

ARCHITECTURAL

# TECHNOLOGY

WINTER 1985

THE AMERICAN INSTITUTE OF ARCHITECTS

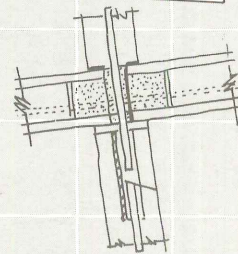
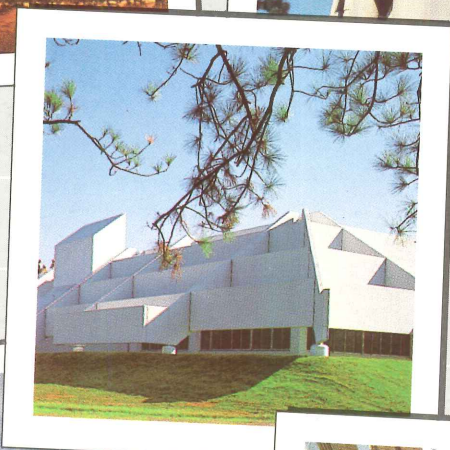
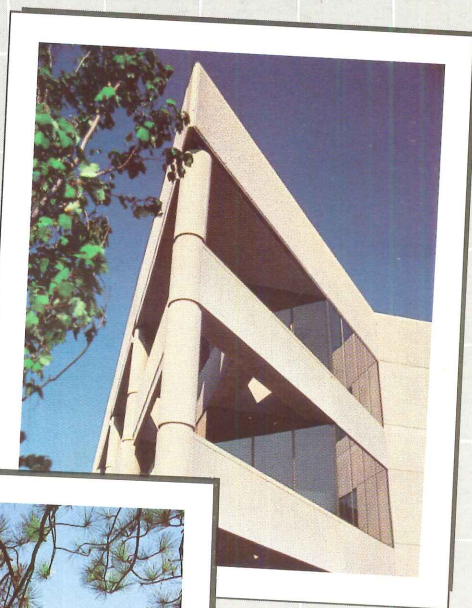
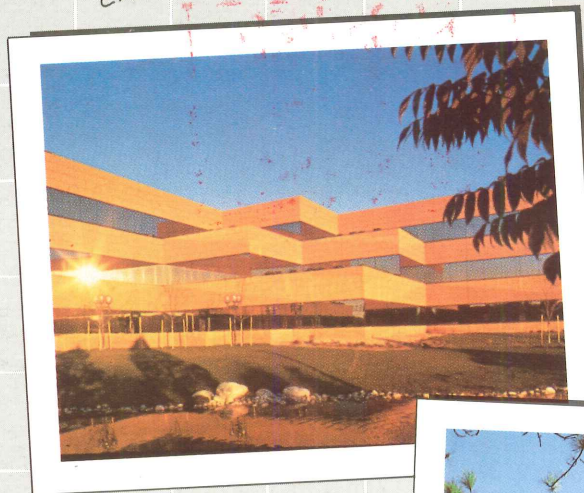


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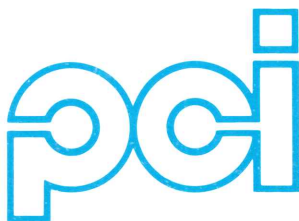
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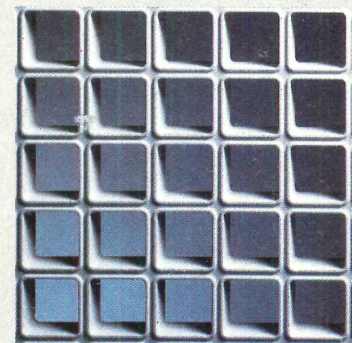


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WINTER 1985

# ARCHITECTURAL TECHNOLOGY

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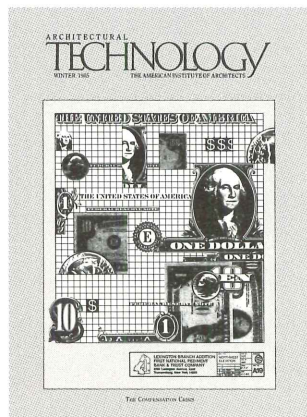
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ARCHITECTURAL TECHNOLOGY, publication number ISSN0740-6142, is a magazine of The American Institute of Architects. It is published by the AIA Service Corporation at 1735 New York Ave., N.W., Washington, D.C. 20006, phone (202) 626-7300. Copyright © 1985 by The American Institute of Architects. Opinions expressed are not necessarily those of the AIA. Vol. 3, No. 1. Single copies \$8. Eighteen month subscriptions (6 issues) \$36. Contact Circulation Manager (202) 626-7327. National Sales Office: Washington, D.C., (202) 626-7470.

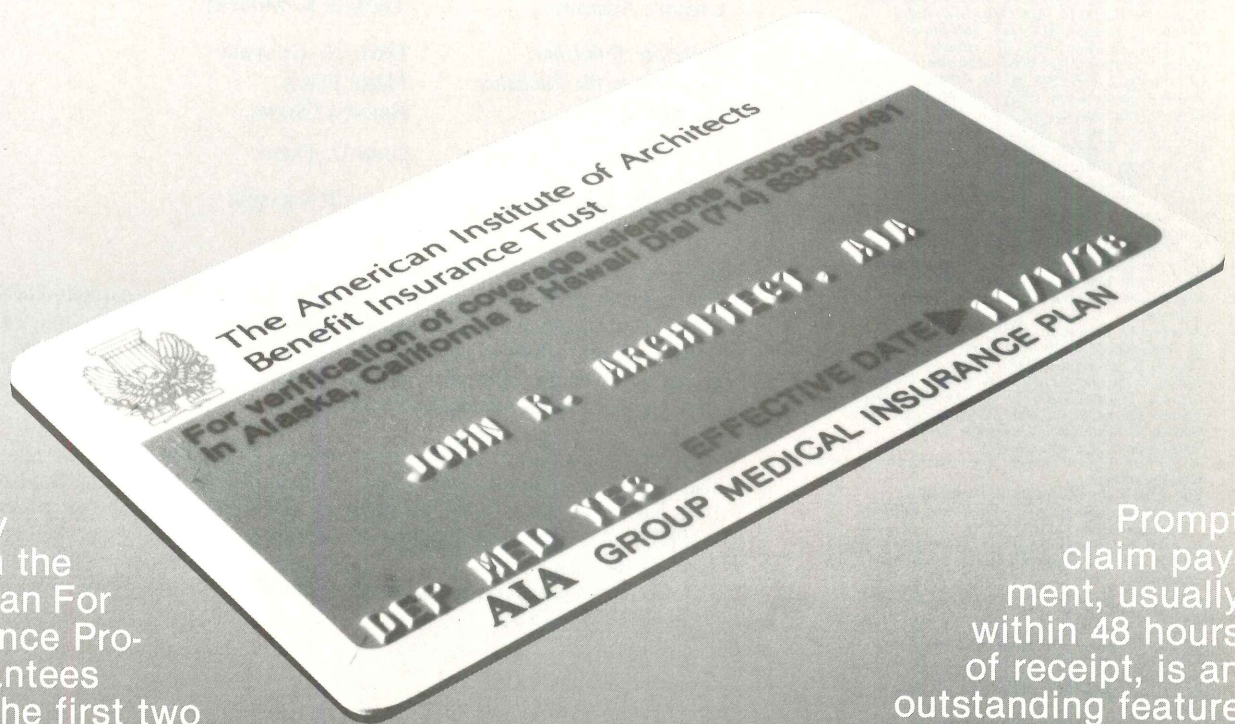


If more architects could bring their skills at design to bear on economic matters, perhaps the issue of compensation would be less critical. Illustrator Michael David Brown wonders abstractly about compensation and design in this issue's cover-art—a prelude to Oliver Witte's in-depth study beginning on page 42.



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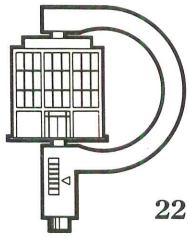


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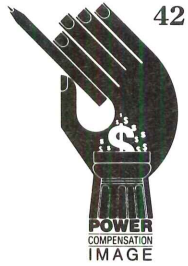
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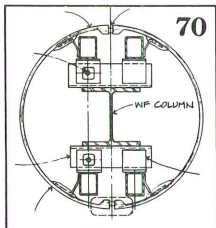
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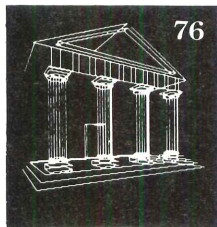
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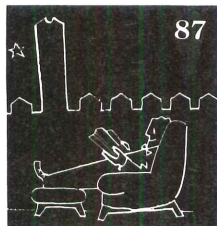


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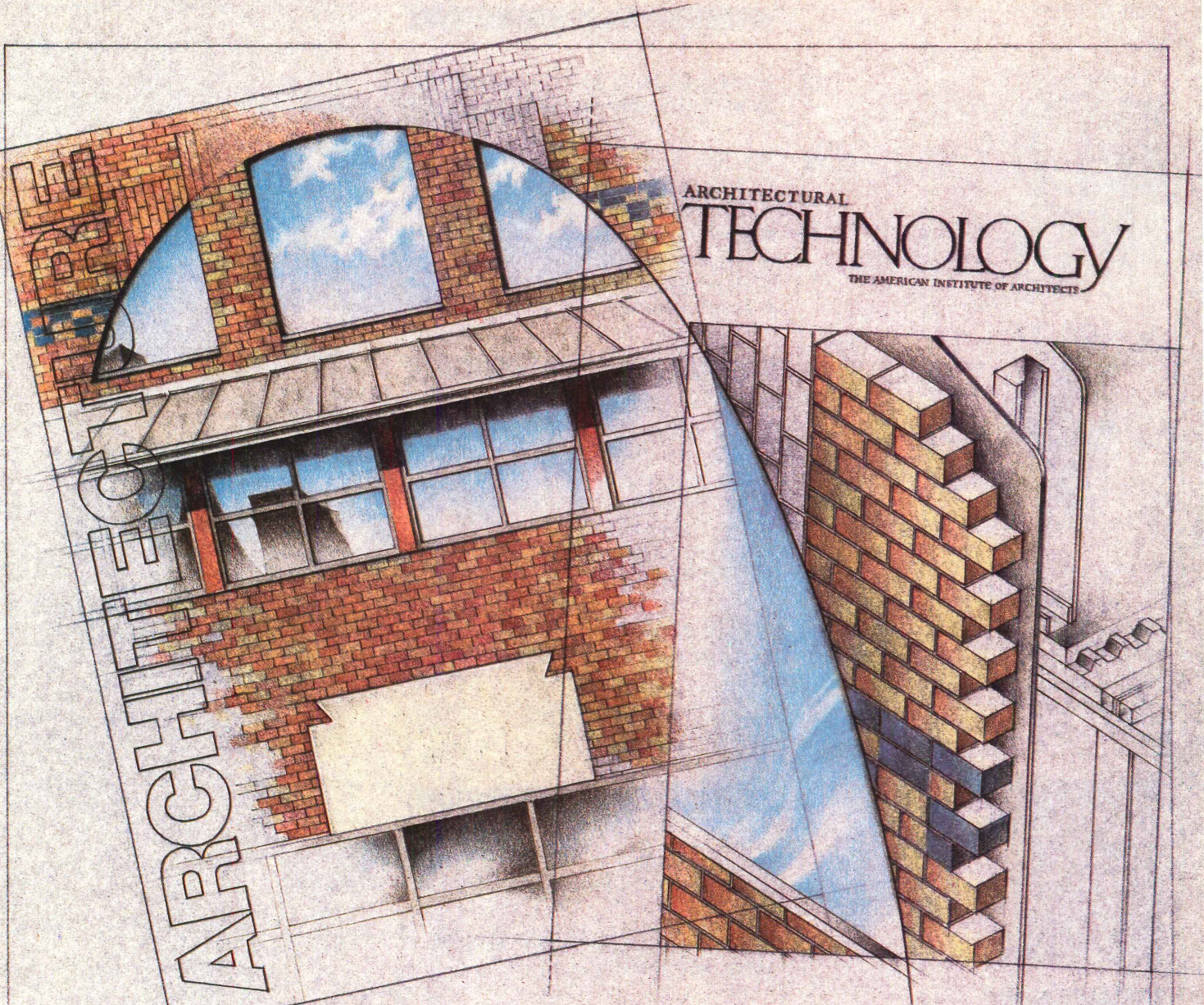
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## VALUE ARCHITECTURE

“VALUE ARCHITECTURE” IS THE AIA’S FAVORITE PHRASE FOR 1985 and the theme of this year’s national convention (San Francisco June 8–13). The concept deserves far more than a year’s worth of attention.

AIA President Bruce Patty, FAIA, coined the expression. He explains it this way:

“When I speak of Value Architecture, I mean architecture that gives the client the best product for the money. Value Architecture means using the newest technology to improve design. It means creative solutions to design problems. It means the use of quality materials that will save money over the life of a building. It means expanding our responsibilities to encompass new design concerns, such as the quality of indoor air.

“Value Architecture takes that which already exists and adds value to it. It adds life to neighborhoods and economic value to properties. It enhances the lives of those it touches. It is not art for its own sake. It is design for people.”

Value Architecture is one more thing, too. It is the permanent focus of this magazine.

Creating architecture of value requires, in addition to design talent, diverse skills. It requires technical knowledge—to use new and existing products and materials most effectively. It requires management strengths—to manage information (our principal tool) and to manage ourselves (if we can’t work efficiently, we soon won’t work). And it requires creative inquiry—to question the way our priorities mesh with the needs of the society we serve.

Sharing information in all these areas is the mission of ARCHITECTURAL TECHNOLOGY.

Here’s what you’ll see this time out:

Architect Bob Miller’s discussion of criminal justice facilities represents the first in a series of ARCHITECTURAL TECHNOLOGY’s building type analyses. Our focus is on the changes in programmatic requirements many building types are experiencing, and ways architects can creatively respond.

Professor Forrest Wilson’s exploration of building diagnostics introduces another theme that will reappear in future issues: keeping

buildings working well after construction. This important and evolving area of specialization not only helps insure that buildings receive the ongoing attention they often need, but opens a new avenue of practice for architects who care about the quality of our environment (not just of new buildings).

One more subject ARCHITECTURAL TECHNOLOGY will continually explore is compensation—money architects receive as personal take-home pay and contracted project fees. We call this issue’s cover story “The Compensation Crisis” because the statistics presented by senior editor Oliver Witte give reason for pause. Yet they are not necessarily cause for despair. Some architects, Witte reminds us, are doing better now than ever before. The lesson to learn is that well-paid architects focus, in performance and salesmanship, on the value of the services they provide.

That’s a theme carried forward in a story by Chuck Thomsen, president of 3D/International. Thomsen calls out five significant trends he sees reshaping the profession and warns that architects who don’t respond to these profound changes in practice run grave risk. For those that adapt, Thomsen says, the future holds promise.

Value Architecture also depends on the materials we specify and the work methods we use. This quarter’s Review section updates our Fall 1984 presentation of micro-based CAD systems and presents guidelines for detailing glass-fiber-reinforced concrete. We’ll be doing more software and materials reviews in future issues, guided in part by the feedback we receive from you.

ARCHITECTURAL TECHNOLOGY belongs to the entire architectural community. We hope you’ll join us in making TECHNOLOGY a forum for dialogue on the vital technical and managerial issues that are so dramatically changing the way we work.

Ask us questions. Contribute ideas. Of even greater importance, use our pages to share, with your colleagues, techniques you’ve learned to improve the value of architecture. —M.R.



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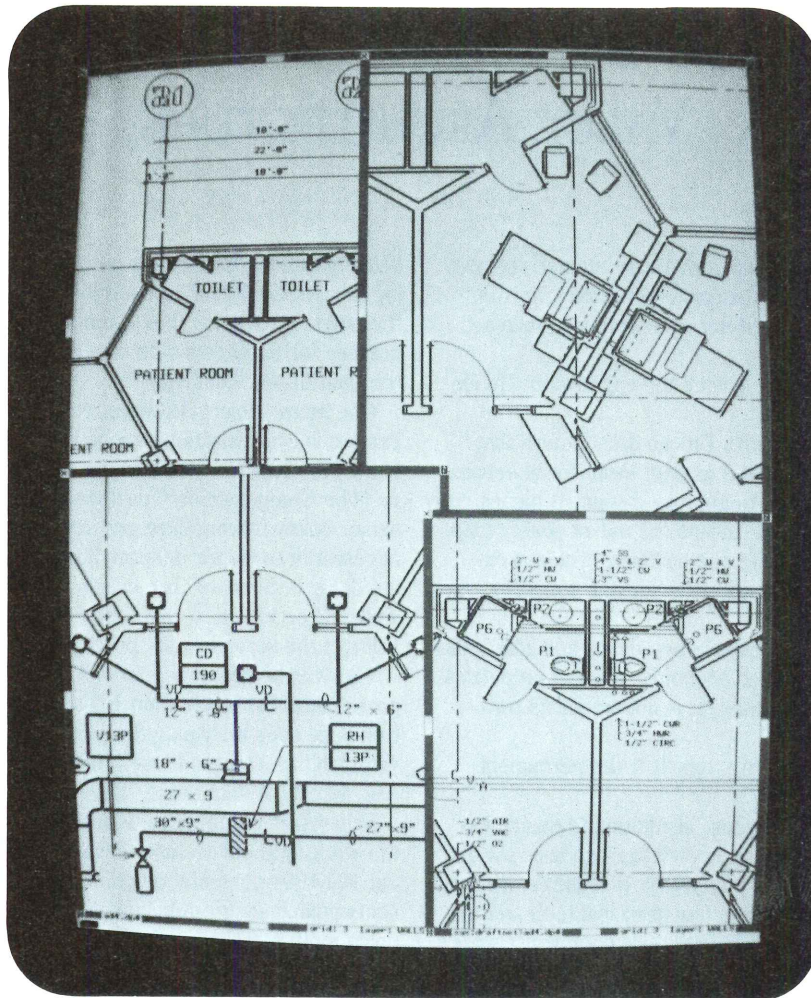
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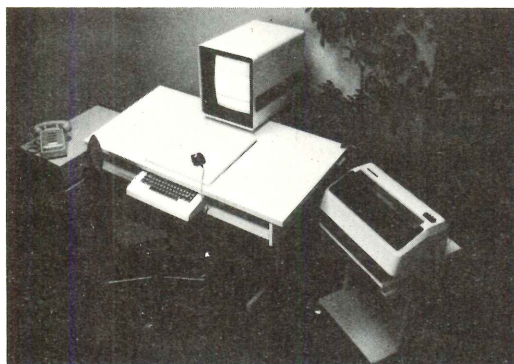
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## FEEDBACK

### CAD SHOOTOUT

I just finished reading your article "Affordable CAD" [Fall 1984] and I am inclined to suggest that your evaluators had not engaged in a "shoot-out," but rather in "shooting-from-the-hip" when they evaluated AutoCAD and rated it anywhere from third to fifth among the programs reviewed.

After spending nearly a year working with AutoCAD, following two years of research into all kinds of CAD systems, which included rejecting at least two of the other systems reviewed by your panel, I believe that AutoCAD is more in the league of mini- and mainframe-based systems, than in the micro-based systems you rated as superior.

One of the attributes you allowed as "perhaps AutoCAD's most valuable feature," namely the ability of the user to make up menus and to create macro-routines suited to his own individual needs, is in itself enough to set it entirely apart from the other programs. It enables one to customize his CAD system with ease and to make his work different from that of his colleagues or competitors. Thus it is perfectly suited for architects who generally like to do things their own way.

Some of the so-called flaws in the system are indeed its pluses: stepping outside "drawing limits" is no different than trying to draw beyond the edge of a sheet of tracing paper. Of course, unlike the sheet of paper, the drawing limits can be extended in a matter of seconds.

AutoCAD, or any micro-based CAD system, is a mere toy without a hard disk and should not even be considered for serious drawing production without one. Thus the so-called "weakness" regarding AutoCAD quitting when out of disk space is not really relevant.

—*Rudolph Horowitz*  
*Rudolph Horowitz Associates, Architects*  
*Pound Ridge, N.Y.*

*It should be noted that Mr. Horowitz markets a turnkey system and an architectural applications package based on AutoCAD. —ed.*

While I acknowledge that CAD is now a must for small offices in order to compete, from all accounts there is a great deal of dust yet to settle.

The problem seems to be that the "Think Tanks" in Silicon Valley are working for the most part in monastic solitude. They are telling us how we should work instead of creating systems directed towards how we do work.

Here's my concept of the optimum micro-CAD system:

- Graphic capabilities of the Mindset
- Screen resolution: Minimum 640 × 480 pixels or a Raster-vector system, with 15–20 color layering
- Symbols (architectural) on the screen menu
- Two screens, one for commands (12") and one for graphics (19")
- Auto dimensioning and area calculations (diagonals, circles, etc.)
- ISO and AXO capability and 3-D, all debugged prior to offering
- Better save and plot programming
- Auto fill
- Auto double line (walls)
- Up-to-date symbols, doors, windows, etc.
- Simpler retrieval
- Little need for a keyboard except for lettering and numerical input
- Peripherals including scanners, mouse (2-command), and D- to E-size flat-bed plotters (for presentation boards)

In summary, an architect's system, and all for under \$20,000!

There is a challenge. Who will respond?  
—*E. "Manny" Abraben, AIA, RIBA*  
*Architects Design Consortium, Inc.*  
*Ft. Lauderdale, Calif.*

### MUSIC TO OUR EARS

I would like you to know how pleased I am with the Fall 1984 issue and with the scope and intent of the magazine in general.

I particularly enjoyed the synopsis of information provided in the article on the Department of Energy's solar energy program [pages 20–27]. I also thought that the article about architectural employees was a real service to that large group of non-owner architects (by extrapolating the information backwards, we principals learned something important as well).

But my real thanks and congratulations is for the article on "Affordable CAD." As an experienced computer user and one who

has, in limited operation, one of the programs reviewed, I still found the information very informative, including the comments on hardware and peripherals.

Although I do not need more things to read, goodness knows, nevertheless I rather wish that this very fine magazine happened more than four times a year. Keep up the good work!

—*William M. Dikis, AIA*  
*Bussard/Dikis Associates, Ltd.*  
*Des Moines, Iowa*

It seems as if the primary concern of many architects is that they are losing control over their "art," when, in fact, they already have lost control over the means and methods of construction.

Architects in the '80s do not realize the creative potential and degree of regained control offered by new building technologies. I believe that your magazine has come at a perfect time to influence architectural practice in a meaningful way; you have provided an open forum for other viewpoints and perspectives on issues that need more exploration and exposure.

—*Elizabeth R. Thomson*  
*Graduate Student, M. Arch. Program*  
*Arlington, Va.*

Congratulations to everyone who had the foresight to understand that people want information, not just beauty pageants. We have been extremely impressed by ARCHITECTURAL TECHNOLOGY itself, but even more so by the interest it has created in the profession. All of our clients tell me that they read it cover to cover as "the only worthwhile architectural magazine going." From that point of view, you clearly have a winner.

—*Joan L. Capelin*  
*Capelin Communications, Inc.*  
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Illustrator and architectural designer Peder Sulerud, of Hammel Green and Abrahamson, Minneapolis, should have been credited for the drawings on pages 16–23 of ARCHITECTURAL TECHNOLOGY's Spring 1984 issue.



