he said that this explanation would be inappropriate

in a serious critical essay.

The history of the profession has always been confused by romantic groupies who don't want to hear that building design is a collective enterprise, or that it is based largely on rational choice. Few architects take the Howard Roarke myth seriously, but we seldom try to set the record straight. After a bad day at the building department, it is pleasant to be mistaken for a genius.

Schools are part of the problem. Much of our current confusion has been generated in the theory courses, which filled the space left in the curriculum when the study of the classic orders was abandoned. These theoretical speculations occupy fortified positions in thickets of dense prose. I once saw a design for a small house described as, ". . . a piece of time which has a tenuous balance in the flux of compositional possibilities."

No wonder we just look at the pictures. Yet, there is hope.

The modernist rejection of history released architectural historians from the task of legitimizing current fashion. As a result the field seems to be attracting serious scholars. Ironically, this may be the greatest legacy of the modern movement.

The vision of the past which these emancipated historians present is less heroic but comfortably familiar. Green marble is selected, not for symbolism, but because the ship carrying the white marble sank. The palazzo is sited after protracted negotiations in the Baroque equivalent of a zoning board of appeals. The module for the pavilion is based on the dimensions of an available block of stone. History is being reconnected to the real world.

And so, when we abandon a space frame, which our client can't afford, and settle for bar joists, we can be comforted by knowing that, though our decision may be viewed by outsiders as technically backward, we are following in Wren's footsteps.

Hartray is a partner at Nagle Hartray Assoc., Chicago, and teaches at the Illinois Institute of Technology.

## BUILDING REDESIGN AND ENERGY CHALLENGES

Boston, Massachusetts 02117 November 15-17, 1984 The Boston Park Plaza Hotel Thursday-Saturday

> Building Redesign and Energy Challenges will examine new energy redesign strategies and technical research in three major and growing areas of architectural practice—historic preservation, rehabilitation, and adaptive reuse—from the perspectives of the building owner/developer, architect, engineer, preservationist, interior designer, researcher and product manufacturer. Architects, engineers and related design professionals are invited to attend this 2½ day series of panel presentations, case studies, exhibits, workshops and walking tours of local redesign sites emphasizing innovative energy redesign strategies that can be applied in practice and business development Discover how energy redesign strategies can expand your practice. Complete the attached reply card and mail promptly to: Building Redesign and Energy Challenges, The American Institute of Architects, 1735 New York Avenue, N.W., Washington, D.C., 20006. ■

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