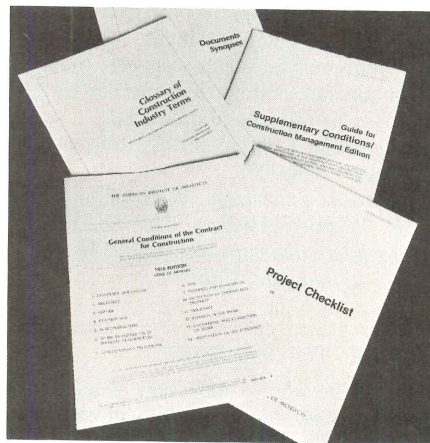
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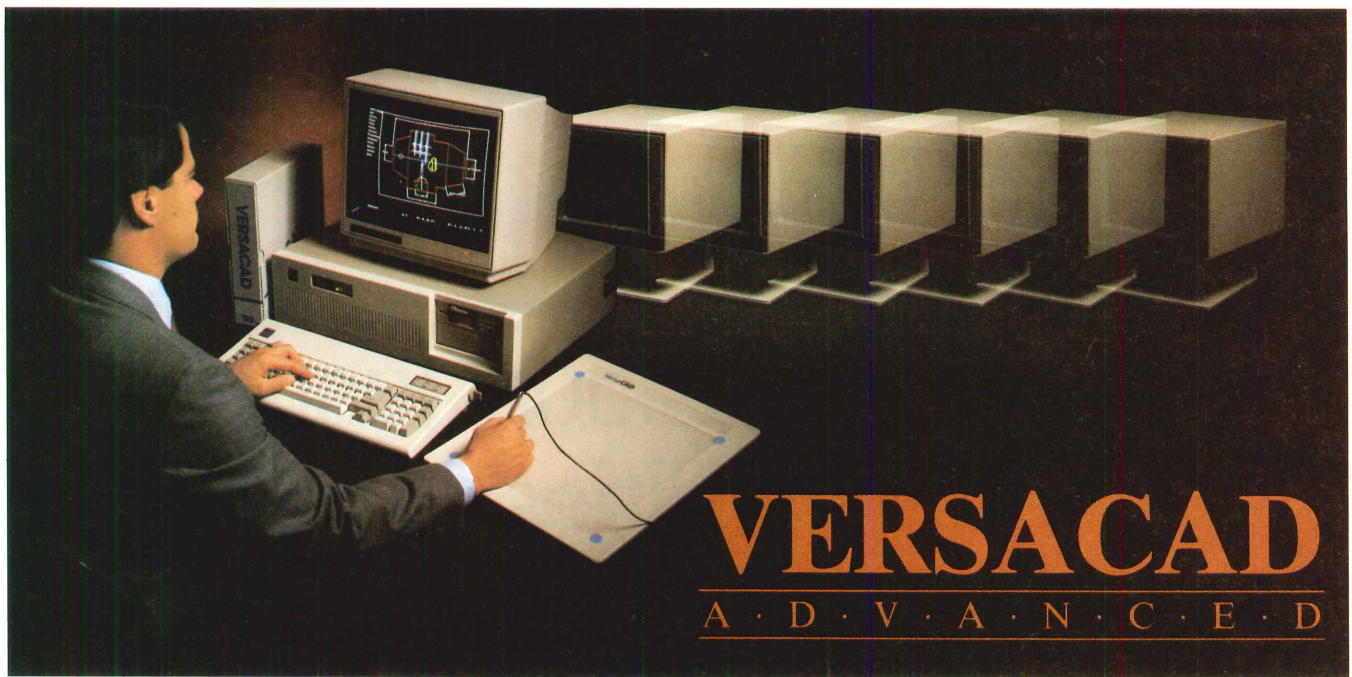
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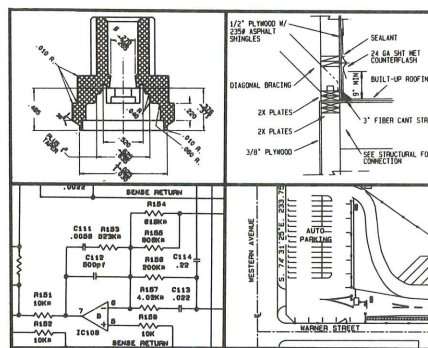
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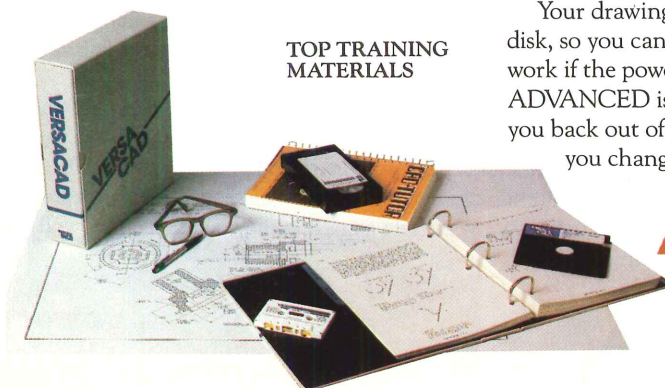
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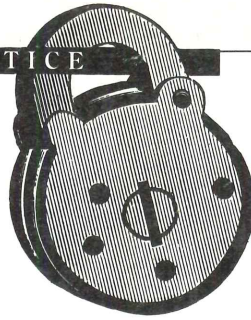
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# New-Generation Justice Facilities

BY ROBERT L. MILLER, AIA

*The case for direct supervision*

**N**O STATISTICS RECORD THE NUMBER OF ARCHITECTS IN PRISON in the United States. But if the country's 60,000-plus registered architects represented a cross section of the population, eight would be in federal prison and 107 in state prison. Another 51 would be spending a few hours to a year in local jails, including 28 who would not have been convicted of a crime.

Another way of saying this is that, on any given day, one in 360 Americans is behind bars. Moreover, this number is increasing steadily. The total in state and federal prisons alone, almost half a million people, has doubled in the last ten years, though the country's total population has grown less than 11 percent.

It is not surprising, then, that according to one 1983 survey, 717 new prisons and jails were under construction or planned "in the next few years" to house an additional 132,829 inmates. The estimated cost for these facilities is \$5.6 billion, a number that makes ten-year projections of \$8 to \$10 billion for correctional construction sound skimpy. While socio-economic and age statistics suggest that architects are underrepresented in inmate populations, these construction figures ensure that at least some architects will be closely involved with prisons and jails for years to come.

Although conventional wisdom suggests that a few large or specialized firms will design most new correctional facilities, the fact is, 717 new buildings cover a lot of territory, especially considering that 480 of these are city and county jails. Jails and prisons will be the biggest building projects ever in hundreds of communities. Even with prefabricated modules and other shortcuts, many architects—including many small, local firms—will participate in planning, programming, design and community review.

There is another reason for architects and their consultants to pay attention to prisons. These projects provide valuable lessons on how to find accountable people and reliable information for public building

projects. The evolution of the building client, from patron to board of directors to public constituency, is widely regarded as a good thing. But, even in this context, correctional-facility design represents a kind of avant garde of unstraightforwardness. The sheer number of shifting, conflicting interests that must be addressed does not guarantee democracy nearly so much as it ensures complexity.

In other words, the corrections planning, design and construction process resembles that of many large public projects, only more so. Typical of the corrections field, but seen elsewhere as well, are the following characteristics:

■ *Urgent need accompanied by reluctant support.*

As the Clark Foundation's report *Time to Build?* puts it, "conservatives who push hardest for crackdowns on crime often balk when it comes to paying the prison and jail construction bills. Liberals who complain loudest about 'intolerable' prison conditions also oppose construction of new institutions."

Prison reform movements and construction campaigns have recurred throughout history on a roughly 30-year cycle. In our own time, little more than 15 years ago, a President's Crime Commission report concluded that, because of declining prison populations, overcrowding would soon take care of itself; there was no mention of new construction. In 1973, both William Nagel's *The New Red Barn* and Jessica Mitford's sensational but well-documented *Kind and Unusual Punishment* made persuasive cases for halting prison construction and dismantling the prison system.

Ten years later, eight states had had their entire prison system declared unconstitutional, 21 more were operating facilities under court order and seven more were in litigation related to overcrowding and other abuses.

By the end of the 1970s, with increased numbers of 19-to-29-year-old males in the population and new "tough" sentencing policies, 16 to 20 thousand inmates a year were crowding into the system. A few states, like California, were predicting the doubling of their prison populations within five years and admitting they had no hope of ending overcrowding.

*Robert L. Miller, AIA, is an architect and public relations consultant practicing in Washington, D.C., and New York City.*

*This article is based on the work of the AIA's Committee on Architecture for Justice (AIA/CAJ).*



■ *A large, conflicting power structure affecting the program.*

Well before the architect's "client" for a new facility is defined, a variety of powerful forces in the state or locality will have influenced the shape of the project. Many of these forces will be felt throughout the design and construction process. Judges, governors and legislators, as well as law-enforcement authorities, decide who is to be incarcerated, for how long and at what standard of accommodation.

Studies show that practices vary widely and often independently of crime rates. Facility-operating authorities and administrators develop their "correctional philosophies" in a decidedly uncontentious, politically charged atmosphere. Indeed, it is hard to think of a building type that is more routinely subject to politically motivated decisions. At issue are location (prisons and jails are usually unwanted by communities, except in depressed rural areas where they are hotly competed for), construction and operating costs, and design standards and operating style (the notions of "humane conditions" versus "coddling criminals").

A typical situation might pit the operating authority (an elected county sheriff who can make political hay with "coddling" charges) against the building authority (a county executive under court order to relieve "unconstitutional" conditions). The local media are an eager third party. A county prosecutor, defense attorneys, the public works department, community groups, and the American Civil Liberties Union (ACLU) chapter might also take part. In Portland, Oregon, where the recently completed justice center replaced a jail that was in the path of an interstate highway, even the Federal Highway Administration was involved.

In recent years many experts have concluded that no building authority alone can manage these powerful forces, and that there are advantages to a justice-planning process that involves all parties and considers all alternatives—including alternatives to building. Jack Chapman, chief planner for the Portland Justice Center and now with Turner Construction Company's corrections consulting group, speaks of "ownership" as the notion of defusing citizen opposition and political bickering by giving the whole "justice community" a stake in the

success of the planning process (this was symbolized in Portland by an inaugural overnight jail stay for both the planners and members of the media).

■ *The probability that the facility will not be run as designed.*

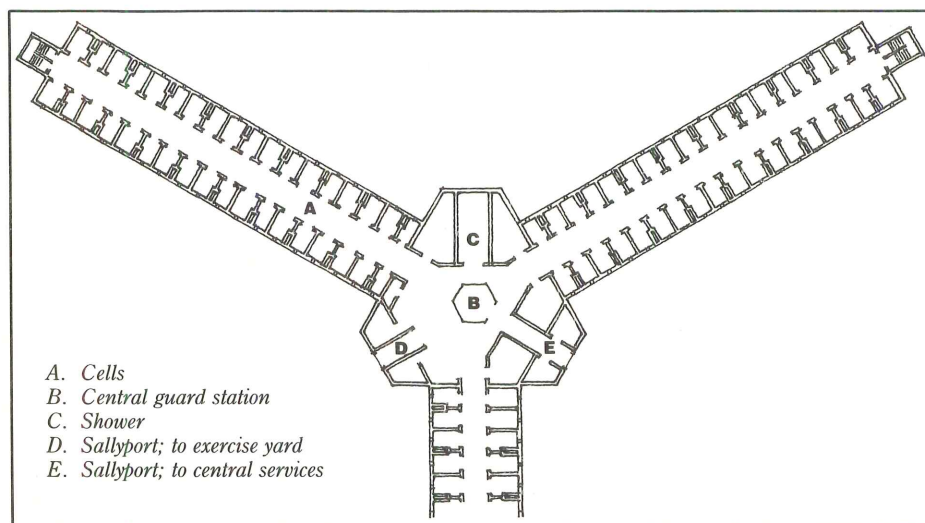
Even such chronically obsolescent buildings as hospitals and laboratories seem to change calmly, and by consensus, compared to prisons. One institution may be proclaiming a "new generation" while another is "getting tough." When a new administrator decides on new supervision concepts, staff levels or inmate classifications, facilities from the 1970s, just like those from the 1870s, may suddenly become outmoded and unworkable.

A recent survey by the Commission on Accreditation for Corrections (CAC) found that over half of the new state facilities studied had changed administrators at least once during planning and construction. In addition, two-thirds reported not enough money or trained staff to operate and maintain the facility as intended. Half of the facilities were already filled beyond designed capacity and a third were housing a type of offender the facility had not been designed to handle.

The CAC study concludes that "many of the problems in facility operation can be traced to institutional use and operation different from the purpose for which it was originally designed." It recommends "establishing administrative policy and operating procedures consistent with the design philosophy of the facility and its intended mission." Another approach involves designing jails and prisons that can be modified to accommodate a range of possible operating styles and inmate classifications. But history suggests that the changes in question are often too radical for this kind of fix.

■ *A glut of broad policy directives.*

As in other areas of public administration, the corrections field is a rich compost of research, standards-setting, and policy-making organizations and agencies. As some organizations drop out of sight, others pile on in their place. Beginners in the field may be surprised to

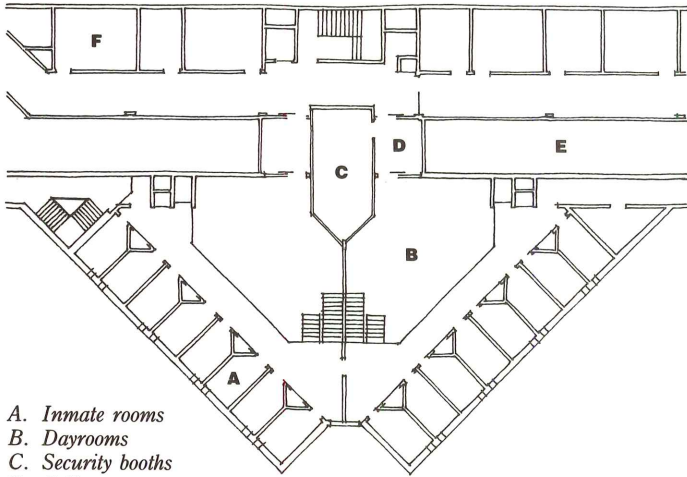


*Linear/Intermittent Surveillance, sometimes called "first generation" or (when the cell blocks attach at right angles to a central circulation spine) telephone pole design. Standard for almost 150 years, still occasionally being built. Inmates have considerable privacy from line staff, if not from each other, and leisure to think up surprises for officers on their intermittent rounds.*



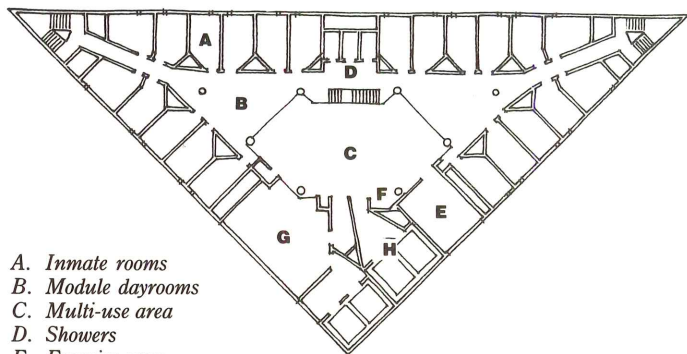
## Judges and politicians make the real design decisions

*Podular/Remote Surveillance* puts officers in glass security booths with an array of electronic equipment; their implied duty is to watch and wait for something to go wrong. Pods seldom house more than 50 inmates, and are often subdivided into units as small as 16, as shown here. Widely used only since the 1960s, and popular.



- A. Inmate rooms
- B. Dayrooms
- C. Security booths
- D. Sallyports
- E. Maximum security corridor
- F. Inmate services

*Podular/Direct Supervision*, the third or "new generation." Similar to the remote pod in plan, different in operation and feeling. No guard booth; officers roam common rooms or sit at desks, in the process, keeping tabs, spiking trouble. Active supervision allows user-friendly, lower-cost amenities such as carpet, wood doors and porcelain toilets. Origins in the Federal Metropolitan Correctional Centers of the mid-1970s. The plan shows Chicago's MCC by Harry Weese & Associates, in turn the model for the Contra Costa jail.



- A. Inmate rooms
- B. Module dayrooms
- C. Multi-use area
- D. Showers
- E. Exercise area
- F. Kitchenette
- G. Visiting
- H. Secure elevator

find both a National Institute of Justice (research, development, evaluation, information) and a National Institute of Corrections (research, evaluation, information, training, technical assistance, policy) within the Department of Justice. In addition, there is the American Justice Institute, a private research organization. The American Correctional Association (ACA) represents a broad group of state and local administrators and managers as well as a few correctional officers. It publishes what have been called the best, if most conservative, standards for prison construction and operation, as well as its own set of national correctional policies.

The American Institute of Architects sponsors its own committee, the AIA Committee of Architects for Justice (AIA/CAJ). ACA's 28 affiliates (in addition to component chapters) include groups which are also AIA/CAJ affiliates. These include the American Jail Association, the Association for Correctional Research and Information Management, the Correctional Facilities Association, the National Council on Crime and Delinquency and the Association of State Correctional Administrators. Related groups frequently represented at AIA/CAJ meetings are the National Sheriff's Association and the International Association of Chiefs of Police.

The Commission on Accreditation for Corrections (CAC), founded in 1974, is a group of 20 correctional and criminal justice professionals elected by the ACA membership, which implements ACA standards and currently accredits about 600 institutions, most of them federal and state prisons. Its primary purpose is defending against possible litigation. Such groups as the National Association of Counties and the Center for Effective Public Policy have separate jail or prison projects. Then there are advocacy organizations that affect national policy. These include the National Coalition on Jail Reform, the National Institute for Sentencing Alternatives, the National Prison Project, the National Moratorium on Prison Construction and, of course, the AIA/CAJ.

### ■ A shortage of specifics on sub-types in the field.

There are only a few published post-occupancy evaluations or programming documents to guide architects. And though there are several recent manuals on correctional design, such as ACA's useful *Design Guide for Secure Adult Correctional Facilities* (1983), there is still too little recognition of the difference between a jail and a prison in planning, design and construction. There is, furthermore, not enough distinction between the different needs of maximum- or close-custody units versus medium security, minimum security, and work-release or community-based facilities. Each of these practically constitutes its own building type. In addition, differences in operating philosophy can, in effect, create new programs and new building categories.

As Peter Papademetriou wrote in his article "From Dungeon to Dayroom":

In a truly democratic society, the distinction between jail as a place for pre-trial detention (where the inmate is theoretically innocent) and prison (where a guilty party is serving a sentence) is critical, and their architectural forms should reflect the difference. Historically, however, the terms have remained interchangeable even as philosophies of law, order and justice change.



While professionals in the field today make this distinction between jails and prisons, it often has little practical effect. If anything, jails are chronically tougher and harder than prisons—on the rationale that while prison inmates are pre-classified, “anyone” may show up at a jail. (The argument that this “anyone” is presumed innocent is apparently unpersuasive.)

■ *Scarcity of user information.*

Among hundreds of prescriptions and policy statements it is hard to find any material that directly presents users’ reactions, observations or prescriptions relating to jail and prison design. Users in this case include inmates and their visitors, correctional officers, staff, support personnel, wardens and other on-site administrators.

NIC’s recent 45-page bibliography *Resources for Prison Design*, for instance, describes only one post-occupancy evaluation, Wener and Clark’s *User-Based Evaluation of the Chicago Metropolitan Correctional Center* (which influenced the design of the now famous Contra Costa jail and led to other studies by Wener and Farbstein). Abstracts of two other publications, Nagel’s *The New Red Barn* and Seymour’s *Niches in Prison—Ameliorative Environments Within Maximum Security Correctional Institutions*, describe interviews with inmates and staff. Elsewhere, conversations and interviews point to only a few more informal information sources. These are unpublished evaluations containing user interviews, a number of experts who claim to have talked to users, and a broad base of designers who have talked to people who have talked to users.

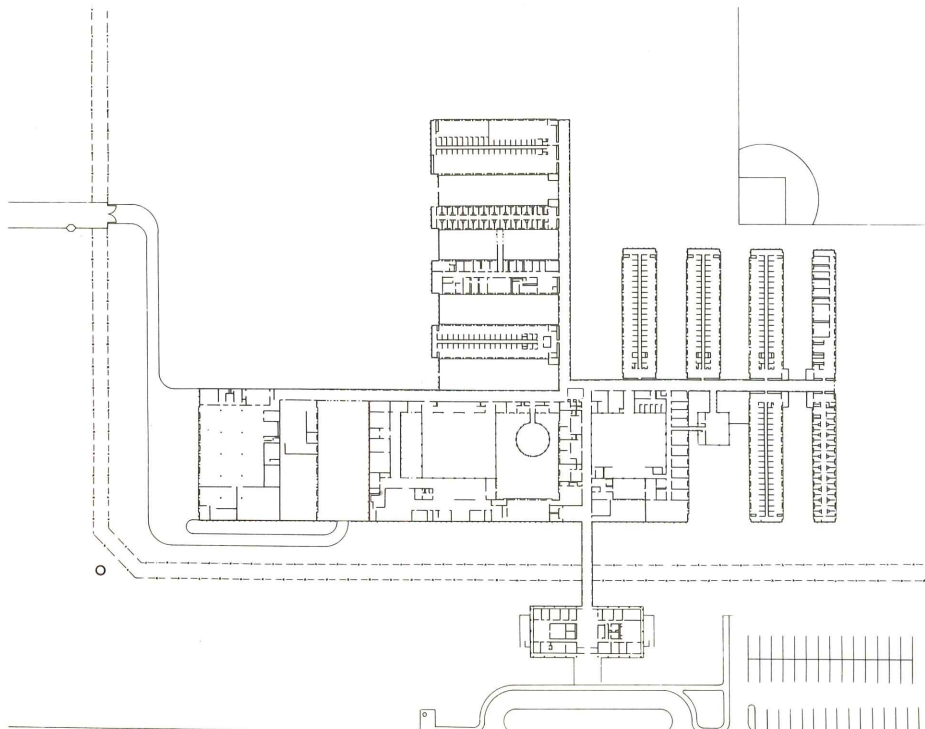
■ *Inability to find the client.*

Lastly, a distinctive characteristic of large public projects and especially of jails and prisons is the inability to answer the question, “Who is this being designed for?” The Commission on Accreditation report focuses on the tendency of administrators to come and go during construction, and offers several suggestions for establishing a client project manager who is not affected by this kind of turnover.

While this is a helpful suggestion, it begs the question of who really has the power to legitimate the design and make it succeed. As the CAC report points out elsewhere, there is really no substitute for getting the support of the highest political authorities, whether governor, mayor, sheriff or administrator of corrections. And while line staff have not traditionally been a focus of power, experience from other fields that have large numbers of public employees suggests that they, too, may become important (see sidebar, p.20).

### THE ARCHITECT’S CHOICES

In the corrections field, as elsewhere, as the building process grows in complexity, the architect becomes more vulnerable. Relatively well-informed, liberal and open-minded, the architect may suddenly be found no longer the executor of a well-defined program but, to paraphrase architect Paul Gallis of the Grad Partnership (Newark, N.J.), a “facilitator” shuttling between parties seeking consensus, or worse yet a punching bag in the middle of a politically charged feud. At the same time the architect may be left holding another kind of bag: legal liability.



*United States Penitentiary, Marion, Illinois, Hellmuth, Obata & Kassabaum. For comparison, the successor to Alcatraz, completed in 1962 as the country's most exemplary prison. The elegant (if somewhat premature) swan song of the old generation, reminiscent of the General Motors Technical Center including a Saarinenesque round chapel off the circulation spine.*



## Changing policies require built-in flexibility

"My concern," says architect John McGough, a partner of Walker McGough Foltz Lyerla, Spokane, Washington, and a former member of CAC's board, "is the disastrous result when an innovative management plan doesn't work—for whatever reason. The architect is usually the only one left and is placed in the position of covering a political situation with his errors and omissions insurance."

The architect, then, is vulnerable in corrections projects legally and otherwise. And, as McGough implies, the best defense will involve at least some offense. At the very beginning the architect can limit his or her vulnerability in one of several ways:

■ *The architect can refuse to design prisons.*

This radical but not unknown position can be made for practical and ideological reasons. The arguments for a moratorium on prison construction and for abolishing prisons altogether are too long to present here, and given the usual timing it may be another 20 years before they resurface in force. It is worth repeating Mitford's observation: to condemn prison as a failure "is a cliché dating from the origin of prison." Her conclusion is worth repeating too: Pending basic structural changes in society that will make imprisonment truly unnecessary, it is important to sort out and support internal reforms that will make prison life more open and democratic, as opposed to the perennial nostrums of "more money, more research and more construction."

■ *The architect can combine knowledge of local norms with "flexible" design.*

Responsiveness to community and client standards, combined with built-in flexibility of use, is urged for many building types as being good design practice, an antidote to architects' perceived dogmatism and a way to avoid liability for problems caused by unsympathetic or unanticipated users. This prescription is especially attractive for jails and prisons.

In an article in *The National Sheriff*, which illustrates various

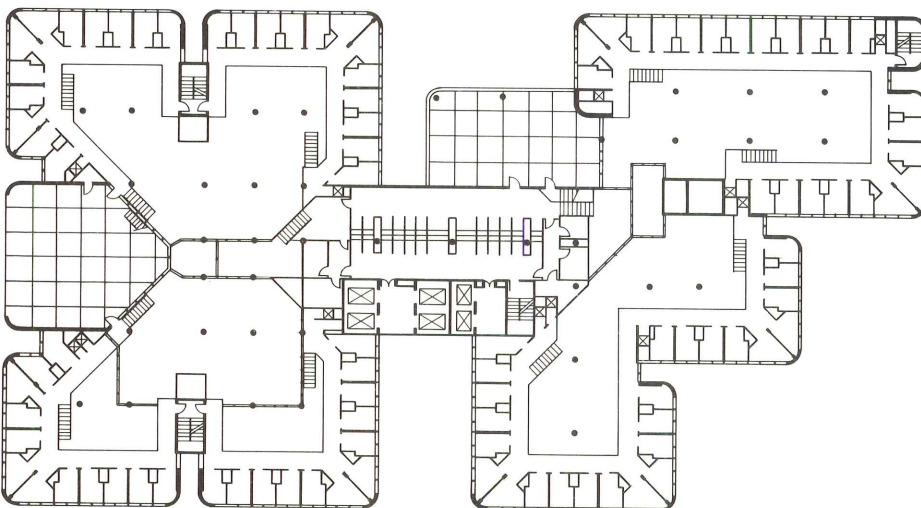
"correctional philosophies" with jail designs by AIA/CAJ member firms, architect Dale Nederhoff of the Durrant Group, Dubuque, restates the proposition:

A new detention facility has a useable life of 60 years . . . renewable with major renovation. Correctional trends have a life-span of 10 to 30 years. It is apparent that detention facilities being designed today will not be utilized exactly as designed except for a small portion of their useful life. The mark of a good detention facility is a design that meets today's demands and is readily adaptable towards accommodating the unknown demands of the future.

Chuck Oraftik, vice president of HOK, San Francisco, lists flexibility, security, capital cost and operating cost as primary design criteria for any new facility. He speaks of a "generic" jail or prison, and envisions inmate housing as a "stage set" that gives the administrator the flexibility to play out one philosophy or another. For instance, there is *indirect supervision* with the officer in a control booth or *direct supervision* with the officer mingling with inmates in the dayroom. An example Oraftik uses is the recently completed Clark County Detention Center in Las Vegas (see plan). This facility, designed by HOK and Jack Miller & Associates, Inc., Las Vegas, permits three scenarios—a booth overseeing 96 inmates, direct contact with groups of 48 inmates, or subdivision into units of 24 inmates.

■ *The architect can actively seek and promote ideas that work (or fail less often).*

The third alternative, and the ideal way to limit vulnerability, is to enlist clients and users in the design of a facility that performs better than anticipated and that contributes to the field as a whole. The first few clients, users and architects experimenting in this way take a risk. But this is the kind of risk that professionals—and especially architects, who espouse creativity and social responsibility with equal fervor—are supposed to support. And as examples are built, operated and studied, the element of risk is reduced and further refinements can be made.



Clark County Detention Center, Las Vegas, Hellmuth, Obata & Kassabaum. HOK 22 years after Marion; the state of the art in podular/remote design. Highly flexible, with pods subdividable into small units according to security levels, or, to accommodate a future sheriff's way of managing things. Articulated pods and highrise design recall the MCCs, but the Las Vegas facility is harder and higher-tech.



What is being described here is scientific method, which, because of the large number of variables involved, is hard to apply to architecture. Yet successful examples of architectural research do exist. Eventually, direct-supervision or "new-generation" jails and prisons, or something deriving from them—as described in the following section—may be established as another such success.

Of these three approaches to limiting vulnerability and finding relative happiness in the corrections field, the AIA/CAJ understandably ignores the first (refusing to design) and shows varying interest in both the second and third (normative flexibility and seeking new, workable ideas).

Flexible design seems like an essential strategy for corrections facilities, but it does not absolve architects from the responsibility of searching for new ideas. With that in mind, the remainder of this treatise addresses the third option.

### NEW-GENERATION PLANS

While architects working in corrections are professionally and legally vulnerable, because of the field's lack of public support and administrative consensus, they are often even more visible and influential than their counterparts who specialize in other kinds of institutional buildings. The physical reality of imprisonment is its very essence in a way that the physical surroundings of education or medical care are not. Since the 18th century, theories of incarceration have usually been accompanied, if not precipitated, by a new building design. So it is today with the *new-generation* jail or prison, formally endorsed this year by the AIA/CAJ and the American Correctional Association, and actively promoted by the National Institute of Corrections and many individual architects.

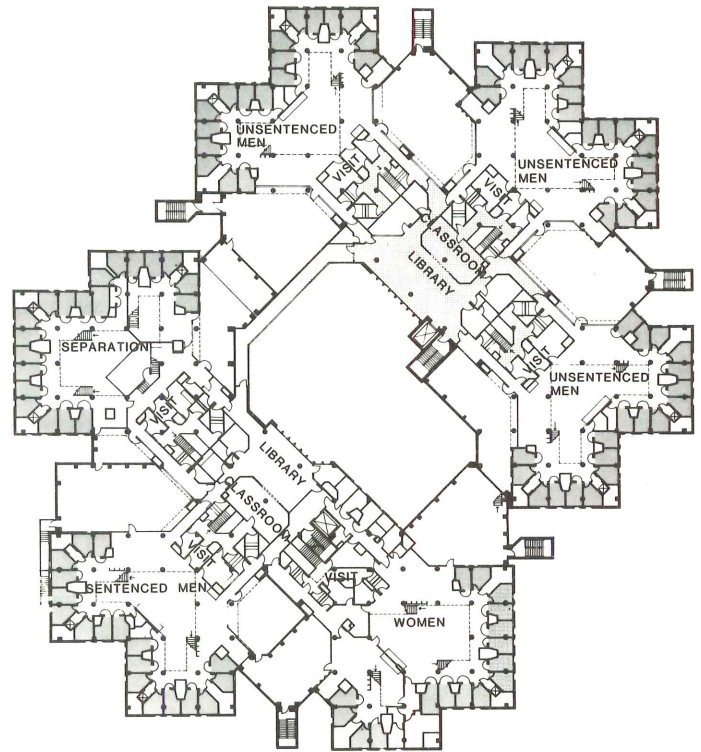
### Historical models

The term *new generation* has been used indiscriminately—"few are inclined to claim credit for a 'past-generation' jail," NIC pungently notes—but NIC retains the phrase to distinguish what is technically called "podular/direct-supervision" design from its predecessors (see drawings).

The predecessors are "linear/intermittent surveillance," the old straight-line cell block in which a patrolling officer can only occasionally look in on one cell at a time, and more recently, "podular/remote surveillance," which allows an officer in a glass booth to maintain fairly constant line-of-sight surveillance of about 50 inmates, usually clustered in a triangle of cells around a dayroom. These "podular" clusters evolved in the 1960s in the federal prison system and their size was based on the traditional 44-man army platoon.

Since these pods have been accepted for years by all but the most conservative jurisdictions, it is the concept of *direct supervision* that continues to make the "new-generation" facilities relatively new.

Direct supervision means that within a pod there are no barriers between officers and inmates. Typically, one officer is locked up in a 50-person living unit and stays there, at a desk or walking in and around the central dayroom, through his or her shift. In the new-generation plan, which is a management plan as much as a building design, the officer takes an active role, anticipating and spiking problems and, ideally, providing informal counsel and leadership.



*Contra Costa Detention Facility, Martinez, California, Kaplan McLaughlin Diaz Architects. A direct-supervision county jail designed for 382 inmates, completed in 1981. In the National Institute of Corrections book, Example Number One. Living proof that the first direct-supervision innovations of the MCCs can work at the local level. A highly structured routine keeps officers alert and inmates out of trouble. Not perfect ("everything for inmates, nothing for staff"), but persuasive.*

There may be back-up systems such as closed-circuit television, but the emphasis is on interaction and the encouragement of decent behavior, rather than the nominally safe but passive "wait for something bad to happen" attitude that characterizes podular/remote surveillance. The principle, contrary to the expectations of many corrections veterans but borne out in practice, is that putting officers in constant contact with inmates results in less, not more, violence. As NIC's Ray Brown says, it is like the difference between a patrol car and a cop on the beat.

NIC does not deny that classification of inmates, as authorities stress time and again, is essential to correctional management. Still, NIC maintains, in its publication, *Direct Supervision Models*, that probably 90 percent of inmates can be booked, housed, fed and otherwise accommodated according to new-generation principles. The result can be a big difference in the look and feel of a jail or prison.



## Breaking down the guard/prisoner barrier

### A normalized environment

An integral part of the direct-supervision/new-generation idea is a "normalized environment": for example, wood doors instead of steel bars, porcelain instead of stainless steel sinks and toilets, butcher block tops on dayroom tables, carpeted floors, and such relative privileges as contact visits, unlimited telephone use and a choice of television stations. (As one study points out, in a housing unit of 50 felons representing a variety of cultural backgrounds, the resulting discord over channel selection can be very violent.)

While these amenities can be defended on the grounds of humane treatment alone, critics who charge "coddling" can be met with a list of practical advantages: the softer, more normal environment is found to calm tensions. It provides a real alternative, and therefore a behavior-improving incentive, to the always-present option of solitary confinement. It can also be cheaper. Wood doors and porcelain toilets, for instance, cost a fraction of their steel counterparts. But all of this normality depends on the mixture of "pro-active," behavior-conscious management and the fairly continuous contact that direct supervision provides.

Architects, as much as if not more than other experts in the corrections field, find direct supervision attractive. First of all, many AIA/CAJ members begin by saying, it is self-evidently more humane. They see in it an opportunity for design to be a positive influence on better behavior, not merely an inhibiting barrier to escape or destruction. As the AIA/CAJ's policy statement says, the new-generation concepts provide more direct application of the architect's influence and expertise.

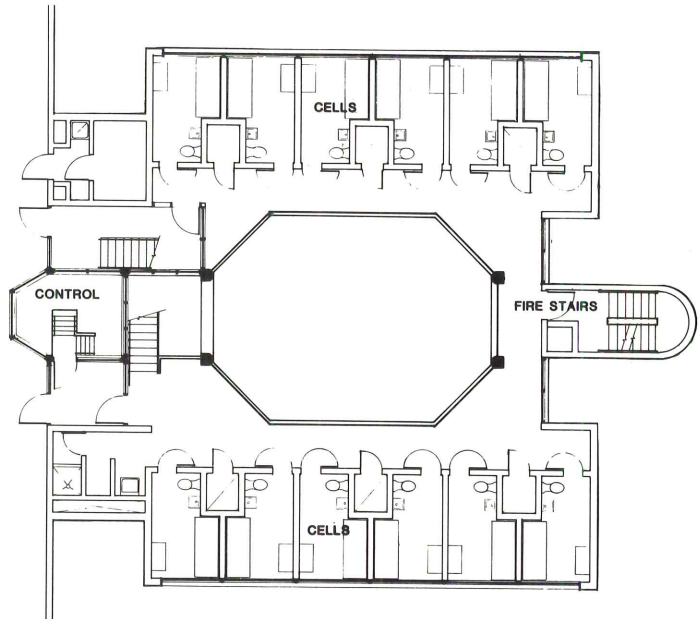
### Slow start

Yet 15 years past its inception and ten years after its first full-scale use, despite both official and grass-roots endorsements and evidence of success, and in the midst of the biggest prison and jail building boom in history, direct-supervision/new-generation facilities are not sweeping the country.

In round numbers provided by NIC, there are 500 existing state and federal prisons and 230 more in some stage of construction or planning. Of these, somewhere between 15 and 35 (including all new federal correctional institutions) are now, or are planned to become, direct-supervision facilities. Out of roughly 3,000 jails in the U.S., with about 480 more planned or underway, at last count a mere five were in operation with direct-supervision management and between 15 and 30 were planned or under construction. NIC project director Aaron Brown estimates that, at most, 5 percent of new correctional facilities are presently designed for direct supervision.

This slow start is most often attributed to resistance to change on the part of correctional management: administrators, wardens and sheriffs. NIC's account of "Acceptance of the Podular/Direct-Supervision Concept," part of a publication promoting new-generation jails to corrections professionals, can hardly be accused of flattering its intended audience:

The overall concept was generally rejected by local jail administrators. True, the podular design was accepted by many, but it was modified to fit traditional jail practices [most notably, remote supervision from a booth or corridor].



*Middlesex County Adult Correctional Facility, North Brunswick, New Jersey, (The Grad Partnership, in association with Fred Moyer and Associates, Criminal Justice Consultants). Plan of wing shows ample space for correctional officers as well as inmates, with carpet and soft colors, and the paradoxically happy feature of unused control booths. Designed for indirect surveillance; changed by opening day in 1984 to direct supervision, thanks to the architect's persistence and a change of administration. No coddling, but a handsome and very quiet workplace.*

There was virtually a universal disbelief among local jail administrators that direct supervision . . . could be safe, secure, cost-effective, free of vandalism, and a desirable place to work. [They felt that] even if the Feds found this [approach to work, it] would not work with local jail prisoners, nor would it be accepted in the local communities. . . . The successes [of direct supervision] in the [circa 1974 New York, Chicago and San Diego] Federal Metropolitan Correctional Centers were either ignored or attributed to the idea that the federal prisoner was somehow different. . . . A second substantial barrier to general acceptance was that the jail did not look like a jail. . . . Community leaders . . . have been reluctant to tell the public that the imposition of conditions of confinement for the purpose of punishment [in a jail, where over 60 percent of prisoners have not been convicted,] is in direct violation of the Fifth and Fourteenth Amendments.

Not much has changed. NIC's response has been to assume a need for education and to provide it. Administrators and managers can take NIC-sponsored tours of Contra Costa's exemplary direct-supervision jail and attend one week training sessions at NIC's Boulder, Colorado academy on such topics as Planning of New Institutions (PONI), Architectural Design, and Managing New-Generation Jails. AIA/CAJ has also tried education and has met varying amounts of resistance. A recent AIA/CAJ-sponsored presentation at a National Sheriff's Association convention, which let the Contra Costa County



Sheriff present the case for direct supervision with equal time for his opponent from Ventura County, California, site of a well-regarded podular/indirect-surveillance jail, was reported a success.

Yet at an American Correctional Association, New Jersey Chapter, meeting, an elective workshop on new-generation design attracted only six of the 250 total attendees. Whatever the response to the theory, in practice, architects say they find good design a political liability linked with coddling criminals. They repeatedly report seeing their ideas, which often appear better and less expensive, defeated by vested interests in the status quo. Resistance to change, many conclude, is simply part of the correctional mentality.

### Immaculate conception

There is another explanation for the lack of acceptance direct supervision has met with, however, and that is that the entire model comes purely from the top down. The direct-supervision concept was first put into operation in three federal Metropolitan Correctional Centers in 1974. The impetus came from a committee of experts, not employees or even managers pushing for change. And these lower ranks were excluded throughout the process in what was a remarkably immaculate conception:

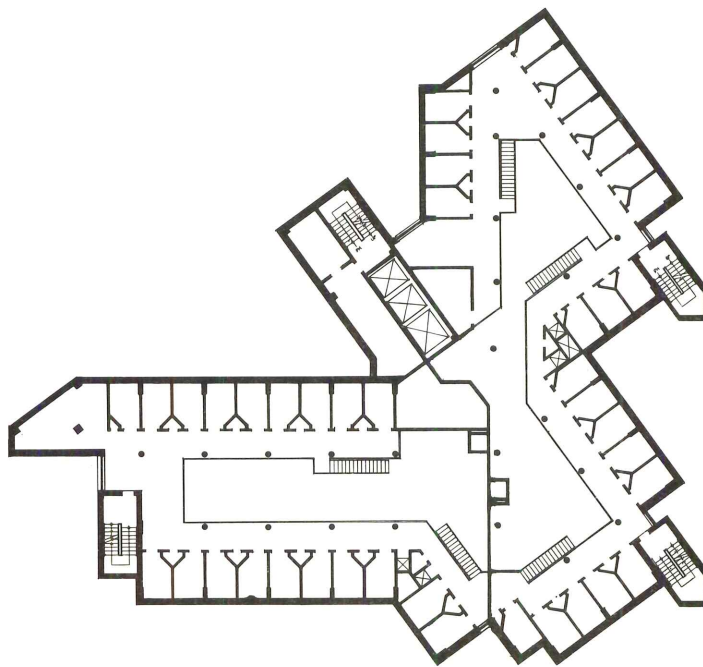
It all began with President Johnson's appointment in 1967 of a blue-ribbon commission to study prison reform and a U.S. Department of Justice pilot program to "humanize" correctional facilities. The program's ultimate vehicle was a group of three U.S. Bureau of Prisons jails for federal prisoners, to be built by the General Services Administration in major cities. While the population of these so-called Metropolitan Correctional Centers, or MCCs, would vary considerably, and critics would maintain that these federal prisoners

were different from those in a county jail, NIC's contention that they were, and are, a fairly typical mix of convicted and unconvicted detainees is probably closer to the truth.

The GSA, the Bureau and its chief of facilities development, Robert Messmer (now head of HOK's criminal justice facilities group), then picked three downtown sites and an architect for each: Gruzen & Partners for New York City, Harry Weese & Associates for Chicago and Tucker, Sadler & Bennett for San Diego.

As Thomas Tucker recalls, there followed in the summer of 1972 a most extraordinary design process. The three firms, none of whom had designed a prison before, were forbidden by the Bureau to visit the other's offices or to do any other specific research, including talking to consultants in the field, corrections officers or prisoners. Indeed there was no time for such research, since the Bureau and GSA had scheduled a total design time for these 10-to-15-million-dollar facilities of eight months, with the three firms scheduled to unveil their concept or schematic designs after about 60 days. Programming was even more concise—no written program, but two days of interviews with administrative staff to produce something called a "narrative program."

Tucker also met with the Presidential Commission. "They told us the general philosophy was to move away from the cell block, steel-cage concept and to think more along the lines of a residential type of decor." According to Messmer, "The only concrete thing we insisted on was the idea of a functional unit [of] no more than 50 persons. We wanted a multi-purpose area and single rooms. . . . We wanted detainees segmented according to sex, age and gravity of alleged offenses." Not prominent in these decisions was information on what employees below the administrative level might hope for, or object



*Erie County Holding Center, Buffalo, New York, Cannon Design in association with The Ehrenkrantz Group. One of the newest direct-supervision jails. A successfully contextual, urbane addition that fulfills the promise of the highrise MCCs of ten years before. Made possible by the local correctional officers' union buying into the Contra Costa idea, but convincingly remote from sunny California.*



## Correctional officers: architects' allies?

One feature of direct-supervision jails and prisons is frequently mentioned almost in passing: that correctional officers take on a new, "more professional" role. That most officers like this change is fortuitous, especially since this group of users is virtually always excluded from participating in the facilities planning process.

It is ironic that architects, usually voracious in pursuit of "user input," both to gain information and to limit their own liability, seldom report talking with correctional officers. Architects designing a unionized factory would be wary of taking the foreman's word for employees' program needs. But a similar thing seems to happen all the time in corrections. The result is that correctional officers tend, at least at first, to reject all new ideas, even when the changes may ultimately result in job improvements.

In Buffalo, New York, where a 220-bed jail is being built on the direct-supervision model, architect Ken Ricci of The Ehrenkrantz Group credits sheriff Ken Braun's political instincts in gaining early acceptance for the new design. Representatives of the correctional officers' union were sent on an NIC-funded trip to Contra Costa. As undersheriff Tom Higgins recalls, the union was influenced by face-to-face interviews with Contra Costa deputies. He expects the new jail to be "conducive to good labor relations." In any case, the design has been legitimated by employer and employees; the architect is less vulnerable.

Despite this success story, most administrators tend to change the subject when questioned about officer participation in planning. Mention of officers' unions is good for a nervous chuckle. Advisors at ACA and NIC, including several former correctional officers, also discount or discourage officer involvement. Aaron Brown of NIC said:

Line staff typically have experience with only one institution, and they think in those terms. If you asked them, 80 to 90 percent of officers would want a control station. We deal with managers and supervisors. We don't consider it critical that officers be actively involved.

Architects who persist in wanting to know about the people who will actually operate their buildings may find that the greatest barrier is not official reluctance but the officers' own invisibility. With inmate populations soaring, custody personnel, at a staff-to-inmate ratio of from 1:3 to 1:10, cannot be far behind. ACA estimates total U.S. line staff at 200,000. Yet they are rarely considered central to justice planning. And while as many as three-fourths of officers may belong to a union, pay remains low: ACA's 1984 survey finds starting salaries from \$10,000 to \$17,000, with \$26,900 the highest reported.

Whatever the past truths behind stereotypes, the architect is stuck with a picture of the correctional officer as a reluctant, if not incompetent, resource. Steve Lerner's *New Republic* article on prison violence illustrates this subtle bias all the better for being a perfectly good piece of reporting:

. . . over the last decade, the opening of the jails and prisons to court inspections, state monitoring boards and the media has reduced guard brutality. The considerable increase in funds available for corrections has raised salaries and has allowed departments to become more selective in their acceptance of applicants. That corrections has become a recognized field of study has also brought growing professionalism. The old macho approach to keeping inmates in line by busting heads is less and less in evidence. Ultimately, inmates and guards share a common interest in improved conditions in prisons. Overcrowding, inadequate services, idle inmates, badly designed facilities, lack of officer training and involuntary overtime can lead to guards being hurt or occasionally killed as well as inmate casualties.

In other words, only outside pressure or fear of injury or death can account for officers' interest in changing the status quo.

Post-occupancy studies have begun to upset this sort of bias. This is important, not just for the sake of fairness, but because officers and their work are anything but stereotypical. There is a complex management system and subculture that architects, planners and programmers must understand if they choose to seek models that work better.

No amount of study of existing job descriptions could have predicted officers' favorable response to the direct-supervision/new-generation model. Common sense would have suggested the opposite—that a facility designed to boost productivity by cutting total staff and giving each officer more to do, with few protective barriers and "soft," relatively damage-prone materials, would be resisted and ultimately rejected.

No national organization really speaks for line staff, making it hard for architects to involve officers directly in programming and design. But a growing body of programming interviews and post-occupancy studies can partially fill this need. (One need scarcely look beyond the "everything for inmates, nothing for staff" comment from the Contra Costa evaluation, referring to the lack of officers' dining, recreation and locker space, for a striking example.) It remains for AIA/CAJ and NIC to make this information available to each other, to architects and to the corrections field at large. —R.L.M.



### *Users say new concepts are safer and cheaper*

to, in a national model facility. Nor was the Bureau's five-year-old experiment with small-scale "unit management" at the Morgantown Federal Correctional Institution available for study. Tucker's notes from two days of programming have only two mentions of correctional officers: how many, and who they report to.

Whether despite or because of this self-consciously innovative design process, all three designs came out remarkably alike, and the MCC model went into operation in 1974. It immediately seemed to work well. This overall success was confirmed after 1976 by a series of formal post-occupancy studies—the beginning of the only sustained evaluation of this kind in the history of corrections, and perhaps the only "multi-generational" behavioral study in the history of architecture.

#### **Post-occupancy evaluations**

Several post-occupancy studies of the MCCs were carried out with environmental psychologist Richard Wener as senior researcher. When the planners of the Contra Costa detention facility decided to use the Chicago MCC as a model to create the first direct-supervision county jail, these studies helped San Francisco architects Kaplan McLaughlin Diaz design the new facility (or at least confirmed the planners' decisions, since the first documents arrived during preliminary design). Meanwhile Wener and research architect Jay Farbstein, an AIA/CAJ member, drew on these and other studies (and on a survey of AIA/CAJ members) to develop a standardized evaluation method for correctional environments.

Farbstein's work, published in 1982, won a *Progressive Architecture* architectural research award. In turn Contra Costa was built, occupied and evaluated—most recently by in-house researcher F.W. Frazier. Today, proposed modifications to Contra Costa are being adopted in newer facilities.

Apart from a Canadian study by K.L. McReynolds, and a number of evaluations which are said to be contracted for or underway, this string of studies is the total literature on comprehensive post-occupancy evaluation of jails and prisons. Though they are tucked away in social science journals, the studies are clear and informative. Their content and significance are summed up best by Wener, Frazier and Farbstein in an article for *Environment and Behavior* titled "Three Generations of Evaluation and Design of Correctional Facilities":

The studies show that the direct-supervision/new-generation model works, and is transferable from one type of facility to another. Compared to other facilities, the new, softer design and "pro-active" management plan appears to reduce violence and stress among inmates and employees. It also appears to limit damage to buildings and furnishings.

Neither published nor informal reports suggest that the relative openness of the direct-supervision model leads to attacks on officers or breaches of security, as many administrators fear.

Problems have been mostly of a "nuts and bolts" nature, like excessive noise and the inability to regulate air flows and temperatures. When items identified as weaknesses in the original MCCs have been replicated at Contra Costa they have been problems there, too—a kind of negative validation of the evaluation.

What this begins to suggest is that NIC and other promoters of direct-supervision have, if anything, undersold the new-generation concept. As even no-build advocates like Nagel have conceded, these facilities at least approach no-harm-neutrality in a field where disaster is the norm. A reading of the post-occupancy studies bears this out. It is unfortunate that the studies are not available in useful form. Despite their resistance to change, administrators might find the statistics and the records of management, staff and inmate interviews persuasive. Certainly they would go farther than the lofty policy statements, or even the "religious experience"—the phrase is that of Edgar Smith of the California State Board of Corrections—of a NIC-sponsored visit to Contra Costa. □

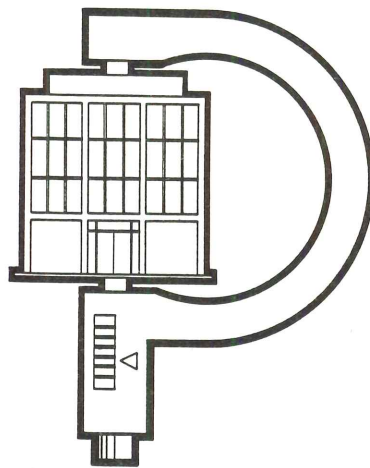
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# Building Diagnostics

BY FORREST WILSON



Architects claim to be the protectors of the built environment, yet most have little to do with the buildings they design after signing off on contract documents. This is particularly ironic, since the quality and effectiveness of structures often depend on refinements made after occupancy.

Building diagnostics is a rapidly evolving field of architectural specialization that reasserts the architect's (and mankind's) control over the environment. In building diagnostics, as in preventive medicine, practitioners assess the continuing performance of architectural, structural and mechanical systems, identify areas of concern and, of greatest importance, prescribe ongoing treatment.

Practitioners of building diagnostics report

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Forrest Wilson, Ph.D., who wrote and illustrated these articles, is a regular contributor to ARCHITECTURAL TECHNOLOGY. He is a professor of architecture and director of the doctoral program at Catholic University in Washington, D.C.

finding a receptive market for their services. The numbers of both older and newer buildings needing attention is vast, and dollars spent for building-rehabilitation and new construction are now nearly at parity.

Many older buildings show clear signs of decay or require substantial renovation to accommodate altered patterns of use. Newer buildings have problems, too. While they may not have deteriorated as profoundly as older structures, they also rarely have the same built-in tolerances.

Architects who have begun to offer building diagnostics as a follow-up service find that by remaining close to their projects after design and construction, their buildings perform better, longer. Ongoing involvement also helps build relationships with clients, resulting in repeat commissions.

Most architects, however, prefer to turn building diagnostics over to specialists who possess the unique skills required. These specialists, in some cases, are architects who've given up conventional design practice altogether to become diagnosticians—knowing that they will affect the built environment as surely as any design architect.

ARCHITECTURAL TECHNOLOGY's exploration of building diagnostics comes in five parts:

- an introduction to the field.
- a background on diagnostic theory, including case studies of practical applications.
- a guide to diagnostics tests, accompanied by charts showing when and how to use them.
- a dictionary of diagnostic techniques.
- a compilation of comments on the "state of the art" by some of today's foremost building diagnosticians.

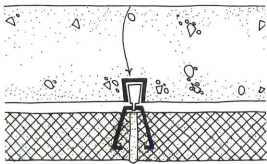
This collection of articles represents excerpts from Forrest Wilson's forthcoming book, *Building Diagnostics: New Opportunities for the Design Profession*, to be published by John Wiley & Sons in late Fall 1985.

It's all a warm-up to what may be the most important trend in architecture today—concern for buildings as living systems, not paper solutions. —M.R.



**B**UILDING DIAGNOSTICS IS DEFINED, according to the National Academy of Science's Building Research Board (formerly the Advisory Board on the Built Environment, or ABBE), as "all activities involved in judging how well a building performs its functions, through an understanding of the building's purpose, present use, environment and history."

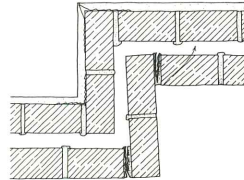
We might say, further, that building diagnostics assesses the fitness of building spaces—the entire building or complexes of buildings—for the intended or unintended purposes they serve. When we assess the structural capacities of older buildings, calculate the energy consumption of newer buildings, analyze indoor air quality, evaluate rehabilitation costs or look for the causes of a



mechanical system's failure—all of these activities are building diagnostics.

Three important events of the last decade have greatly spurred the development of the science of building diagnostics. Together, they opened the door to reconsidering the safety and effectiveness of structures at other times in their life cycle than during major alteration or upgrading programs.

First was the energy crisis, which led to a reevaluation of the performance of mechanical systems in virtually all buildings—old and new. Second was the marked increase in injuries resulting from deteriorating facade ornamentation. This caused a reanalysis of long-term material performance (see sidebar). Third was the trend toward historic preservation, which spurred an interest in prolonging the life of buildings and also revealed some horrifying realities. (Ezra Ehrenkrantz, of the Ehrenkrantz Group in New York, has a favorite illustration here. He recently participated in the restoration of Manhattan's Woolworth Building, and found that, though the building was once the tallest in the world, it contains no expansion joints!)

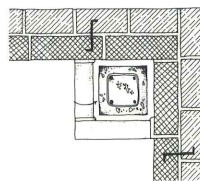


## MEASUREMENT

Building diagnostics is grounded in a search for patterns and conditions that can be measured. Building owners, visual observations, historic analyses, instrument measurements, studies of building occupants and surveys of their opinions are some, but not all, of the sources of information. Improved measuring devices and advances in information processing (in particular, instrument technology combined with microprocessors and mini-computers) has further aided and directed investigations.

The first use of sophisticated equipment for building diagnostics was the application of infrared thermography to determine energy efficiency. Since then, diagnosticians have steadily exploited scientific advances in other fields. (Examples are the varied data and applications available from thermographic, vibrational and acoustic techniques.)

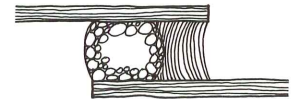
Instruments used as sensors in building diagnostic measurements include radiographic and sonic measuring devices, remote probes and recording instruments, and human sensors (through occupant observation, user-surveys and checklists). All these



techniques require standards, so that measured results can be accurately compared and implications, correctly determined.

Developments in other disciplines and industries, such as the complex, built-in equipment used for automobile diagnostics, may foretell the future for building diagnostics. For now, we use a variety of both crude and

advanced tools. Few phenomena are measured directly. For example, ordinary mercury thermometers measure temperature by the expansion of a liquid in a scaled glass column. The length of the deflection of a needle on a voltmeter can also indicate temperature. Heat flow through a building-material assembly is not measured, but the electric current required to maintain a constant temperature difference across a wall can be recorded. The soundness of a stone slab or the density of a fired brick is assessed by the blow from a rubber mallet and an interpretation of the sound. A chain dragged across a parking deck can enable an experienced evaluator to detect surface delamination through an interpretation of the change in acoustic values.



Often, however, measurements are infinitely more complex, perhaps involving the spectral distribution of electromagnetic radiation emitted by a sample or the destructive signatures associated with a chemical element to determine material composition. Similarly, a material's optical properties may be combined with a knowledge of how stress governs optical patterns to determine material strength.

Diagnostics also surveys human physiology and psychology to discover why people use or misuse spaces in certain ways.

## REACHING CONCLUSIONS

For all this focus on measurement, however, the essential imperative of building diagnostics lies not in the sophistication of the measurement procedures, but in the conversion of measurement to an accurate assessment of the present and future state of a building and its occupants. The goal is to verify building health or, short of that, to determine ways to bring the building back to health.



## Local laws require diagnostics

As municipalities adopt "facade laws" with the intent of protecting pedestrians from falling masonry, building diagnostics promises to become an increasingly large part of the architect's repertoire.

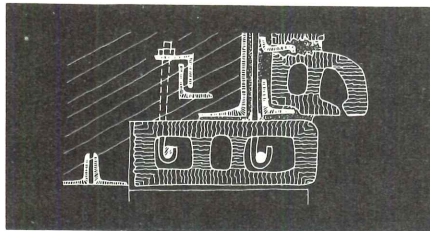
Since 1980, New York City Local Law 10/80 (the "Facade-Repairs Law") requires that all buildings (regardless of age) over six stories be inspected and certified every five years by a licensed architect or engineer. Even with a number of exemptions, over 8,000 structures are subject.

According to N.Y.C. Buildings Department spokesman Vahe Tiryakian, the city has been unable to furnish its own manpower to perform the inspections, and relies on the expertise of licensed professionals at large. Because the law does not specify techniques for building diagnosis, certifiers use their own discretion in choosing methodologies.

Though the Buildings Department is in general satisfied with the quality of the reports generated under Local Law 10/80, Alex Herrera, architect and deputy director of the New York Landmarks Preservation Commission, finds that the quality of techniques and reports varies widely. In the same light, the Law seems to be a mixed blessing for preservation.

Inspections of structures has resulted in a mandate for immediate repair of many buildings. When the building is a designated landmark, restoration work must be accompanied by a permit from the Commission, which strives to preserve historical integrity. On the other hand, if the building is not protected by landmark status, its ornamentation may be stripped, resulting in what Herrera terms "well-intentioned-but-architecturally-mangled" projects.

From the building owner's point of view,



compliance with Local Law 10/80 has cost millions of dollars. Allan S. Birk, P.E., speaking for the Building Owners and Managers Association of Greater New York, said his organization has found no fault with the law, and supports its intent and use. Buildings Department figures bear this out: only 1.8 percent of the owners of applicable buildings have not completed filing their reports.

Although building owners are responsible for hiring a licensed architect or engineer who will certify the structure "to the best of his knowledge and belief," there is a question as to whether the certifier would be held responsible should subsequent facade-failure occur.

With building diagnostics in its infancy as a profession, and choice of diagnostic tools not yet standardized, licenses may be on the line. New York attorney Barry B. LePatner, Esq., offers the following opinion: "All architects and engineers must recognize that performing facade inspections is at best a risky venture. This is so because without extensive removal of portions of the facade, it is impossible to ascertain the true condition of the structure. Therefore, an architect or engineer who agrees to provide such an inspection or report must advise the owner that he can only look for patent signs of distress; latent conditions which have not manifested themselves cannot realistically be ascer-

tained. As such, and because the public would have a legal right to rely on the architect's or engineer's report (which is filed with the buildings department), the prudent course of action is to get an indemnification and hold-harmless agreement from the owner before doing this work."

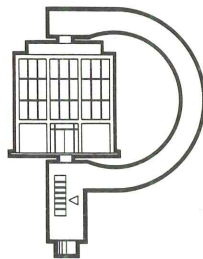
Interestingly, most of the certification under Local Law 10/80 has been performed by engineers. However, Migyatt and Perry, Architects, an architectural firm specializing in restoration and maintenance continuation work, seems to have found a workable solution. According to principal G. Daniel Perry, AIA, the firm will not prepare a certification report unless they also perform necessary restoration work. In fact, most of the 15 or so projects given to the firm under Local Law 10/80 jurisdiction owed to the building owner's desire for a more thorough follow-up of reports previously filed by others. Visual and physical observation and test probes are Perry's diagnostic tools; he also relies heavily on past experience and knowledge of historical construction and materials. To the question of liability for his firm, Perry says, "It's only as much of a problem as the rest of private practice."

The New York City Buildings Department is pleased with the effects of Local Law 10/80—"One of the City's most successful safety programs," Tiryakian said. Since the law came into effect, over 1,025 buildings classified as "unsafe" have been, or are being, repaired. Now only 186 buildings (2.2 percent) remain in this category, and the department is working to get that number down to zero. With figures like that, building diagnostics used as preventive maintenance will likely proliferate, as other municipalities follow suit.

—M. Stephanie Stubbs



# THEORIES AND EXAMPLES OF DIAGNOSTICS PRACTICE



Just as architects evolve a personal repertoire of characteristic formal solutions, diagnosticians develop a personal style of detecting, verifying and solving building problems.

Approaches have no set patterns. They may be as simple as smelling wood rot and fingering beetle frass, or as complex as interpreting vibrational particle movements or deciphering the agonized sound of a crack propagating under stress.

The case descriptions that follow describe the varied, everyday diagnostic approaches of several masters of the art. Spectacular failures have been consciously avoided because, though usually well-known, they are rarely characteristic.

## THE CRIST METHOD

Common to each case study presented is the utilization of theories postulated by Dr. Robert Crist, of Wiss, Janney, Elstner (WJE), Chicago. Crist divides the diagnostic process into three rational time-related functions that can be applied to all assessment problems, testing conditions and diagnostic techniques. The functions become three variables in an equation, posed in terms of time( $t$ ):  $F(t) \rightarrow G(t) \rightarrow Y(t)$ .

$F(t)$  = forcing function, causing change;  $G(t)$  = transfer function, the properties of the element, component or structure such as stiffness, chemical composition, damping or other system characteristics;  $Y(t)$  = output or response, such as corrosion, deflection or strain.

The statement  $F(t) \rightarrow G(t) \rightarrow Y(t)$  characterizes all engineering problems, Crist says, whether in the area of mechanical, electrical,

civil or chemical investigations. If two of the functions are known, the third can be found. This is the key to identifying diagnostic procedures and techniques.

All testing or diagnostic devices can therefore be catalogued under one of the following six combinations:

| Known | Measure | Find |
|-------|---------|------|
| F     | Y       | G    |
| Y     | F       | G    |
| G     | Y       | F    |
| Y     | G       | F    |
| G     | F       | Y    |
| F     | G       | Y    |

To find  $F(t)$ , diagnosticians employ a variety of instruments. Devices such as force links, pressure gauges (inside or outside a building) or anemometers (wind speed) can be used to measure  $F(t)$ . Measurements may also be obtained by electronic means, photographically, by hand or through intuitive judgment. Sometimes, visual inspection quickly indicates the causative function, and this may be all the information necessary to proceed.

Stress cannot, however, be measured directly. Rather, it is calculated by measuring strain or deformation. To successfully transform the measured deformation,  $Y(t)$ , to engineering units of the quantity to be assessed (a basic premise of measurement engineering), it is essential that measurement devices be accurately calibrated.

To apply Crist's equation to, for instance, the problem of corroding reinforcing rods

embedded in concrete, let  $F(t)$  = chlorides,  $G(t)$  = the properties of the reinforcing steel and  $Y(t)$  = oxidation or corrosion. Deformation,  $Y(t)$ , is easily measured (through a host of instruments) and is transformed through known properties,  $G(t)$ , to an actual force,  $F(t)$ . The transfer function,  $G(t)$ , reflects the properties of materials: chemical, physical, tensile strength or molecular composition.

Note that time is the one consistent element of the expression. While the problem and solution can be frozen in time at the appropriate point, according to Crist, the diagnostic equations should be analyzed as a function of time. Therefore, measurement techniques must measure time as well as amplitude, particularly where progressive deterioration is evident.

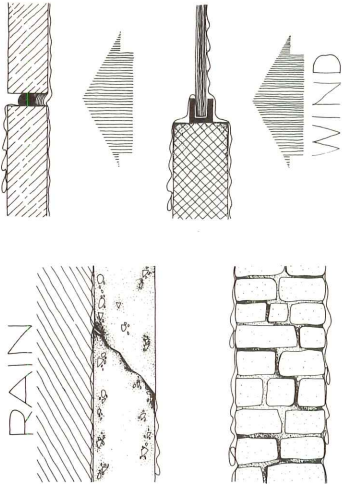
## TIME TO CRACK

The importance of time in Dr. Crist's formula is demonstrated by research he conducted in the time-dependent nature of concrete fracturing. Concrete failure begins in the form of micro fractures. These aren't dangerous by themselves, for in fact concrete is full of minute cracks. When the cracks join, however, the system becomes continuous and sets up a relative motion between cracks—a mass movement. When loads are applied at a rapid rate, masses are accelerated. But these masses can only move so fast.

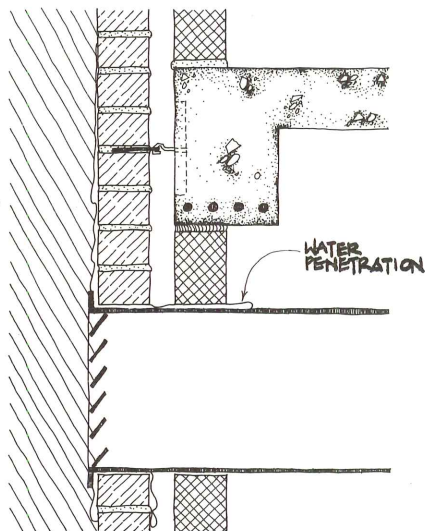
If loads are applied very quickly, cracks theoretically do not have time to connect; the load may pass through the system faster than the material can respond. Thus, at least



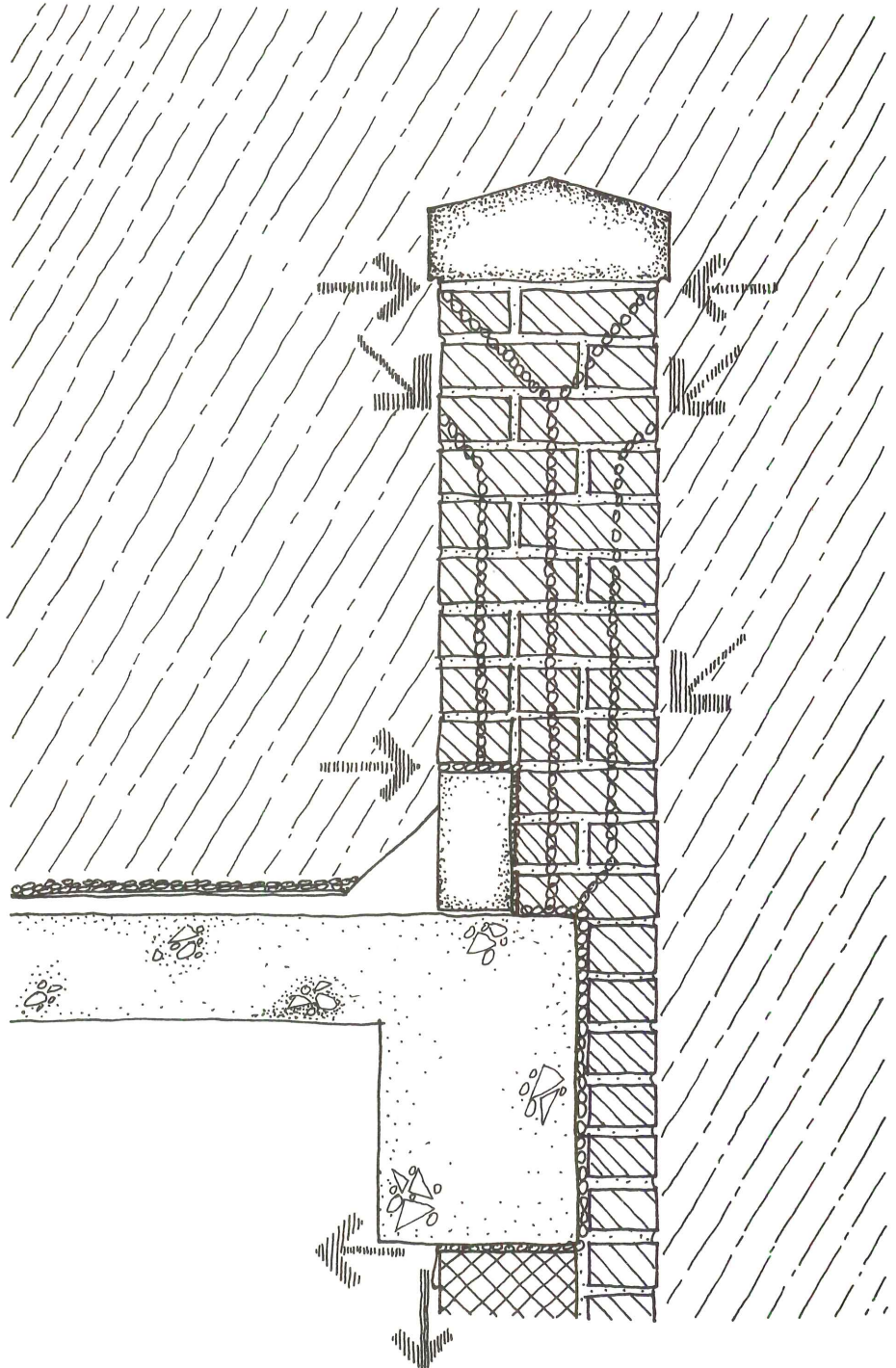
## How water and masonry mix



When wind pressure is high, water may be forced into joints (top left and top right) that are otherwise waterproof. Cracks (above left) are open invitations to water. Even a sound masonry wall (above right) can permit moisture to seep into mortar (through an action called wicking).



When materials such as a heated duct penetrate a cavity wall, problems may be expected. Here, expansion of the duct breaks a caulked seal and allows rain to follow the duct and collect (who knows where) inside.



Where and how water gets into a masonry wall, a parapet in this instance, is no secret. What exact effect the water has, once inside the building, often requires the expertise of a seasoned building diagnostician.



theoretically, if a load passed through a system at great enough speed, concrete might not crack at all. This limit is, of course, never reached. And conversely, if load is applied gradually, cracks would theoretically have time to move and form to their maximum extent. This static limit, also, can never be reached.

This time factor is especially important with brittle materials. Since cracks affect tensile strength far more than compressive strength, a material such as concrete will have improved tensile characteristics if loads are applied quickly.

### CASE 1: HOSPITAL VIBRATION SURVEY

This diagnostic survey was undertaken to determine the cause of vibrations which interfered with the precision of a hospital's surgical microscopes and X-ray apparatus. The equipment was located in operating rooms that rested on new structural framing.

The framing consisted of steel beams and floor joists spanning the long direction of rectangular spaces, 24 inches on center.

Vibrational performance was tested (by Wiss, Janney, Elstner) under normal operating procedures. Results were compared to minimum performance standards set by hospital staff members.

The task, in terms of the Crist method, was to find  $G$ , given a known  $F$  and a measurable  $Y$ . Vibration was the response function,  $Y(t)$ . The forcing functions,  $F(t)$ , were established by the simulated "normal operating procedures."  $G(t)$ , in this case, represented the acceptable level of transfer function that the equipment could tolerate.

#### Technique

Standards for acceptable performance were established by the chief surgeon for the operating instruments during simulated operating-room activities. These included:

- personnel walking in corridors adjacent to, and in, operating rooms
- operation of mechanical equipment
- elevator operation
- operation of an adjustable tilt table
- personnel walking on catwalk
- movement of X-ray equipment in corridors

Vibration measurements were taken at vibration origin, base of mechanical equipment, and base of the surgical microscope and X-ray machine.

The velocity of structural motion was used as the measure of performance and calculated in terms of distance per unit of time (inches per second). A seismometer with a triaxial transducer recorded particle velocity direction. Velocity was observed in three mutually perpendicular directions.

WJE established velocity levels acceptable to the chief surgeon's requirements during simulated activities performed singly and in combination.

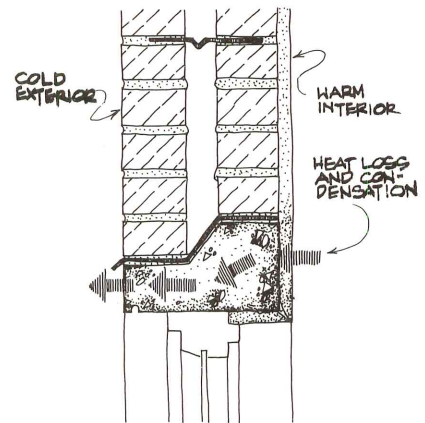
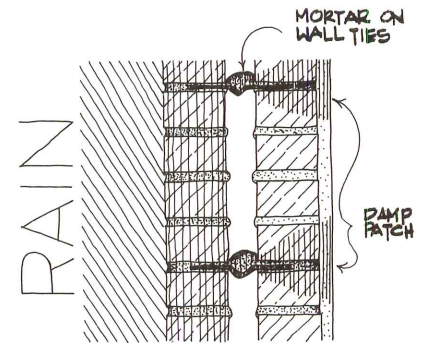
#### Comments

Frame vibrations detected were caused by mechanical equipment two floors above, coupling to the floor through joists, floor beams and columns. They were also caused by a malfunctioning shock isolator on the cooling tower fan.

Because changing the frequency of a building structure is difficult, solutions were few. To stiffen the floor, closely spaced grid beams were considered, but the designers knew that the added mass would not appreciably change floor frequency. The solution to changing the frequency was to alter the spans between beams with intermediate column supports.

#### Lessons learned

The structure of the operating rooms and the functions that took place there did not accord, since bar joist framing is highly resonant. The designer may have made this selection under client pressure for fast and economic construction, and he, or for that matter the hospital staff, may not have known what equipment would ultimately be housed there. If the floor had been constructed of 10-to-12-inch reinforced flat-plate concrete, an expensive floor for normal use, it would have proven considerably less expensive over the long run than the cost of the original floor together with the needed modifications.



Two ways moisture can form on the inside of a cavity wall are via mortar on wall ties (top) and cold bridges (above). In the first case, the moisture is water from rain or snow that has traveled, by wicking, from one side of the wall to the other. Moisture from a cold bridge results, not from outside water, but from warm inside air condensing into water droplets on a cold surface, which in this instance, is a concrete lintel stone.



## CASE 2: WATER MAIN BREAK

When a water main ruptured beneath the on-grade slab of a large single-story building housing manufacturing and office space, Wiss, Janney, Elstner conducted a limited survey to assess building damage. Their study was undertaken three days after the break. The main was located about five feet below the slab and the break, once discovered, was repaired on the evening of the same day.

Since the forcing function,  $F(t)$ , was known (the break in the main), the task, in order to assess the response of the structure,  $Y(t)$ , was to measure  $G(t)$ , the extent and type of change in the properties of the structural components.

### Technique

The investigation procedure included:

- visual survey and documentation of damage to interior, facade and roof
- exploratory small-hole borings made in the slab-on-grade to observe and locate areas of undermining
- determining the causes of damage
- an evaluation of structural effects of observed damage
- recommendations for repair

### Comments

Observations through borings indicated undermining below the slab. Damage appeared to be confined within a roughly 50-foot radius of the break.

WJE found that water from the break lifted the slab, which caused the walls to tilt out of plane. This then forced in-plane shear distortions. (Shear distortions take place when the top of a wall moves horizontally relative to the bottom. The wall shortens along one diagonal and stretches along the other.) When the water subsided, the slab settled back to approximately its original

position. The evidence of this slab uplift was a crack that appeared near the water pipe break and a small residual slope away from the crack. Wall cracking and warping of door frames was a second consequence of slab uplift. As it heaved, walls perpendicular to the crown racked in shear. Short walls absorbed the racking motion without cracking. Longer walls generally cracked at points of reduced section such as door and window openings. The wall cracks remained, even as the slab returned to its original position. Distortions and associated crackings were transmitted along the wall 40 feet east of the break.

The effects of slab movement were magnified at dissimilar wall constructions such as where gypsum masonry and drywall abutted. Adjacent walls of different materials moved and rebounded at slightly different rates, causing vertical cracking at wall interfaces.

Wall cracks observed about 100 feet from the break were not attributed to the break, but to other problems inherent in the building. These were also assessed and remedies, prescribed.

WJE also discovered areas of deteriorated mortar joints and water penetration. Tears in the roof membrane were attributed to thermal movement rather than the heaved walls caused by the water main break.

None of the observed structural damage was considered of major consequence. The steel roof framing was undisturbed. Interior non-bearing walls remained in stable configurations, despite cracks. Undermining of the slab-on-grade did not appear widespread. It was recommended, however, that the subgrade be raised to provide uniform support to the underside of the slab. Repair of mortar joints and tears in the roofing membrane also was suggested. Left unattended, the building owners cautioned, these water-entry points could cause substantial damage. For aesthetic reasons, WJE recommended that the wall cracks be repaired.

Further, they suggested that part of the wall, recently tuckpointed, be further diagnosed, to determine if other problems, such as a leaky capstone or inadequate flashing details, were causing the deterioration.

## CASE 3: WATER INFILTRATION ANALYSIS

A successful building diagnosis may involve no more than a meticulous comparison of design intent with built result. In this procedure, instructions to the builder, detailed in drawings and described in specifications, are compared to the performance of a building after completion.

The diagnostician relies on his or her knowledge, observation and deductive capabilities. These skills are developed over a lifetime of building experience, education, observation and analysis in the practice of architecture. The following excerpt from a report by Elmer Botsai, Dean of the School of Architecture at the University of Hawaii at Manoa, demonstrates a mastery of this simple technique.

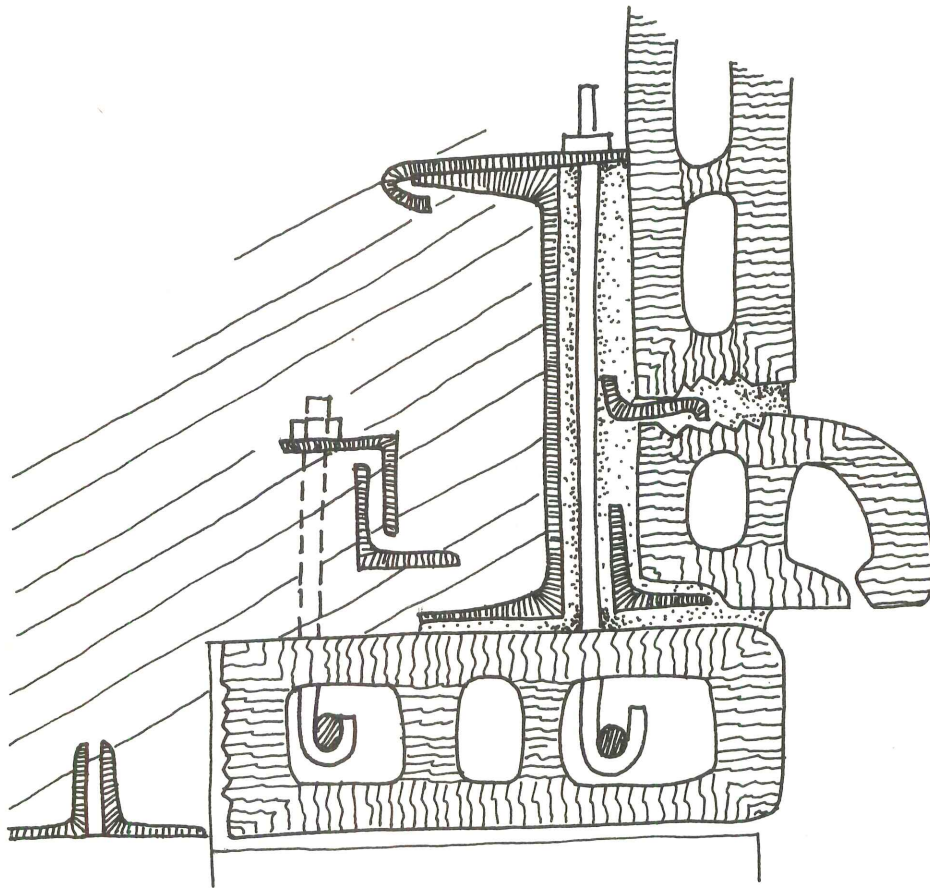
Botsai was retained to investigate complaints of "water infiltration" affecting a townhouse condominium complex. After a cursory examination in which he determined that the complaints were justified, Botsai submitted a proposal and was retained.

The buildings were wood frame, with a combination of flat built-up and shake-covered roofs. Exterior walls were cement plaster, interior walls, of gypsum board on wood studs. Overall construction approximated "Type 5" outlined in the Uniform Building Code. Climatic conditions were warm, damp and semi-tropical.

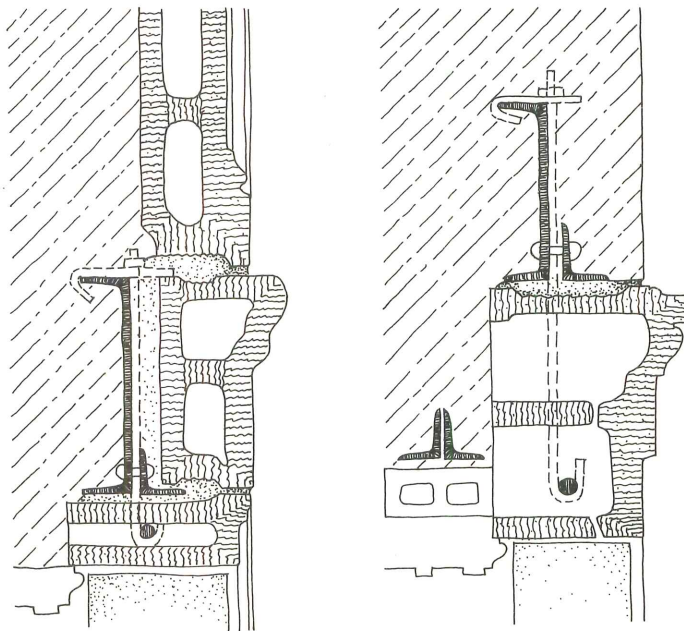
In this case, the response function, in the form of extensive deterioration,  $Y(t)$ , was known. The task was to measure  $G(t)$ , the properties of the elements deteriorated, to find  $F(t)$ , the forcing functions responsible for deterioration.



*Water can make ironwork terra cotta's weak link*



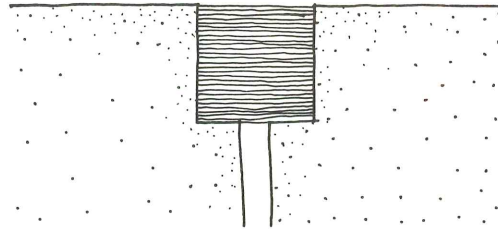
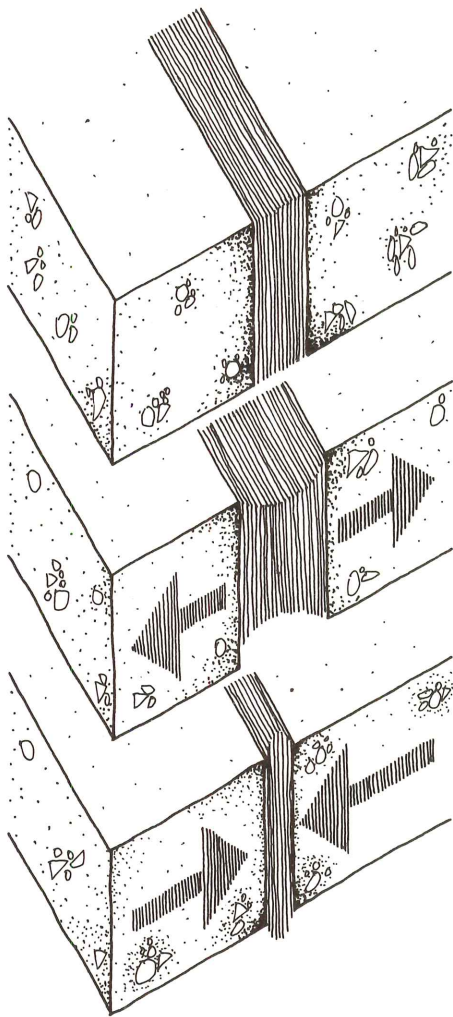
*If not properly treated, ironwork hidden behind terra cotta facades—indeed, holding them up—can corrode following moisture penetration.*



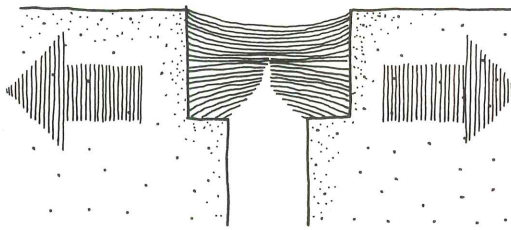
*Typical details of terra cotta ornamentation illustrate potential moisture-entry paths.*



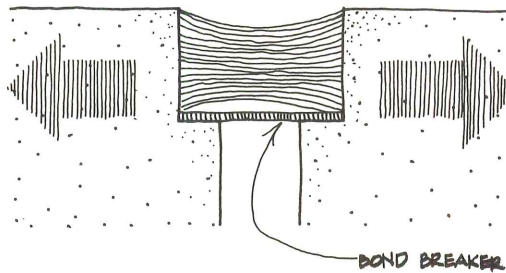
Sealants require care in design and application



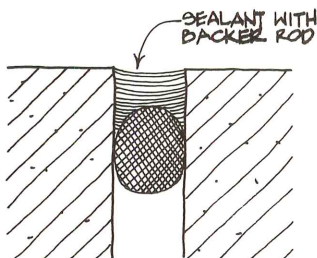
The three drawings at far left illustrate the proper action of a sealant during normal, contracted and expanded positions of a joint.



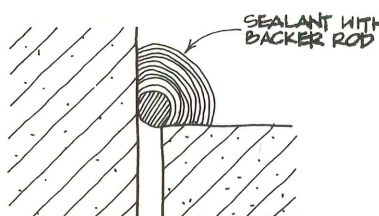
When a sealant adheres to more than two faces of the joint to which it is applied (shown in drawing above left), and the joint opens, it is very likely that the seal may split (left).



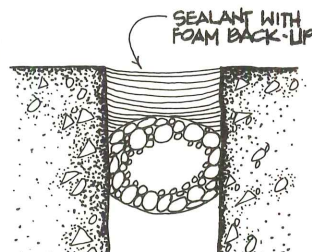
A bond breaker applied to the interior face of a joint eliminates the shear action that can easily start a tear and cause it to spread.



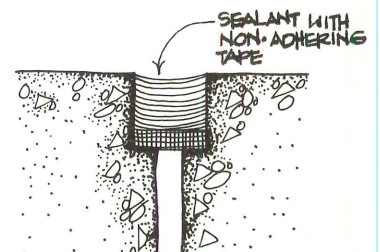
NORMAL WIDTH BUTT JOINT



CORNER JOINT



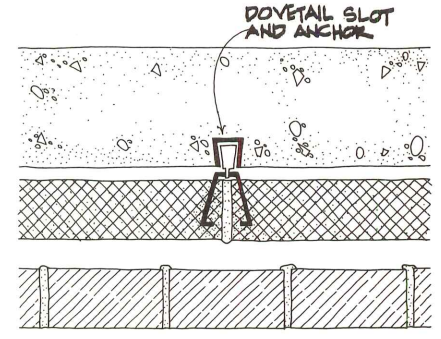
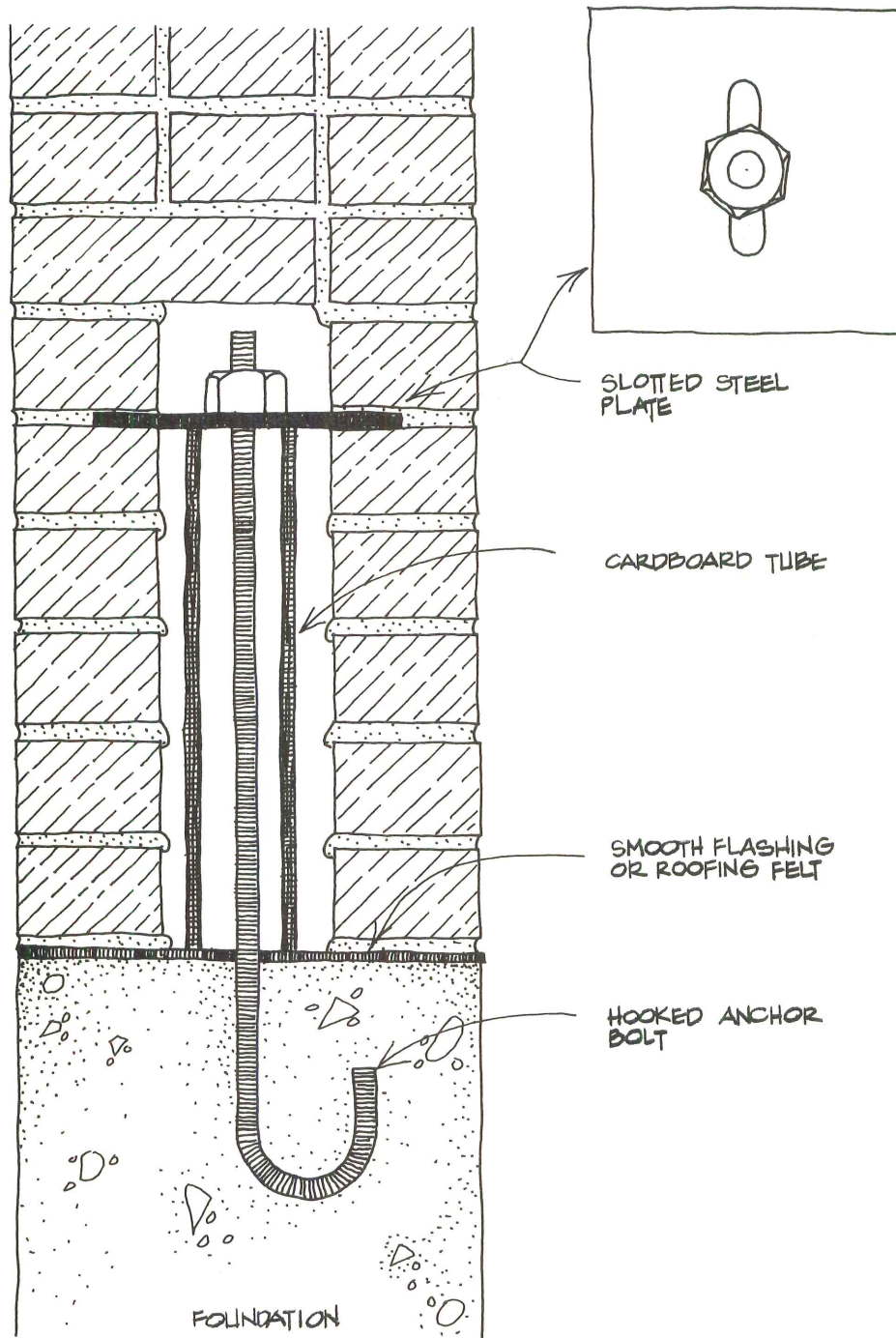
WIDE JOINT



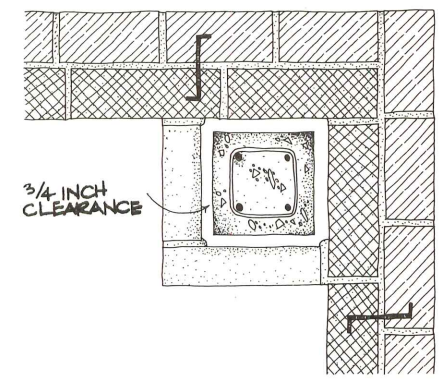
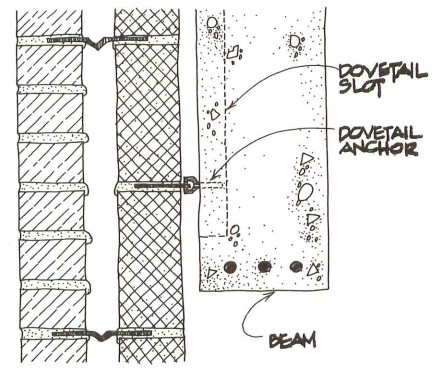
SHALLOW JOINT



*Detailing for movement between structure and skin*



A good way to permit movement between a wall and its foundation is the system shown in the drawing on the far left and above left. In another system, the dovetailed slot and anchor head, shown in plan (above) and in section (below), permits differential movement between a skin and a structural frame.

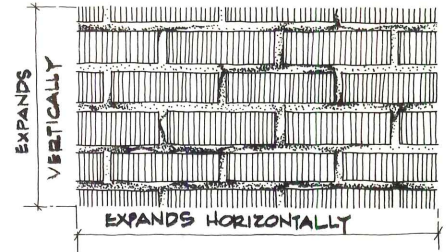
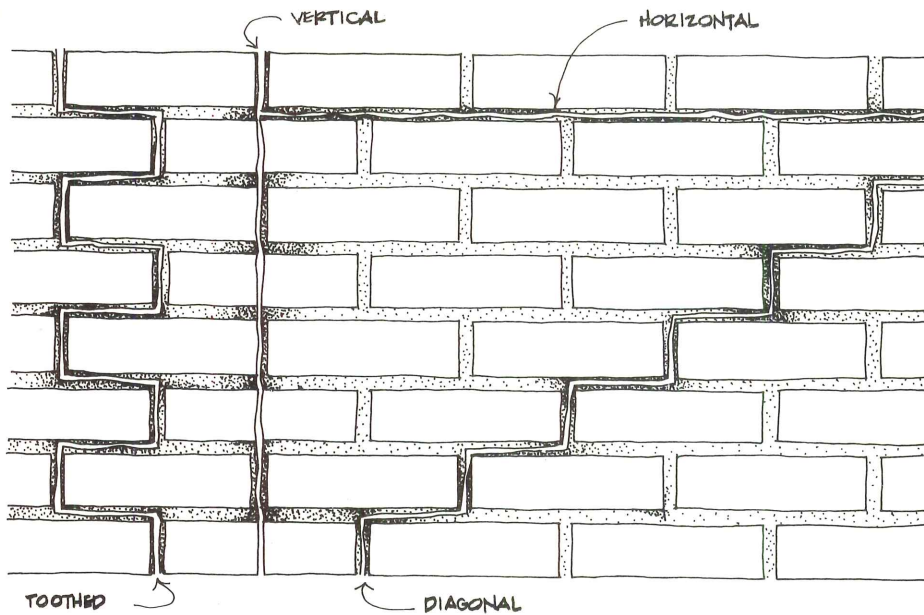


Proper application and action of sealants in joints, especially large, open joints, often requires a backer rod (drawings at left). When the joint is shallow enough (drawing near left), a non-adhering tape will often suffice.

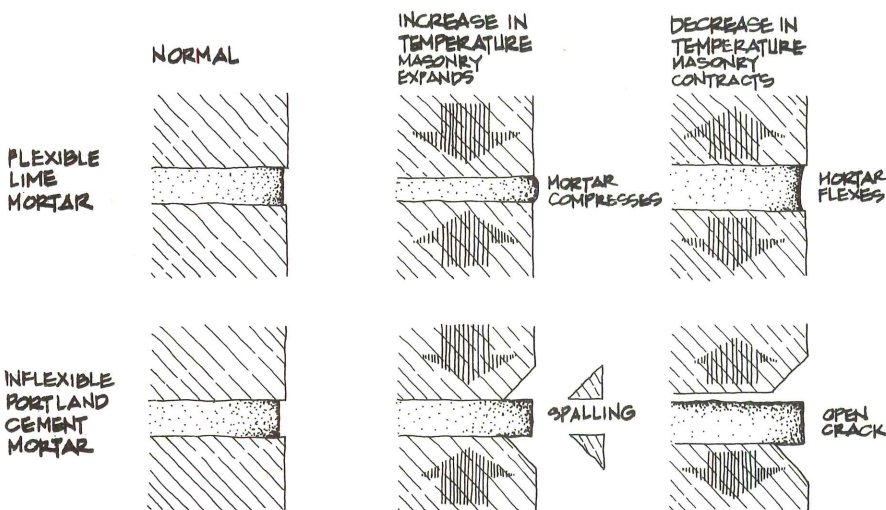
Good practice requires that masonry skins be held clear of columns by a minimum distance of 3/4 inch.



Expansion joints can be planned or accidental

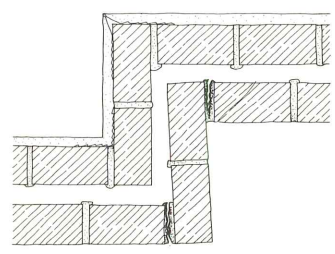
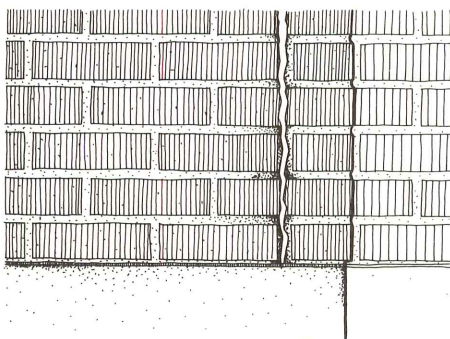
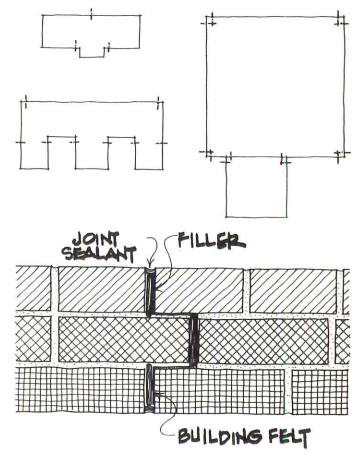


When provisions for movement are inadequate, the four most common responses of a masonry wall to stresses are the crack patterns shown in the top left drawing. Temperature accounts for much of the movement. Masonry's inherent tendency to expand over time accounts for further movement. A third kind of movement can result from chemical action in mortar, in which the mortar may expand, cause cracking of joints, pulverized mortar and an overall increase in dimensions (above).



The behavior of masonry in response to changes in temperature is strongly influenced by the type of mortar used. Responses of two different masonry/mortar combinations to identical temperature swings are shown at left.

Placement of expansion joints for masonry buildings, as shown in the drawings below, is a simple solution to many would-be problems. Proper detailing of joints in straight walls, including the use of a compressible filler and a building felt to break bond, is shown in the bottom drawing.



Elevation and companion plan, left and far left, show the rotation of a short return and resulting cracking caused by expansion of the two walls on either side of the return, when no expansion joints are used. Note that one of the cracks is hidden from view.



### Technique

Plans were examined. Because there were two sets, it was difficult to determine which governed. However, there was no doubt that construction had begun prior to the issuance of the second set of plans. Investigators surmised that the architect's office was working with one set of drawings, the contractor, from another.

Specifications were also in two sets, one dated considerably later than the other. There were substantial differences between the two. A generalized comment concerning this difference was that the second set of specifications upgraded "consumer items" (such as door hardware) and downgraded basic construction components (such as deleting the requirement for pressure-treated wood).

A general review of the documents to determine which were used, for what purpose, and which sets of documents described various project elements, included consultation with the design architect's office and the contractor.

A careful review of the more general features of the buildings followed. Site drainage, roofs and wall construction were examined, and distress patterns determined. A second, more careful evaluation of the documents enabled investigators to become familiar with specific construction details. Botsai paid particular attention to isolated details that he felt were significant. Simultaneous with this investigation, he conducted an in-depth site survey of the buildings. Destructive investigations of concealed spaces, including balconies, roofing, stucco walls, windows, bridges and interior partitions, were conducted as well.

### Comments

During analysis of details in which designs were compared to the actual performance of the building elements described, many discrepancies were found. For example, carpentry specifications for the wood balconies called for sill plates resting on masonry to be pressure-treated. Wood, where adjacent to masonry materials, was to be damp-proofed with roofing felt. Yet drawings called for Douglas Fir construction, including exposed material, with no mention of pressure treatment. Details clearly indicated decking free

of Portland cement plaster or stucco coating of balconies, yet field investigations indicated that the decking was not framed outside the plaster and structural wood framing. Decking penetrated the stucco skin and membrane down to the structural wood framing, creating a direct path for water penetration.

Balconies had deteriorated sufficiently to constitute a life safety hazard. A similar condition existed at stud walls adjacent to balconies, where decay resulted in structural degradation. In some instances, the decay penetrated to floor structures of living spaces. Untreated Douglas Fir, used to penetrate stucco areas, suffered extensive decay from water penetration and inadequate air circulation.

The report submitted to the client by Botsai continued, item-by-item, quoting specifications and working drawings, analyzing their suitability, and then comparing them to the building's performance, as recorded during field observations.

### CASE 4: A GENERIC APPROACH

In this instance, the building is imaginary—an amalgam of many structures diagnosed by Hugh Miller, Chief Restoration Architect, U.S. Parks Department. Together, they reveal another aspect of building diagnostics that is essential: sensuality.

The process of building diagnosis, Miller says, is grounded in the six senses (intuition is included). Instruments are used only as an extension of the senses. Sight is most important, since the symptoms and process of decay are often visually evident. Smell is useful too. Musty odors indicate moisture that may be approaching dangerous levels. Touch, to sense the texture of surfaces, Miller says, can indicate gross distortions. The feel of frass indicates the species of termites or wood-boring insects. Sound indicates the solidness of a member. A stethoscope may reveal carpenter ants or bees chewing. Taste can reveal the presence of salts—but since many toxic substances form crystals on the surface of building materials this, according to Miller, requires caution.

Miller divides the forces of deterioration into two categories, intrinsic and extrinsic. Intrinsic forces are induced environmentally by location, geology, soils and climate, and

may also include structural conditions, materials, design and workmanship. Extrinsic, external forces are natural, biological, chemical, physical and human. Human forces may be direct, such as wear and tear, maintenance, lack of maintenance and physical changes. Indirect human actions, such as riots, war or adjacent construction, are more dramatic.

### Technique

Miller makes his initial evaluation in a walk around and through all spaces. Exterior features are examined for significant signs and conditions that may be diminishing the building's safety, convenience or general performance. Peeling paint may be a concern, but piles of trash, just a nuisance.

A major problem, according to Miller, is moisture. "The roof is the hat of the house," he says, "so my investigations usually begin there." Miller employs photographs, and plans and drawings with spot notations, to document conditions. If he cannot reach the roof directly, he examines it from adjacent buildings, a cherry-picker, through binoculars or a zoom-telescopic camera lens.

Miller inspects the condition of the roofing material, particularly coatings, for wear and failure. Once he has an overall sense of conditions, his examination becomes more specific. Conditions at the edges, intersections and gravel stops, and continuity of joints at flashing and counterflashing, are all points of interest. "Look at the parapets and inspect coping conditions; search for rust stains that may indicate corroding interior flashings," Miller advises. Loose or missing mortar in masonry joints indicates serious problems. Tar on the back of parapet walls is a sign of poor construction and maintenance practices. Cracks, bellies and sags may be signs of structural problems.

"From here," Miller says, "the investigation proceeds. . . ."



# GUIDE TO DIAGNOSTICS TESTS

## Wood

Wood and timber structures are especially vulnerable to three kinds of problems: 1) those associated with shrinkage, deflection and creep, 2) those caused by infestation with wood-inhabiting organisms, and 3) fire.

Experience indicates that most failures in wood structures occur in individual members or components and do not lead to the failure or collapse of the structure. When one member fails, other framing members usually make an elastic or plastic readjustment to redistribute the loads.

Wood shrinkage makes structural connections the weak link in many wood structures. Visible indications of structural distress are splits in the wood adjacent to bolt holes, elongated bolt holes, abnormally large deflections, loss of bearing or sagging. Failure to tighten bolts periodically may result in excessive vertical deflection, in bowing and twisting of members, and in split rings coming partially out of their grooves. The National Design Specification for Wood Construction specifies that the load capabilities for bolted and lag-screwed connections with splice plates should be reduced to 40 percent of full design strength for timber that seasons in place.

Long term deflections in older structures, particularly industrial ones, may open up critical joints, even in the absence of other problems.

*The abstracts and tables presented here and on the following pages are based on Rehabilitation Guidelines (#9), published by the United States Department of Housing and Urban Development. Additional information may be obtained from HUD User at (301) 251-5154.*

| Diagnose   | Test Method                                  | + Advantages – Disadvantages   |
|--|--|--|
| Decay, species   | Visual                                       | + good preliminary step<br>– other tests should follow to determine internal conditions, stability   |
| Strength and grade   | Visual                                       | + Well-suited for grading inspection<br>+ gives a measure of structural adequacy<br>– limited to accessibility, may be impractical if grade marks painted over   |
| Decay extent   | Manual probing                               | + good to detect surface decay<br>+ fast, easy to identify advanced decay<br>– other tests needed to assess internal quality<br>– not all surfaces may be accessible<br>– can not detect internal decay  |
| Density, strength, degree of degradation   | Pilodyn Penetrometer penetration tests       | + equipment simple, durable, can be used by trained field personnel<br>– not a precise strength determination<br>– must calibrate readings with known samples<br>– only measures decay from surface inwards<br>– measures only advanced decay                      |
| Moisture content   | Dielectric moisture meters, power-loss meter | + easy to use, will not upset surface<br>– limited range: 0% to 39% moisture content<br>– sensitive principally to surface of sample<br>– accuracy impaired when moisture gradient present<br>– reading affected by specimen density, chemical treatments or decay |
|  | Resistance-type moisture meter               | + meter simple, rugged; readout in direct units<br>+ calibrations for grades and species<br>– limited range: 7% to 30% moisture content<br>– data influenced by some preservatives, fire retardants and decay  |
|  | Electrical resistance probe                  | + measures changes in long-term moisture content remotely<br>+ can be built into structure<br>– used only in research<br>– limited range: 7% to 35% moisture content   |
| Strength, modulus of elasticity  | Ultrasonic, pulse velocity                   | + equipment portable, fast and readily adaptable for field use<br>– affected by wood characteristics that are not flaws, such as moisture content  |
|  | Stress-wave propagation                      | + portable, light, inexpensive<br>– requires trained personnel   |
| Moisture content   | Weight test, oven-drying                     | + accurate at any level of moisture content<br>– takes time, requires lab test-equipment   |
| Grain direction, irregularities, decay, splits, knots, moisture content, insect damage, location and size of members | Radiographic                                 | + provides permanent record<br>+ equipment light, portable, easy to use<br>– radiation unhealthful, requires shielding<br>– initial cost high<br>– field development not complete<br>– specimen must be accessible on both sides                                   |



## Iron and steel

Iron and steel deterioration most often results from corrosion—also called oxidation. Corrosion is simply the chemical reaction of a metal with oxygen or other substances.

The type and degree of corrosion is affected by minor variations in environment, contact with other metals and materials, and the composition of the metal itself.

Iron and steel structural components most likely to corrode are fasteners, welds and interfaces with masonry or concrete. Column bases located in damp areas or near flooding—particularly if salt is present—are likely candidates for corrosion too. Thin cracks in concrete fireproofing usually indicate only minor corrosion, while extensive spalling may indicate a much more serious condition.

Steel bar joists are particularly sensitive to corrosion. Critical areas are web-member welds, especially near supports, where shear stresses are high and possible failure may be sudden. Iron and steel can also deteriorate from purely physical causes, including fatigue, graphitization, fire, overload or connection failure.

Fatigue is failure of a metal by the repeated application of cyclic stresses below the elastic limit—the greatest stress a material can withstand without permanent deformation after removal of the load. It results from a gradual, progressive fracture of the crystals that form the steel.

Graphitization may be a problem in cast iron exposed to acid rain or salt water. It is caused by the impregnation of porous graphite corrosion residue with insoluble corrosion products. The cast iron retains its appearance and shape but loses much of its mechanical strength.

Fire can cause unprotected iron and steel framing members to become plastic and fail rapidly. Structural iron or steel that has survived a fire without deformation is usually safe to reuse, but any questionable member should be load tested.

Overloading is the stressing of a metal member beyond its yield point so that permanent deformation, fracturing or failure occurs. Failure can result from the application of static loads, dynamic loads, thermal

| Diagnose   | Test Method                                     | + Advantages – Disadvantages   |
|--|---|--|
| <b>Surface characteristics, flaws, corrosion, pits, etc.</b>   | Visual, optical, boroscopes, fiber-optics, etc. | + permits inspection of surface and hidden surfaces if access available<br>– detects only visible flaws on surface or below surface through access channels  |
| <b>Material separations (open to surface)</b>  | Liquid penetrant containing dye                 | + permits inspection of complex shapes in a single operation<br>+ inexpensive, easy to apply, portable<br>– shows only defects open to the surface<br>– messy, with irrelevant indications<br>– results depend on operator's ability<br>– process must be carefully controlled |
| <b>Cracks, voids, porosity, laps, segregated-inclusion, poor brazing or bonding</b>                    | Ultrasonics (vibrations above 20,000 hertz)     | + surface and subsurface defects revealed<br>+ locates small discontinuities<br>+ portable, instant results<br>+ accurate measure of thickness<br>– sensitivity reduced by rough surfaces<br>– odd-shaped geometries difficult to analyze<br>– requires skilled operator       |
| <b>Cracks, seams, laps, voids, porosity and inclusions</b>   | Magnetic particle                               | + simple, inexpensive<br>+ senses flaws down to 1/4 inch as well as surface flaws<br>+ not applicable to non-magnetic metals or materials<br>– messy, careful surface preparation required<br>– irrelevant indications often occur<br>– results depend on operator's skill     |
| <b>Voids, porosity, inclusions and cracks</b>  | X-ray and Gamma-ray radiographics               | + detects both internal and external flaws<br>+ portable<br>+ permanent record<br>– expensive; heavy<br>– health hazard, requires shielding<br>– complex shapes difficult to analyze   |
| <b>Surface-finish discontinuities, cracks, seams, variation in alloy composition or heat treatment</b> | Eddy current                                    | + moderate cost; readily automated<br>+ portable; permanent record available<br>+ can be adapted to comparative analysis<br>– useful on conductive materials only<br>– shallow penetration<br>– reference standards often required<br>– provides only qualitative comparison   |
| <b>Yield strength, yield point, tensile strength, modulus of elasticity, compressive strength</b>      | Coupon  | + fast, accurate results of physical and mechanical values<br>– destructive to sample removed for testing.   |

stresses and settlement stresses, either singly or in combination. "Buckling" is a form of permanent deformation from overloading which is usually caused by thermal stresses. Members can also be overloaded if their support is removed and loads are redistributed to other members, which can become overstressed and deformed.

Connection failure of bolts, rivets, pins and welds, the most common connections of

structural members, can arise from overload, fatigue or corrosion. Most common is corrosion of bolt heads, rivets and areas covered by fastening plates. If not detected and stopped, corrosion reduces a connector's effective cross-sectional area, making it more susceptible to stress failure.



## Masonry

Masonry walls may incur structural damage through overloading, ground movement, thermal or moisture movement, shrinkage, fire, movement of roof or floor, lateral loads, sulphate attack, corrosion of embedded metal, frost, salts or unsound materials.

Even a small wall-bulge may seriously impair strength and stability—especially in cavity walls and those built with hydrated lime mortars.

Because joints, bearing surfaces and connections are the most vulnerable and critical areas of a masonry structure, points of high shear and low movement should be identified and examined. Bulging, sagging or other signs of misalignment may indicate related problems in other structural elements. Vertical and horizontal cracking, where masonry abuts columns or other frame elements such as floor slabs, deserves special attention.

When masonry is used in a reinforced concrete frame, differences in the moisture content and thermal mass of the two materials will cause them to expand and contract at different rates. Unless allowances are made, differential movement between these or other dissimilar materials frequently results in cracking. This, in turn, leads to increased water permeance. Brick Institute of American (BIA) Technical Note No. 18 analyzes (and further illustrates) problems associated with differential movement and masonry cracking.

Metal anchors, ties and reinforcement rods, which are frequently embedded in masonry, if not protected with coatings (such as galvanizing, not paint), may corrode easily and cause serious problems. Rain and snow water with a pH of between three and five—common in atmospheres contaminated with carbonic-, sulfuric-, nitric- or hydrochloric-acids, accelerates corrosion. A masonry cover of at least four inches is considered sufficient for steel in walls.

| Diagnose   | Test Method                 | + Advantages – Disadvantages   |
|--|-----------------------------|--|
| <b>Flexural bond strength</b>                                      | Load testing                | + accurate<br>– destructive  |
| <b>Shear strength or diagonal strength</b>                         | Load testing                | + accurate<br>– destructive  |
| <b>Water absorption</b>  | Weighing, dry and saturated | + accurate<br>– time-consuming   |
| <b>Freeze/thaw</b>   | Repetitive cycles           | + accurate<br>– time-consuming   |
| <b>Size</b>  | Visual measurement          | + fast, requires little skill<br>– will not determine strength or durability.  |
| <b>Warpage</b>   | Visual inspection           | + fast, requires little skill<br>– will not determine strength or durability   |
| <b>Imperviousness</b>  | Ink test                    | + fast<br>– will not determine strength or durability  |
| <b>Chemical resistance</b>   | Acid dripping               | + useful if exposure to certain chemicals is anticipated<br>– will not determine strength or durability  |
| <b>Crazing</b>   | Autoclave test              | + reliable test<br>– safety precautions required<br>– will not determine strength or durability  |
| <b>Leakage, water permeance</b>                                    | Spray test                  | + rate of leakage and water permeance can be observed<br>+ used for comparison of masonry specimens; simple modifications make useful for in-situ testing<br>– will not determine strength or durability, other than that inferred from porosity |
| <b>Compressive strength</b>  | Masonry prisms              | + results reliable if taken from actual building materials<br>– results uncertain if materials different from actual building  |
| <b>Structural soundness, mortar bond, filled cells</b>             | Hammer test (light tapping) | + fast approximation<br>– requires skilled tester with good hearing<br>– may require additional testing to validate findings   |
| <b>Inner cell grout, wall thickness</b>                            | Probe holes                 | + small holes from test easily patched<br>+ requires only semi-skilled evaluator<br>– an approximation, requires many drill holes unless combined with fiber-optics  |
| <b>Continuity, voids, cracks, estimate of compressive strength</b> | Ultrasonics (low frequency) | + accurate evaluation of several parameters<br>– requires skilled, experienced operators<br>– expensive  |
| <b>Voids and reinforcement</b>                                     | Radiography                 | + accurate evaluation of parameters; permanent record on film<br>– requires access of both sides of specimen<br>– requires safety precautions; expensive   |
| <b>Location of reinforcement</b>                                   | Pachometer                  | + requires fast, semi-skilled operator<br>+ gives locations and depth of reinforcement<br>– used only for light reinforcement; difficult to interpret if both joint and cell reinforcement used  |



## Terra cotta

Terra cotta has a proud history as cladding and embellishment on many distinguished buildings, but a litany of disasters in which it has fallen from buildings, in some cases striking pedestrians, points out a darker, less understood side of this material.

Terra cotta is made from controlled-aged clay, sand and pulverized fired clay (grog). It is fired at high temperatures, and gains a hardness and compactness greater than most other fired-masonry materials.

Many designs for terra cotta facades on buildings from the late 19th century to the mid-20th century were predicated on the misunderstanding that moisture would not pass through terra cotta and that painted iron and steel anchors, used to tie the terra cotta to structural supports, would not rust. Unfortunately, this was not the case. Water, in its solid, gaseous and liquid states, accounts for many terra cotta failures.

Most common is spalling, caused by water freezing and thawing within the material (forcing sections to become dislodged), and corrosion of metal anchors. Water infiltrates terra cotta facades, most often, around flashing, capping, roofing and caulking around windows and doors—especially when these joints are poorly maintained.

Faulty original workmanship causes problems as well. Stress-related deterioration, resulting from lack of provision for thermal movement and the growth of the material over time, is common. An understanding of differential movement and stress-relieving details did not take place until the second or third decade of this century. Development of large stress-related cracks is often caused by unaccommodated building frame shortening under load, thermal expansion and contraction of the facade and moisture expansion of the terra cotta units themselves. Cracks running through many units, stories or large areas of material are dramatic portraits of stress-related problems.

Good guidelines for general evaluation are the quality-control tests for new terra cotta recommended by the American Terra Cotta Institute.

| Diagnose  | Test Method   | + Advantages – Disadvantages  |
|---|---|---|
| <b>Internal damage and deterioration</b>  | Tapping with wooden mallet  | + quick, inexpensive<br>– only an approximation<br>– requires experienced operator  |
| <b>Internal metal anchoring, broken or loose internal pieces, deterioration, moisture</b> | Metal detectors<br>Infrared scanning  | + quick, inexpensive<br>– only an approximation<br>+ remote scanning possible<br>+ provides photographic record<br>+ detects wall ties<br>– technique in experimental stage |
| <b>Material stress</b>  | Strain gauges   | + accurate reading of strain<br>+ can be recorded over time<br>– material may have to be cut and removed  |
| <b>Crack movement</b>   | Scratch gauges, dial gauges, vibrating wire, strain gauge,                                  | + provides accurate reading<br>+ can be recorded over time  |
| <b>Internal cracking</b>  | Sonoscope   | + easy, fast; considered by some the most reliable test<br>– not proven thoroughly reliable because of thickness of terra cotta walls and voids                             |
| <b>Water permeance</b>  | Water-permeance test frame  | + measures actual conditions by simulation<br>– time-consuming  |
| <b>Moisture expansion</b>   | Reheat test   | + measures expansion of material over time<br>– only an approximation   |
| <b>Causes of deterioration</b>  | Laboratory testing  | + most accurate analysis<br>– requires removal of material samples<br>– time-consuming  |
| <b>General evaluation</b>   | Quality-control tests recommended by the American Terra Cotta Institute for new terra cotta |   |



## Reinforced concrete

Indications of deterioration and damage in reinforced concrete structures are usually limited and may have a variety of implications. Cracking observed in the concrete, for example, may be caused by corrosion of the reinforcement, deflection, settlement, thermal expansion, contraction or curing stresses.

The location, configuration and pattern of these cracks holds significance. Spalling generally results from corrosion of the reinforcement. Where staining has occurred, its color and location may provide clues too. Brown staining usually indicates corrosion. But occasionally it is caused by the aggregate. Surface disintegration of the concrete is often caused by salt crystallization, freeze-thaw cycles, de-icing chemicals and weathering.

When damage is not extensive, concrete patching procedures will usually suffice. Large amounts of corrosion and spalling may require a detailed analysis, both to determine remaining structural capacity and to suggest necessary repairs.

Precast members may present special problems. End supports should be checked for adequacy of bearing, restraints and potential for end-shear.

Floor and roof systems of poured-in-place concrete with self-centering reinforcing, such as paperbacked mesh and rib lath, should be inspected for corrosion of the unprotected reinforcing.

Two publications by the American Concrete Institute (ACI) are especially useful for analyzing existing concrete structures: ACI 201 R-68, *Guide for Making Condition Survey of Concrete in Service* and ACI 437 R-82, *Strength Evaluation of Existing Concrete Buildings*.

| Diagnose   | Test Method                        | + Advantages – Disadvantages   |
|--|------------------------------------|--|
| <b>Surface flaws</b>   | Visual, optical                    | + inexpensive<br>+ no special equipment needed<br>+ reveals defects other methods won't<br>– provides information on surface only  |
| <b>Differential movements over time</b>                                      | Surveying                          | + provides cyclical relationships between deformation, temperature and load<br>– immediate interpretations not available<br>– trained surveyor required  |
| <b>Joint survey, expansion, contraction, cracking, variety of conditions</b> | Visual joint inspection            | + inexpensive initial first step in a more in-depth investigation<br>+ most applicable to foundations, walls, slabs<br>– trained observer required for data collection and evaluation  |
| <b>Internal cracks, voids, flaws</b>   | Fiber optics visual survey         | + yields clear, high-resolution image of remote inspection areas<br>– requires path to surface; may require multiple boreholes   |
| <b>Surface hardness—relative quality of concrete</b>                         | Rebound hammer                     | + inexpensive, fast; can be used by inexperienced personnel<br>– indications of strength not accurate<br>– results affected by condition of concrete surface<br>– requires correlation between rebound value and concrete  |
| <b>Compressive strength</b>  | Penetration, Windsor probe         | + equipment is simple, durable<br>+ field operation requires minimum training<br>– accuracy depends upon location of test and accuracy of depth gauge<br>– slightly damages small area of concrete<br>– provides accurate strength determination only with correlation of depth of penetration and concrete strength |
| <b>Moisture content</b>  | Dielectric                         | + equipment readily automated<br>– used in the past only in laboratories<br>– accuracy of 25%<br>– equipment very expensive, tests only for moisture content   |
| <b>Slab thickness, re-bar location</b>                                       | Electrical resistivity             | + equipment easy to use<br>– limited to pavements and on-grade slabs<br>– results inaccurate, affected by air entrainment, density, moisture, salt content and temperature gradients   |
| <b>Locate ferromagnetic elements, location and depth</b>                     | Magnetic cover meters, Pachometers | + light, portable, easy to operate, inexpensive<br>– battery equipment will not operate satisfactorily below 32°F<br>– good results only with one layer of re-bar<br>– will not work well with mesh  |
| <b>Growing internal flaws</b>  | Acoustic emission, stress waves    | + equipment simple, easy to operate<br>+ data gathering requires minimal training<br>– data interpretation requires an expert<br>– background noise distorts results<br>– computer recommended for triangulation of flaw location<br>– used only when structure is loaded and flaws, increasing                      |



| Diagnose   | Test Method                                   | + Advantages – Disadvantages   |
|--|---|--|
| Debonds, hairline cracks, voids  | Acoustic impact                               | + equipment portable, easy to operate and automate<br>– used mainly for pavements or slabs-on-grade<br>– expensive<br>– in developmental stage; not commonly used  |
| Thickness, quality, uniformity   | Ultrasonics (high energy velocity)            | + very accurate; only method to measure slab-thickness accurately and nondestructively<br>– requires large, heavy power supply<br>– data interpretations limited to measurements of thickness<br>– both surfaces must be accessible  |
| Density, internal structure, re-bars, debonding, voids, density, thickness | Radiographics, X ray, gamma ray               | + permanent record on film<br>– X ray only on samples<br>– gamma ray only applied to samples on in-situ structural components<br>– equipment heavy and expensive for field-use with concrete<br>– radiation unhealthful; operators must be adequately shielded<br>– both surfaces must be accessible |
| Moisture   | Microwave absorption                          | + easy to use and moderately priced<br>– low degree of accuracy<br>– two opposite faces of specimen must be accessible   |
| Quality, strength, modulus of elasticity, rigidity, durability             | Ultrasonic pulse-velocity, resonant frequency | + easy to determine uniformity<br>– requires skill to analyze results<br>– equipment expensive; requires field calibration<br>– background vibrations can affect results   |
| Moisture   | Nuclear, neutron scattering                   | + accurate measure of moisture content<br>– method has a short track record<br>– equipment complex, expensive, not widely used<br>– calibration procedures not standardized  |
| Internal flaws, voids, growing cracks                                      | Infrared testing                              | + potential of becoming relatively inexpensive and accurate method of detecting concrete defects<br>– results not yet considered reliable  |
| Verify load-carrying capability  | Load testing                                  | + reliable<br>– validity for long-range performance questionable<br>– may cause cracks, distortion or failure<br>– lengthy preparation and clean-up time   |
| Substratum voids   | Radar   | + scans large surface areas quickly<br>– not reliable with slabs containing reinforcing mesh<br>– very expensive<br>– operator needs technical training  |
| Strength   | Pullout test                                  | + fast, simple, inexpensive, easy to apply in field<br>+ direct determination of strength parameters<br>– procedures and equipment not standardized<br>– design of split-sleeve assembly critical<br>– epoxy grout must cure at least 24 hours before test commences                                 |

Selecting the best method for nondestructive evaluation of concrete requires sound judgment.

A visual inspection of concrete in all accessible parts of the structure should generally precede on-site nondestructive or destructive testing and be used to further evaluate the effect of distress on the concrete members already observed. A good general procedure to follow (in order of priority) is to use: 1) visual evaluation, 2) nondestructive evaluation, 3) destructive evaluation, and 4) load tests. Use in-situ testing to verify strength and condition estimates already derived from visual inspection.



# DICTIONARY OF DIAGNOSTIC TOOLS AND TECHNIQUES

**Acoustic Emission**—Acoustic (sound) waves result from the rapid release of strain energy during crack growth or plastic deformation. Sensors attached to the surface of a test specimen can detect these waves.

**Acoustic Impact (Hammer Test)**—Indicates defects in an object struck with a hammer through analysis of the frequency, through-transmission-time and damping characteristics of the resultant "ringing."

**Boroscope**—Optical device, normally equipped with a light, for seeing in tight locations and around corners. Boroscopes are available in many lengths and diameters. Some models can be fitted with a camera.

**Brittle Coating (Stress Analysis)**—An experimental technique which, in crude form, is the observation of mill-scale cracking on hot-rolled steel during a test to destruction. Cracks in the sample reveal the direction of principal stresses and the yield area.

**Cast-In-Place-Pullout**—Determines the pull force required to dislodge a steel rod, with an enlarged head, embedded in a sample of concrete.

**Chain Drag**—A method of inspecting large areas of concrete by dragging a length of chain systematically over the surface and interpreting the resulting sound signals. The operator, an experienced assessor, further examines areas of possible difficulty.

**Coupon (Metal)**—A laboratory test that determines compressive and tensile strength of samples removed from the structure. Determines ductility and modulus of elasticity as well. The shape and milling of the specimens and their testing is carefully controlled according to current ASTM standards.

**Covermeter and Pachometer**—Instruments employing magnetism and electricity to detect ferromagnetic components, such as rebars in concrete. Also effective in locating electrically conductive components in masonry and other nonconductive materials. The instruments operate on the principle that ferromagnetic- and electrically-conductive materials affect the field of an electromagnet.

**Eddy Current**—An electric current that, when made to flow through a sample of metal, generates an electromagnetic field. This field is easily altered by flaws or anomalies in a sample, and the changes can be sensed by the coil that generates the original charge. A change in the impedance of the excitation coil indicates the presence of flaws or anomalies.

**Electrical Resistance Strain Gauge**—A strain gauge, utilizing Ohm's law, that consists of a zig-zag wire or thin foil attached to a paper or lacquer backing that is glued to the part of the structure to be examined. Tensile strain causes the wire to elongate and become thinner, consequently passing less current. Compressive strain causes an increase in current. This is measured

with a Wheatstone Bridge or other suitable circuit. With careful choice of wire, adhesive strains as low as  $1 \times 10^{-6}$  can be determined.

**Fiberscope**—An instrument comprising a bundle of flexible optical fibers, lens and illumination system. Usually inserted into small openings such as bore holes to inspect cavity interiors.

**Freeze/Thaw Test**—Repetitive cycles of wetting, freezing, dragging and weighing.

**Gamma Radiography**—A procedure utilizing photographic film to record variations in gamma rays passing through a sample. The permanent sheets of film provide information on material density and thickness.

**Guarded Hot Box (Calorimeter Box)**—An insulated box that is sealed against a building material or component to determine the sample's heat transmission. Any loss of heat in the box (the heat is generated by a thermostatically-controlled electric heater) is measured and taken as the heat transmitted through the building material or component in question.

**Hair Hygrometer**—An instrument based on the relation between the increase in the length of certain animal hairs and the relative humidity of the atmosphere.

**Heel Drop Test**—An impact test performed at various points on a floor slab by a person who drops suddenly from heel to toe and measures the impact with instruments or personal impressions. The test is usually begun at the geometric center of the floor and repeated at the  $\frac{1}{4}$  and  $\frac{1}{6}$  points of the floor.

**Humidity Transfer (Wood)**—A test that utilizes small pieces of wood placed in contact with a material, left to reach moisture equilibrium, then removed and tested for moisture content.

**Hygrometer**—An instrument for measuring humidity in the air. The simplest type is the wet-and-dry bulb thermometer.

**Hygrometer (Electrical Impedance)**—An instrument with sensors having dual electrodes or windings containing a salt solution (such as lithium chloride) that can measure the electrical impedance of a sample by determining its conductivity. High conductivity indicates high moisture-content.

**Indentation Hardness Test**—A procedure that measures the penetration of a pointed probe into the surface of a material, usually metal, under a specified load, and estimates the strength of the material on that basis.

**Liquid Penetrant**—A liquid, often containing a fluorescent dye, that is applied to the surface of a test item to illuminate flaws when examined under ultraviolet light.

**Load Testing**—Application of a design load of lead, concrete or water to a structural system to verify load-carrying ability of the structure.

**Low-Frequency Ultrasonics**—A test system based on the transmission and reception of sound waves through a structure. Travel time and relative strength of transmitted signals indicates

structural soundness.

**Magnetic Particle Inspection**—A test utilizing small red or black particles containing fluorescent pigment that, when applied to the surface of a test sample and magnetized, tend to outline certain discontinuities or imperfections.

**Manual Probing (Wood)**—Probing of wood with a sharp, pointed object to test penetration. Splinters are pulled out of the surface and broken. Decayed wood splinters break off evenly. These are compared with the breaking characteristics of sound wood.

**Microwaves**—Electromagnetic radiation at frequencies between 300 MHz and 300 GHz—corresponding to wavelengths of one meter to one millimeter. Microwaves are reflected when they intercept a boundary between regions of different dielectric properties, recorded and measured.

**Moisture Meters - Electrical Resistance Probe**—Electrical resistance between two probes inserted into a test component is measured. The resistance decreases with an increase in moisture content.

**Penetration (Windsor Probe)**—Measures compressive strength by depth of penetration of a probe driven into a material.

**Petrography**—Examination employing microscopy and/or X-ray diffraction, differential thermal analysis and core testing, to determine the physical and chemical properties of aggregates and concrete.

**Portable Water Leakage Frame**—A portable test frame is attached to the exterior surface of a wall, and water and air pressure are applied according to ASTM standards. The water applied to the wall is collected and recirculated, and water loss is monitored to determine amount of leakage.

**Resistance-Type Moisture Meter**—Measures moisture content by determining the electrical resistance between two probes held in contact with a sample.

**Schmidt Hammer (Rebound)**—An impact hammer that tests the relationship between the recoil of a steel hammer and the compressive strength of a material (concrete). Intensity of rebound is calibrated and interpreted as the sample's compressive strength.

**Scratch Gauge**—A device that monitors crack movements continuously and records movements with scratches on a replaceable brass button. The brass button is removed and read with a calibrated microscope.

**Strain Rosette**—Measures strain at one point in several directions.

**Tomography**—A diagnostic technique employing X-ray photographs in which the shadows of structures, in front of and behind the section under scrutiny, do not appear.

**Ultrasonics, High Energy**—Evaluates the thickness, quality and uniformity of a material by measuring the velocity of a high-energy ultrasonic pulse transmitted through a sample.



## DIAGNOSTICIANS SPEAK

### LEV ZETLIN:

*Lev Zetlin is president of Zetlin-Argo Liaison & Guidance Corporation in New York City.*

"Engineering theory is an approximation. Fewer parameters are considered than actually exist. The question that building diagnostics must answer is, what is the degree of error? We do not know at this moment how inaccurate our theories have become.

"Experience has taught us that columns and beams specified in a steel handbook will perform predictably, and if the specifications are followed, the structure will be within safe limits. But when a contractor punches holes in the web and an engineer designs a cockeyed flange to facilitate construction or save material, normal I-beam formulas no longer apply."

### JOHN M. HANSON:

*John Hanson is president of Wiss, Janney, Elstner Associates, Inc. in Chicago.*

"We were taught to judge building structures by strength and stability. Yet structures fail not just from lack of strength, but from lack of serviceability.

"Investigative costs are high, but we have little problem collecting our fees. Even though they can amount to a significant percentage of the overall cost of the construction system, compared to a client's potential loss of property or liability if a building fails, our fees are small."

### JERRY G. STOCKBRIDGE, AIA:

*Jerry Stockbridge is vice president of Wiss, Janney, Elstner Associates, Inc. in Chicago.*

"People that built buildings in the early part of this century, by our standards, did not know what they were doing. Fortunately, they used much greater factors of safety than we use today. When you have a 2½-foot-thick wall you can do all sorts of things and it comes out alright, at least for a period of time. We have no such luxury with our present 8-inch-walled buildings. Today we must maintain our buildings better. There is simply not the 'fat' there anymore.

"Diagnostics must be learned by experience. After you have looked at your 200th or 300th masonry wall, you can tell by the shape of the building where problems are most likely to occur.

"Buildings often house functions more expensive than the building itself. If the enclosure is not kept serviceable, the potential for loss is staggering."

### JOSEPH NEWMAN:

*Joseph Newman is president of Tishman Research Corporation in New York City.*

"Building diagnostics is unquestionably valuable. It began when people became interested in building automation and recognized the increasing number of variables introduced into building: heating, ventilation, security, energy audits, lighting, etc. There is a growing tendency in America to mandate and regulate. If the diagnostic revolution leads to a greater degree of preventive regulation it will, in my judgment, have a short life."

### HUGH MILLER, AIA:

*Hugh Miller is Chief Historical Architect with the National Parks Service in Washington, D.C.*

"Building diagnostics in the U.S. is evolving from the lessons learned in managing historic structures, from the application of the 'house doctors' service to condo management, and a general awareness of maintenance as a preventive practice rather than a 'fix-it-when-it-happens' approach. Renovation of historic structures has become our diagnostic history.

"Continual observation and monitoring is building diagnostics at its very best. In this mode there are opportunities to learn how buildings really behave, since the diagnostic work is not distress-oriented."

### PLEASANTINE DRAKE:

*Pleasantine Drake is a principal of Architectural Diagnostics in Ottawa, Ontario.*

"There is a significant gap in knowledge about the effective operation and maintenance of buildings. Many of the professionals

that are responsible for the initial design of systems do not fully understand the actual performance of the systems in place. Adaptations are always made as the building is fitted up and as occupants tinker with it over time. In addition, the demand for improved environmental quality and control is becoming a major factor in the development of diagnostics. The backlash from building occupants in response to the lack of collective competence appears to be growing rapidly.

"Building diagnostics, as we in Canada define it, represents a real paradigm shift. It is not merely a new term for doing more of the same."

### JOHN EBERHARD, AIA:

*John Eberhard is executive director of the Building Research Board at the National Academy of Sciences in Washington, D.C.*

"The building occupant's functional environment is the essential element of the performance concept. This environment, however, cannot be diagnosed apart from the building's material properties. Therefore material and structural performance can be stated in terms of human performance."

### NEAL FITZSIMONS:

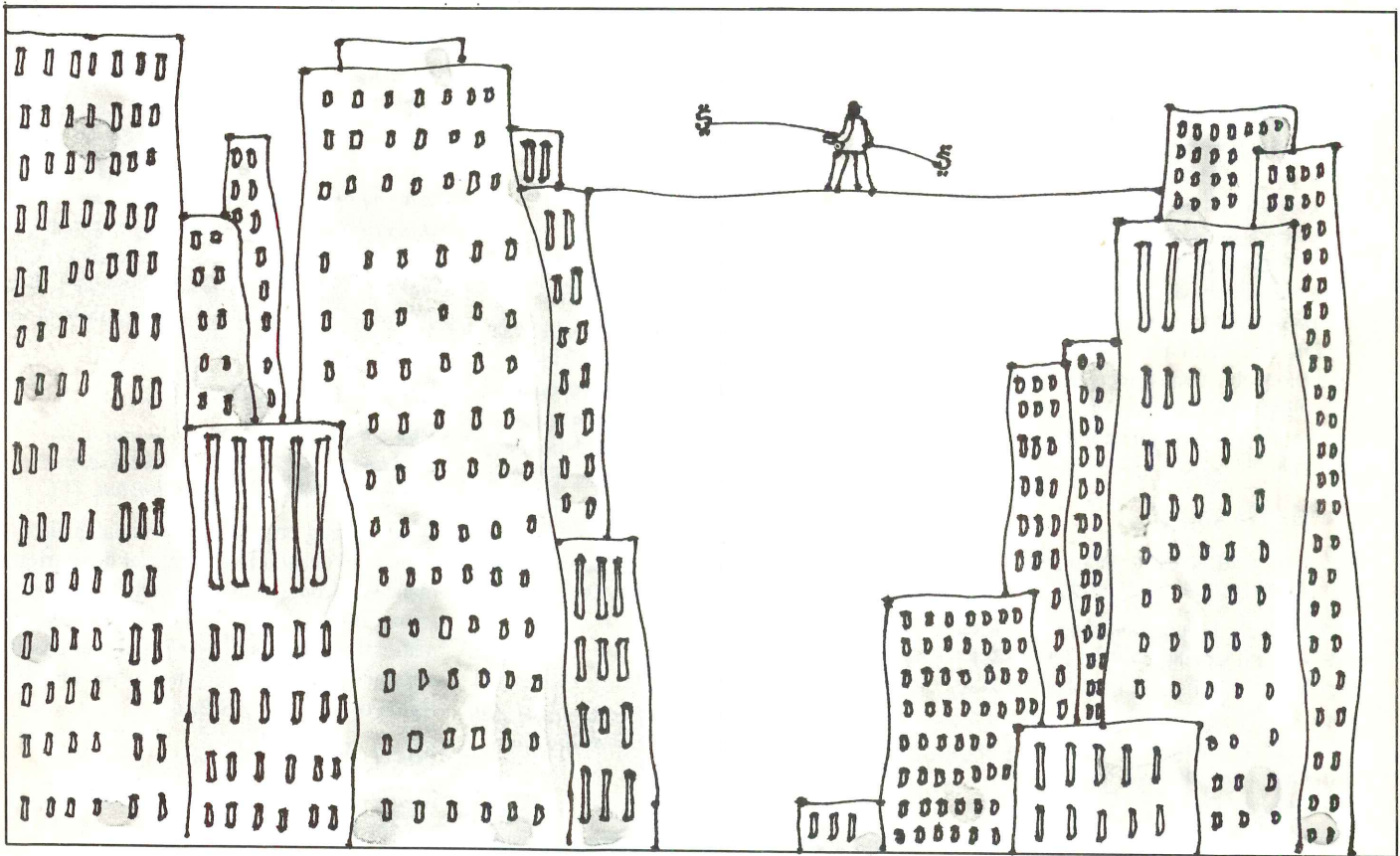
*Neal FitzSimons is a principal of the Engineering Counsel in Maryland.*

"There are three systems we might consider when assessing a building: natural, artificial and teletic. Natural systems are perpetual and operate without, and despite, human intervention. Artificial systems employ mechanical principals devised by humans. These systems, within narrow limits, are predictable. The third system, termed a teletic system, also devised by man, results in behavior that is far less predictable than an artificial system. A political system is teletic; foundations, columns, beams, etc., are artificial. A finished building is best conceived as a teletic system, particularly for the purpose of investigation. Only by examining a building with respect to all these can necessary changes be managed and appropriate adjustments be made." □



# The Compensation Crisis

BY OLIVER R. WITTE



Michael David Brown

*For fun, we design buildings; but what shall we do for a living?*

**T**HE COMPENSATION CRISIS IN architecture is real. Sad jokes like the one about the architect who inherited \$1 million and continued to practice until he went broke are wearing thin. If we have met the enemy, and he is us, then we also have met the solution, and that most certainly is us too.

To get at the solutions, the Chicago chapter of the AIA, under the guidance of its president, Thomas J. Eyeran, FAIA,

*Senior editor Oliver R. Witte based this collection of articles, in part, on the work of several AIA component organizations as well as the AIA's Special Task Force on Economics and Compensation.*

launched a fee survey and sponsored a two-day seminar last October on architectural fees. As individual practitioners, the members of the board also issued a statement on fees, known as the "Chicago Statement." If each of those initiatives can be considered a candle, the darkness was thrust back considerably.

The articles that follow draw heavily upon the Chicago chapter's work, but also borrow from efforts by other chapters, the AIA leadership and many concerned individuals. The articles present:

- *The judgment of the marketplace:* It's a buyer's market. Opportunities are not growing as fast as graduates and new firms are entering the workplace.
- *A ground-breaking study of fees* by Design Management Consulting. It shows that 1) median design fees for most project types

are 5 to 6 percent of construction cost, 2) one-third of the firms have participated in straight bidding, 3) most firms offer the same level of service on work obtained by price competition and negotiation and 4) the median billing rate for principals is \$75 an hour.

- *Two owners look at fees:* The keys to success, they say, are value, service and management.
- *The architect's perspective:* Only the profession can solve the profession's problems. But while architects may wish to boycott selection procedures based solely on fees, anti-trust laws prohibit the profession and the AIA from coordinating such action.
- *A bubbling stew of ideas* to challenge and perhaps inspire the profession.



## THE JUDGMENT OF THE MARKETPLACE

Architectural fees are being negotiated today in an atmosphere of intense competition and wrenching change, both within the profession and in the construction industry at large.

Although it may be true that competition has always been fierce and fees have never been high enough, some evidence does indicate that architects are not participating in the nation's economic recovery and that the profession generally is creating wealth in which it may not be able to share.

A precise depiction of the environment in which individual firms operate is difficult to obtain. Statistics abound but differences in the way they were collected make comparisons less meaningful than they might at first appear.

## MARKET STATISTICS

The construction industry has recovered from the 1981-'82 recession. Spending has increased from \$230 billion in 1982 to a current annual rate of \$315 billion, an increase of 37 percent, according to the Commerce Department. Chart 1 shows construction spending over the past four years.

Fees for A/E services, on the other hand, rose only 9 percent over the same period, to \$34.2 billion in constant 1983 dollars, according to the U.S. Bureau of Industrial Economics and Arthur D. Little Inc., the Cambridge, Mass., research analysts.

Although fee volume in the federal figures does not show the sharp fluctuations typical of construction spending, Chart 2 shows that the compounded rate of growth for A/E fees is becoming flatter as annual increases become smaller, according to Marc D. Rubin, a consultant for Little.

Rubin estimates that the demand for design services and employment opportunities is shrinking while new firms are being created at an expanding rate. The result is more, but poorer, firms. As Donald J. Hackl, FAIA, Chicago, puts it, "This profession does not believe in planned parenthood." Chart 3 presents Rubin's assessment of the market place.

Chart 3 presents Rubin's assessment of the market place.

CHART 3  
Real Annual Growth Rates

|                 | 1972-1979 | 1979-1984 |
|-----------------|-----------|-----------|
| Demand for:     |           |           |
| Design Services | 5.6%      | 4.8%      |
| Establishments  | 3.3%      | 5.4%      |
| Employees       | 5.3%      | 2.1%      |

Source: Marc D. Rubin, Arthur D. Little, Inc.

Another reason for the tough competitive environment is that firms seem to be battling for pieces of a pie that has been growing more slowly than the economy as a whole. Chart 4 shows construction as a percent of the gross national product.

Moreover, during the last few years has come the advent of non-traditional competitors: design/builders, construction managers, owner representatives, developers, metal building manufacturers and clients and manufacturers with their own design departments. No look at the market environment would be complete without discussing this trend.

The construction manager is an example of a new discipline developed within the past dozen years, according to William F. Fanning, a consultant from Marietta, Ga. He recalls that when he started out in the profession, construction was managed by architects, most of whom did it rather poorly. But today, CM fees average 2 percent of construction costs. "This is because owners perceive it as valuable," he says.

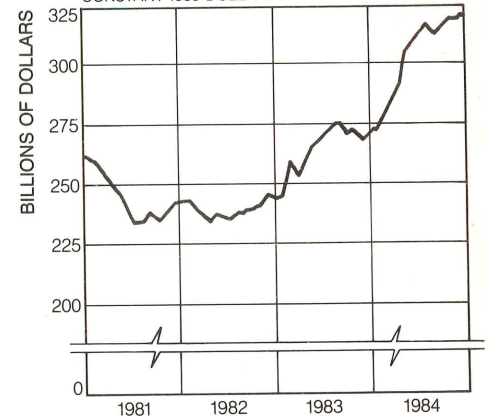
"Do you know where that 2 percent comes from?" Fanning asks architects. "Right out of your pockets. And what's worse, some CMs are now bidding architectural services."

## THE PROFESSION

Any profile makes it clear that the design profession is fragmented, with many small firms and a few large ones.

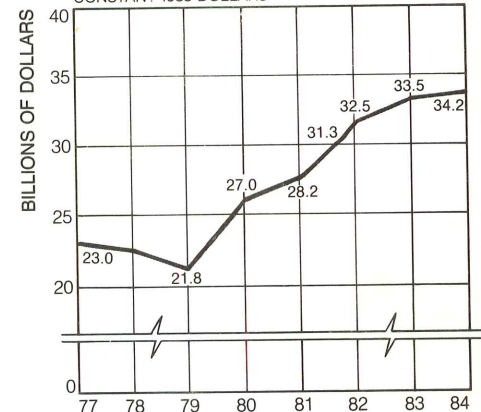
According to Rubin, the number of firms keeps increasing because of the entrepreneurial spirit of many architects and the ease of start-up. The many existing firms have not aggregated because labor costs, debt and fixed expenses are so low.

CHART 1  
Construction Spending  
CONSTANT 1983 DOLLARS



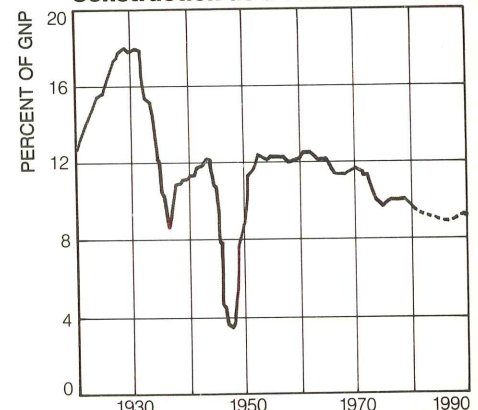
Source: U.S. Commerce Department

CHART 2  
Fees for A/E Service  
CONSTANT 1983 DOLLARS



Sources: U.S. Bureau of Industrial Economics and Arthur D. Little, Inc.

CHART 4  
Construction as a Percent of GNP

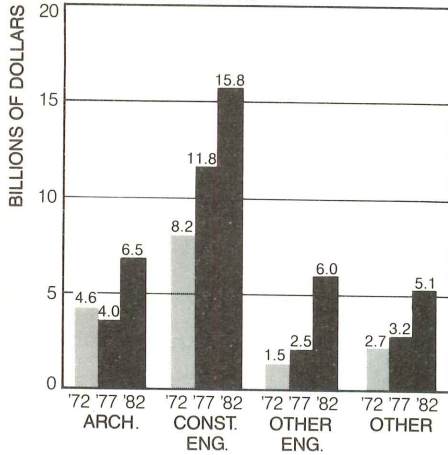


Sources: U.S. Commerce Department and Arthur D. Little, Inc.



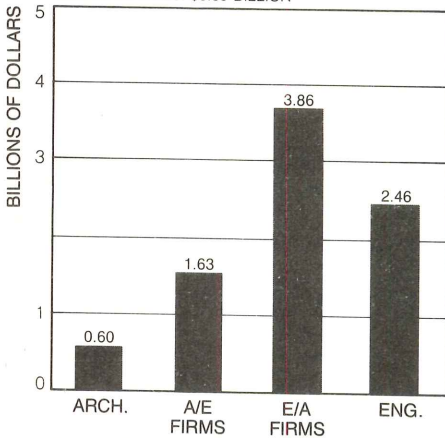
The profession doesn't believe in planned parenthood

CHART 5  
Design Fees by Profession  
CONSTANT 1982 DOLLARS



Sources: U.S. Census Bureau and Arthur D. Little, Inc.

CHART 6  
Fees by Profession  
500 Largest Firms  
1983 TOTAL FEES: \$8.59 BILLION



Sources: Engineering News-Record and Arthur D. Little, Inc.

The number of A/E firms in 1982 was estimated at 100,000, but only 45 percent had payrolls. There were 75,583 firms in 1977 and 64,246 in 1972, according to the Census Bureau.

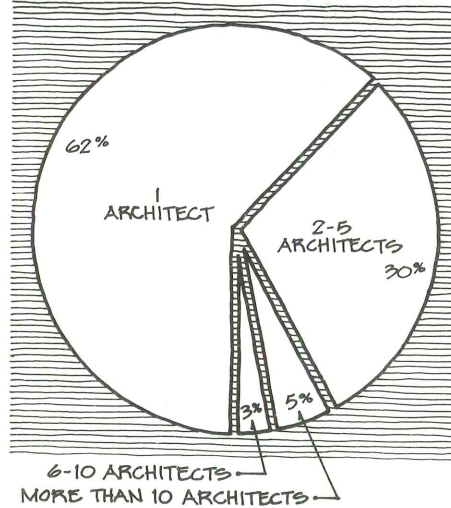
Total fees for all firms are shown in Chart 5 and, for the 500 largest, in Chart 6. If *Engineering News-Record* and the Bureau of Industrial Economics (Chart 2) gathered figures the same way, this would mean that the largest one-half of 1 percent of all architectural and engineering firms earned 25 percent of all fees.

Trying to calculate an average design fee as a percent of construction cost using this data (Chart 1 divided by Chart 2) probably is not valid. Plans are sometimes prepared years before construction, and reports of architectural fees often include engineering services that are counted again when engineers report their fees.

One of the most comprehensive analyses of architectural firm size is done by James A. Scheeler, FAIA, group executive for the AIA. His analysis is based on supplemental dues payments by Institute members.

As of September 1984, 13,404 firms were owned by AIA members. Only 391 employed more than ten architects, as shown in Chart 7. A significant majority of the firms employed only one.

CHART 7  
ARCHITECTS EMPLOYED  
AIA MEMBER OWNED FIRMS



Source: AIA

AIA member-owned firms have been growing every year since Scheeler began keeping track in 1982—from 11,685 firms in 1982 to 13,404 as of September 1984 (see Chart 8).

The percentage of firms employing only one architect has grown 1 percent a year to the current level of 62 percent.

Firms in all size categories have participated in the growth, but the largest percentage gains have been made by firms with one architect and with more than ten.

The number of architects working in AIA member-owned firms has increased from 28,491 in 1982 to 33,149 currently, Scheeler said. Regularly updated reports are available from Jim Frye at AIA headquarters, telephone (202) 626-7516.

GETTING STARTED

The United States had about 62,000 architects in 1982, according to a study of resident registrations by Rose E. Mohan, AIA's administrator of membership/component affairs. She estimates that about 4,000 begin practice each year.

In 1984, the 91 accredited schools of architecture graduated 3,978 students from their five- and six-year programs. Another 2,439 graduated from four-year programs, plus an unknown number from nonaccredited schools. The total appears to be holding rather steady in recent years, according to John M. Wilson-Jeronimo, AIA, executive director of the National Architectural Accreditation Board.

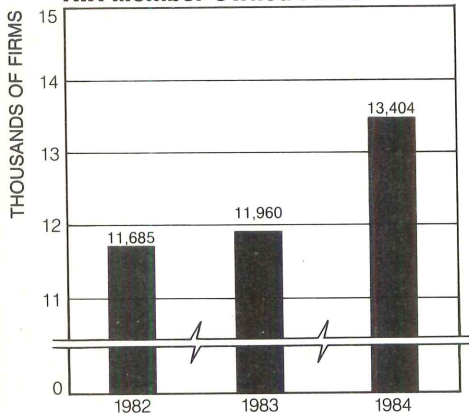
After graduation, most appear to work for architectural firms or else work in architecture-related activities for developers, contractors, industry or government. Studies published in 1977 and 1980 found that 52 to 60 percent of all students with architecture-related degrees were still working for architectural or A/E firms—as much as 11 years after graduation.

If architects working for contractors, developers, related design professionals and schools were counted as "staying in architecture," the percentage remaining in the profession would rise to 90 percent, according to the 1980 Tracking Study by the Association of Collegiate Schools of Architecture (ACSA).

The 1980 study covered 1967, 1972 and



CHART 8

**AIA Member Owned Firms**

Source: AIA

1977 graduates of 27 schools, said Roger L. Schlutz, former executive director of ACSA and now chairman of the department of architecture at Arizona State University, Tempe. The number of those remaining in architecture did not vary much by year of graduation, he said.

**SALARIES**

The young people and new firms entering the market can expect to find wide variation in financial rewards. But again, the available information must be interpreted with the caution that techniques for gathering data can shade reality.

Compensation averages are skewed by the few architects with very high compensation and the many with rather low compensation—a situation more typical of artists, writers and musicians than of doctors, dentists or lawyers. The more meaningful statistic, especially for principals, may be the median—the figure at which an equal number of people make more money and make less money. In some categories, the average doubles the median.

The median salary of entry-level employees of AIA member-owned firms was \$12,000 and the average was \$13,349, according to the 1983 AIA Firm Survey. At the 95th percentile, the base salary was \$18,000, indicating that a few firms were paying entry-level people more than twice as much as what firms in the 25th percentile were paying.

The lowest salaries were paid by firms in the Central States and by firms with fewer than ten employees.

By contrast, registered nurses, with as little as three years of post-high-school education, now start at \$18,000 and are striking and bringing suit to raise their salaries.

Base pay for principals was a median of \$34,000 and an average of \$39,327, according to the AIA Firm Survey. At the 95th percentile, the salary last year was \$84,000.

Compared to 1978, total compensation (including benefits) for architects was up 28 to 37 percent, depending on the level of responsibility. The smallest increase was for principals; the largest was for what the Firm Survey calls Technical II, which is the step above entry level.

But while these compensation improvements may seem gratifying, evidence suggests that—overall—they might not be keeping up either with inflation or other professions.

For example, the price of all goods and services (GNP deflator) increased 43 percent between 1978 and 1983 and the Consumer Price Index increased 53 percent.

The most recent picture is a little brighter. From 1981 to 1983, total compensation for architects climbed 9 to 14 percent, compared to inflation of 9.6 percent (CPI) or 10.5 percent (GNP deflator), according to the AIA Firm Survey.

**OTHER PROFESSIONS**

Comparisons with other professions are difficult because each profession has its own structure, reporting techniques and measurement periods. In general, though, since 1979, it appears that compensation of lawyers and engineers has kept pace with inflation; compensation of accountants and construction workers has not.

Employed accountants and auditors showed gains in earnings of 24 percent from 1979 to 1983 and 7.5 percent from 1981 to 1983, according to the Labor Department. Note, however, that partners and sole proprietors were not included.

For employed lawyers, the comparable figures were 34 percent and 14 percent.

Doctors showed a gain of 52 percent in average net income from 1978 to 1982, but only 7 percent from 1981 to 1982, according

to the American Medical Association.

Engineers' median total income rose 35 percent from 1978 to 1983 and 10 percent from 1981 to 1983, according to the National Society of Professional Engineers.

Average weekly earnings for construction workers rose 39 percent from 1978 to 1983 and 11 percent from 1981 to 1983, the Labor Department said.

And raises for managers of small-to-medium-size manufacturing companies in the Midwest were 1.5 percent in 1983 and 12.3 percent in 1984, according to a survey by Hewitt Associates, a consulting firm in Lincolnshire, Ill.

**CHICAGO SURVEY**

The Chicago compensation survey found that the pay range for draftsmen was \$13,700 to \$42,000 as of mid-1984. For partner/principals, the median range was \$45,000 (in a small firm) to \$56,700 (in a large firm). The lowest salary reported for a partner was \$26,000 in a small firm; the highest was \$140,000 in a large firm.

One self-employed sole proprietor in the city reported compensation of \$350,000 and another in the suburbs said he was earning \$250,000 a year. The median for self-employed architects was \$50,000 in Chicago and \$40,000 in the suburbs, according to Alice A. Sinkevitch, executive director of the Chicago chapter.

The chapter also gave average salaries by age group. Not counting sole proprietors and partner/principals, the 20-to-24-year-old group earned an average of \$14,250—down \$750 from last year. Salaries rose steadily and peaked at \$44,300 at age 45-49 before starting back down. The largest number of responses was from the 30-to-34-year-old group, which earned an average of \$31,950, up \$4,000 from a year ago.

Salaries of sole proprietors peaked at an average of about \$70,000 between ages 50 and 64 this year, according to the Chicago compensation study.

**DALLAS SURVEY**

The Dallas chapter surveyed salaries in February 1984 and found that entry-level pay for draftspersons/designers averaged \$10,872 in medium-size firms (six to 15 employees) and \$15,341 in large firms. The lowest paid



## Surveys show low median salaries

entry-level employee earned \$6,000 and the highest paid earned \$19,000. The average for secretaries was comparable: about \$15,200.

Top pay went to executive managers, with averages ranging from \$41,920 in small firms to \$72,250 in large firms.

Profit sharing and bonus income was not considered in the Dallas study.

### KANSAS CITY SURVEY

Kansas City's 1983 Firm Survey reported entry-level salaries for drafters and intern architects with and without A/E degrees.

Without degrees, drafters' base salary ranged from \$10,000 to \$24,600. Their average experience was 4.7 years. Intern salaries ranged from \$10,500 to \$11,500. Their average experience was one year.

The range for drafters with degrees was \$10,600 to \$26,000. Their average experience was 3.4 years. Interns' salaries ranged from \$10,500 to \$16,200. Average experience was 1.6 years.

Additional compensation in the form of bonuses ranged from \$100 to \$1,500 a year.

At the owner/principal/partner level, annual base salaries ranged from \$20,000 to \$85,000. Bonuses ranged from nothing to \$100,000. Kansas City did not report overall average or median salaries by category.

### NEW YORK SURVEY

The New York chapter surveyed its firms in January 1984 and compared the results with a survey from December 1981. This year, the chapter selected data only from the professional staff of firms with more than five employees.

New York's survey is especially interesting because the chapter named the 45 firms, four government agencies and four companies that participated. The participants included some of the most prominent firms in architecture today.

Salaries paid to entry-level employees of firms in New York City ranged from \$10,000 a year by a six-to-ten-person firm to \$26,000 by a 41-to-100-person firm. Median salaries hovered between \$15,000 and \$16,000. Bonuses and profit sharing added up to \$1,200 in additional income.

The real plums, though, were in the government sector, where the minimum pay for

a beginning architect was \$21,758, and in the corporate sector, where the top pay for a beginner was \$30,000.

Compared to 1981, average starting salaries in New York City were up between 8 and 44 percent, depending on firm size. The smallest average hikes in entry-level compensation, \$1,123, were given by the largest firms (more than 100 employees) and the largest average raises, \$6,469, came from firms with 41 to 100 employees.

For the managing partner/chief officer, the average reported salary was \$20,000 to \$156,000, with bonuses and profit sharing of zero to \$94,000. No firm with more than 100 employees divulged the compensation of its chief executive.

"The survey indicates a definite improvement in the compensation paid to most architects in New York, particularly those at the entry level," says Carmi Bee, AIA, survey chairman.

The same could be said of billings. In 1981, participating firms with six to ten employees reported billings of \$116,000 to \$935,000. In 1984, the range was \$230,000 to \$1 million. In 1981, the largest firms in New York billed \$6.9 million to \$17.5 million. In '84, it was \$15.4 million to \$17.5 million.

### BENEFITS

One of the more colorful images from baseball describes a struggling shortstop: "He isn't much of a hitter, but he can't field." To paraphrase that architecturally, "The salary isn't much, but the benefits are terrible."

The 1983 AIA Firm Survey found that median "extra compensation" (including bonuses, overtime, profit sharing and benefits) ranged from \$1,000, for the two lowest levels, to \$5,000, for principals. Averages were a little better, ranging from \$1,698 to \$13,913. At the 95th percentile, extra compensation ranged from \$4,600 for beginners to \$38,400 for principals, indicating that a few prosperous firms shared their success rather broadly.

Total compensation thus ranged from a median of \$13,000 and an average of \$15,047 at the entry level to a median of \$39,000 and an average of \$53,240 for principals.

As for the length of the workday, another important compensation measure, the

Chicago study indicated that 17 percent of member offices worked more than eight hours a day on a normal basis, and 36 percent did not compensate employees in any way for overtime (more than 40 hours a week). Another 10 percent got compensatory time off and 20 percent were compensated for overtime by year-end bonuses.

Vacation and time-off statistics looked no better. Thirty-four percent got ten days or less paid vacation; 20 percent, less than six paid holidays and 34 percent, less than seven paid sick days.

In other areas, only 53 percent of the Chicago chapter's member firms offered fully paid health insurance; 19 percent, dental insurance; 26 percent, life insurance; 11 percent, disability insurance; 40 percent, pension plan; 54 percent, profit sharing and 66 percent, AIA dues reimbursement.

The bitterest pill, though, may have been that 34 percent of employed architects moonlighted (90 percent of them for extra income) but, according to Sinkevitch, earned less at it per hour than they earned at their regular jobs.

In Kansas City, of the 58 percent of the firms responding, only 42 percent of their staffs earned overtime pay. Seventy-seven percent of the firms granted six paid holidays and 75 percent granted paid sick leave (average number of days granted was seven). Year-end bonuses were granted by 54 percent of the firms, 35 percent had profit sharing and 13 percent offered retirement benefits. Benefits fully paid by firms included AIA dues, 27 percent; medical insurance, 60 percent; dental insurance, 8 percent; life insurance, 50 percent and disability insurance, 15 percent.

New York's study, like the AIA's Firm Survey, put a price on fringe benefits. For example, the managing partner of a firm with six to ten employees received a median of \$11,078 in benefit value. For an entry-level employee in a firm with six to ten employees, it was \$1,338.

### PROFITABILITY

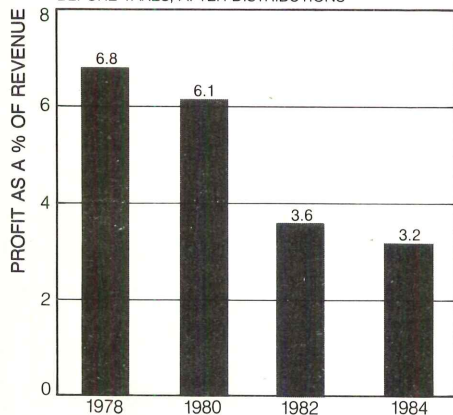
Progress in pay and billings reported by individual chapters is borne out by the Birnberg Financial Performance Survey, performed every two years since 1978 by Birnberg Associates, Chicago. The latest survey tabu-



CHART 9

**Net Profits on Net Revenues  
for Design Firms**

BEFORE TAXES, AFTER DISTRIBUTIONS

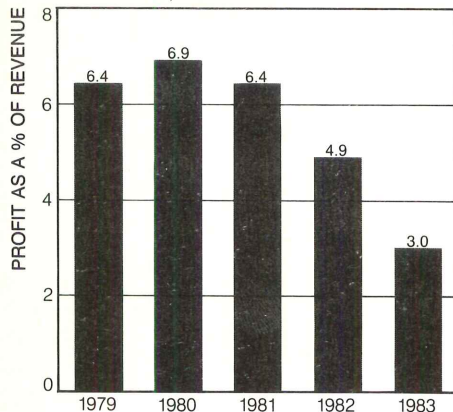


Source: Birnberg and Associates

CHART 10

**A/E Firm Profits as a  
Percent of Revenues**

BEFORE TAXES, AFTER DISTRIBUTIONS



Source: Robert Morris Associates

lates responses from 254 firms. Fifty-four percent of these were "primarily architects" (defined as those deriving 60 percent or more of their revenues from architectural practice), 12 percent were A/E's or A/E/Ps, 26 percent were engineers and 8 percent were "others" (including landscape architects and interior designers).

Net revenues per employee have shown increases in every survey Birnberg has performed—with revenues per staff member up from \$28,515 in 1978 to \$44,316 in 1984 and revenues per technical-staff member up from \$34,775 to \$56,173.

To some extent, though, these gains have cut into firm's profitability.

Birnberg measures profitability in three ways: net profits before taxes and after distributions (such as bonuses) on total revenues, net profits before taxes and after distributions on net revenues, and net profits before taxes *and* distributions on net revenues. All three have declined in every survey in which they were recorded.

The third—net profits on net revenues—is perhaps the most significant. It declined to 6.8 percent this year from 8.3 percent two years ago, the first time that Birnberg collected the data.

Chart 9 tracks net profits before taxes and after distributions on net revenues. It is the only one of the three measurements appearing in all four Birnberg surveys. Chart 10 shows A/E profitability as compiled by Robert Morris Inc., a commercial bank in Philadelphia.

The 1984 study showed that profits were highest in the Sunbelt, for firms working primarily with public sector clients, and for architects. Profitability increased as firm size increased, but the economics of scale did not begin to affect overhead rates until the firm size topped 200. The percent of time charged to projects continued its four-year decline to 61 percent.

Both the greatest profits and the greatest losses in the Birnberg survey were by firms defined as "primarily architectural." The top profit (net profits on net revenues) was 44 percent. Second best was 31 percent. The greatest loss was 50 percent. Losses were reported by nearly 25 percent of the respondent firms, Birnberg says.

The AIA 1983 Firm Survey showed that revenues for one-person firms decreased between 1978 and 1983. But revenues increased 25 percent for other small firms and increased 88 percent in large firms. Only firms with more than ten employees increased their average revenues for the last three years in a row.

Adjusting for inflation, however, dims the results. The average firm with fewer than ten employees failed to keep pace with inflation. Only larger firms can be said to have seen real growth in average revenues.

Nevertheless, Michael R. Hough, a specialist in marketing and management of architectural services from Newington, Conn., says architects lose money—that is, they do not recover their direct and indirect costs—on one in three projects.

"But that's not the whole story," Hough says. "Many firms are making 20 or 30 percent pretax profits. Some principals are taking home \$200,000 or \$300,000 a year. Those who practice in a businesslike way are making more money than ever."

Hough challenges architects to think about their attitudes toward clients. Some architects consider their clients an inconvenience, he suggests. Other architects may be more interested in delivering what they want rather than what the client wants.

"The first thing we have to do in an architectural firm is change attitudes toward management," he says. "It's often thought of as control, and architects don't like controls. But it's not just control. Good management is planning, organizing, directing and *then* control."

"Study what clients want—the hassles they want us to solve," Hough says. "Then specialize in solving those needs." According to Hough, it's a vicious circle: "Architects get low fees, so they pay low salaries, can't invest in the firm, can't provide new services, can't improve productivity and thus can't get higher fees, can't pay well and so on."

William F. Fanning, another consultant in professional services management and president of Design Management Consulting, Marietta, Ga., offers similar advice: "Income cannot be self-generated. It comes only from clients. The only way architects can improve what they take home is to convince the client to pay higher fees."

Since clients are interested only in service, Fanning contends, architects must show them, in *their* terms, how design is a beneficial service.

"There's too much inward-looking in this profession," Fanning says. "You design to please other architects rather than your clients. Most of your brochures would be better-appreciated by other architects. Most of the PR of the profession is targeted at the design community itself."



# A GROUND-BREAKING STUDY OF FEES



Median design fees range from 2 percent on motels and restaurants to 8 percent on warehouses, hospital renovations and education buildings, according to the 1984 Design Services Fee Structures Survey by Design Management Consulting Inc., Marietta, Ga. The survey was performed for the *Professional Services Management Journal*.

William F. Fanning, president of DMC, said fees were expressed as a percent of construction cost to provide a "neutral standard" for comparison. The percentages include complete services—including architecture, engineering and interior design—to the standard of a speculative office building. Construction management by a specialist outside the design team was not included.

## DIFFERENT BUILDING TYPES YIELD DIFFERENT FEES

Opportunities for high fees were greatest for transportation planning studies and state and local government offices. At the 75th percentile, they commanded fees of 15 percent and 10 percent.

Least lucrative were motels and restaurants, which ranged from 1 percent at the 25th percentile to 3 percent at the 75th percentile. Design of midrise offices was almost as poorly paid, with fees ranging from 2 to 3 percent at the 25th and 75th percentiles, respectively.

At the bottom, nursing homes and "strip" shopping centers tied with motels and restaurants, paying 1 percent at the 25th percentile. But they offered greater upward mobility, paying 5 percent at the 75th percentile.

Room for negotiation was particularly great in transportation studies and in state and local government offices, with ranges of 3 to 15 percent and 4 to 10 percent between the 25th and 75th percentiles. The tightest ranges between the 25th and 75th percentiles were highrise offices, with no spread at 6 percent, and single family homes, midrise offices and military offices, each with a 1-percent spread.

Chart 11 shows a variety of common project types, listed in order of median fees. The right hand column indicates how often design contracts are awarded after price competition for each project type.

The primary determinant of fee levels, according to the DMC's study, is the type of project. No significant differences could be found in the percent of construction cost according to size of firm, type of firm, region or source of work. However, regional differences do apply in construction costs, so a 5-percent fee in New York City represents more dollars than a 5-percent fee in a low-cost area.

Fees also were reported by discipline, based on the proportion of construction cost attributable to a profession. For example, median architectural fees were reported to be 7 percent of the cost of the architectural construction in education and local government offices. Structural engineering fees were 6 percent of the structural cost, mechanical fees were 6 percent of mechanical construction costs and so on.

Construction-management fees, not included in the reported complete-service fee, typically ran 2 percent, but at the 75th percentile, CMs were paid 8 percent of the cost of constructing military medical facilities and 7 percent of the cost of corporate offices.

## SURVEY BACKGROUND

Fanning's study is based on 474 responses to a questionnaire sent last summer to 2,350 architects, engineers and related specialists. All asked to be included in the survey or subscribe to the *A/E Marketing Journal*, Fanning said.

Copies of the report are available for \$90 from *Professional Services Management Journal (PSMJ)*, 126 Harvard St., Brookline, Mass., 02146. The survey is new this year. It will be repeated annually, according to Frank A. Stasiowski, editor of *PSMJ*.

Twenty-five percent of the respondents were architects, 11 percent A/Es, 15 percent A/E/Ps, 8 percent architects and interior designers, 28 percent engineers and 13 percent "others," including construction managers, planners, interior designers and researchers. All sections of the United States were covered rather uniformly, 2 percent of the firms were located overseas and 3 percent were Canadian.

Thirty-seven percent of the firms surveyed employed one to 20 people; 26 percent, 21 to 50 people; 18 percent, 51 to 100 people; 12 percent, 101 to 200 and 6 percent employed more than 200.

Half of the firms said they earned more than two-thirds of their fees from private clients; 20 percent earned more than two-thirds from government and the rest were more evenly balanced.

More firms—92—said they designed corporate offices than any other project type. The other leaders were education, 78; lowrise condominiums, 77; wastewater treatment plants, 71; hospital renovation, 68; water and sewer lines, 63; and lowrise offices, 62.



The project type that led in value of design work was wastewater treatment plants with \$189 million. Following in order were: water and sewer lines, \$104 million; corporate offices, \$103 million; water treatment plants, \$98 million; hazardous waste facilities, \$88 million; process plants, \$86 million; lowrise multifamily housing, \$79 million; education buildings, \$78 million and hospital renovation, \$77 million.

In all, 40 project types were compared, accounting for \$1.56 billion in construction. Ten of the project types did not involve significant architectural effort. A project was considered only if the type accounted for more than 5 percent of a firm's fee volume.

To make fee comparisons more meaningful, firms were asked to indicate whether they provided any of 14 specified services beyond the normal scope of work defined in the standard owner/architect contract, AIA document B141.

## MAJOR FINDINGS

One of the most interesting conclusions gleaned from the DMC survey was that although government agencies tend to pay higher fees than private clients, they also demand more services. Government agencies ranked particularly high in requiring multiple design-submittals, use of their own specifications, presentation of cost estimates by detailed line item, and written reports on design choices.

Another conclusion Fanning drew is that there does not appear to be any significant difference in the scope of services furnished on bid and negotiated projects.

The most commonly furnished pre-design services were project cost/budget programming (for nursing homes, warehouses and government offices) and surveys of existing facilities (for warehouses, light industrial, process plants and restaurants). Designers provided both services on 77 percent of all warehouses, for example.

At the preliminary/concept design stage, the most common services were shepherding the agency approval process and multiple design-submittals. For example, designers made multiple submissions on 88 percent of

CHART 11  
Fees by Project Type

|                          | 25% | Mean | 75% | % Bid |
|--------------------------|-----|------|-----|-------|
| Warehouses               | 4%  | 8%   | 9%  | 34%   |
| Hospital renovation      | 7%  | 8%   | 9%  | 20%   |
| Education buildings      | 5%  | 8%   | 7%  | 13%   |
| State/local gvt. offices | 4%  | 7%   | 10% | 46%   |
| Light industrial         | 5%  | 7%   | 8%  | 32%   |
| Correction facilities    | 3%  | 7%   | 7%  | 14%   |
| Transportation studies   | 3%  | 6%   | 15% | 26%   |
| Military offices         | 5%  | 6%   | 7%  | 4%    |
| Corporate offices        | 5%  | 6%   | 7%  | 18%   |
| Military medical         | 3%  | 6%   | 7%  | 23%   |
| Highrise offices         | 6%  | 6%   | 6%  | 9%    |
| New hospitals            | 5%  | 6%   | 6%  | 15%   |
| Lowrise multifamily      | 4%  | 6%   | 6%  | 17%   |
| High rise multifamily    | 4%  | 6%   | 6%  | 24%   |
| Hotels                   | 2%  | 5%   | 8%  | 32%   |
| Lowrise offices          | 3%  | 5%   | 6%  | 42%   |
| Research facilities      | 3%  | 5%   | 6%  | 23%   |
| Postal facilities        | 3%  | 5%   | 6%  | 9%    |
| Single family housing    | 4%  | 5%   | 5%  | 17%   |
| Military housing         | 2%  | 5%   | 5%  | 4%    |
| Retail stores            | 2%  | 4%   | 6%  | 5%    |
| Outpatient clinics       | 2%  | 4%   | 6%  | 5%    |
| Federal offices          | 3%  | 4%   | 5%  | 32%   |
| Medical offices          | 3%  | 4%   | 5%  | 15%   |
| Enclosed shopping malls  | 3%  | 4%   | 5%  | 24%   |
| Nursing homes            | 1%  | 4%   | 5%  | 24%   |
| Strip shopping centers   | 1%  | 3%   | 5%  | 26%   |
| Midrise offices          | 2%  | 3%   | 3%  | 33%   |
| Motels                   | 1%  | 2%   | 3%  | 0%    |
| Restaurants              | 1%  | 2%   | 3%  | 15%   |

Source: Design Management Consulting, Inc.

military housing projects, 84 percent of military offices and 83 percent of military medical facilities. Agency approvals were obtained by designers on 87 percent of all outpatient clinics, 86 percent of shopping malls and 84 percent of motels.

The most popular construction document services sought from designers were obtaining permits (by private clients), and use of

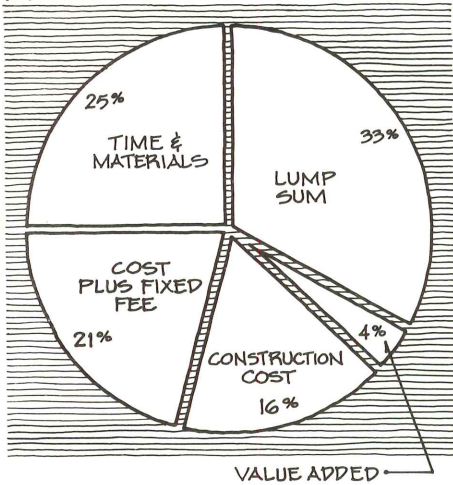
owner specifications and line-item cost estimates (by government clients). Shopping mall designers obtained the permits in 93 percent of the projects. Government agencies required use of their own specifications on 80 to 90 percent of the projects.

Project types most likely to require full-time site representation from the designers were process plants (50 percent), medical



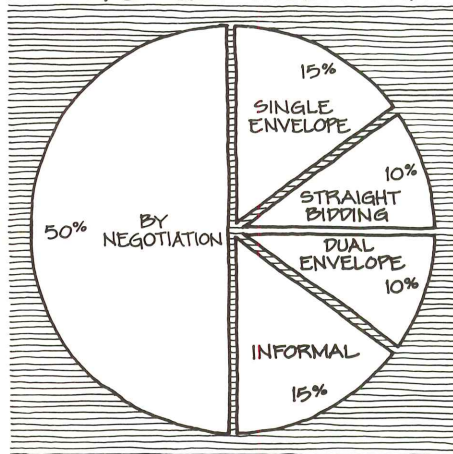
Fees and billing rates vary widely

CHART 12  
METHOD OF PAYMENT



Source: Design Management Consulting, Inc.

CHART 13  
HOW A/E'S GET THEIR WORK



Source: Design Management Consulting, Inc.

offices (44 percent), and federal offices and postal facilities (40 percent each). Most private clients gave designers relative freedom in specification. For example, use of client specifications was required on only 6 percent of restaurants and 7 percent of motels.

METHODS OF PAYMENT

The most common methods of payment are shown in Chart 12. "Value added" is defined as relating to overall project results, shared savings if cost targets were achieved or equity participation.

The smaller the firm the more likely it was to accept payment as a percentage of construction cost. Only 7 percent of the work performed by the largest firms was on this basis.

Lump-sum payment was most popular among the largest firms, the architectural/interior design firms and firms in the Southwest and South. Time-and-materials was used twice as often in the Mountain States and West, as in the South.

Project types on which lump-sum payment was made to designers, 90 percent or more of the time, include military medical facilities, midrise offices, shopping centers, motels, military housing, federal offices and postal buildings.

Percentage of construction cost was used most often with medical offices, state and local government offices and lowrise multi-family housing. Time and materials was most popular with restaurants, process plants and planning studies. Cost-plus contracts were favored primarily on engineering-intensive projects such as roads, bridges and wastewater plants.

Despite strong statements by professional leaders against fee bidding, 75 percent of respondents said they had participated in some form of price competition and that they were obtaining half their work on this basis. A third of the respondents said they had submitted proposals where price was the sole criterion and had obtained 10 percent of their work from straight bidding.

Participation in price competition increases with firm size. Only 64 percent of the smallest firms, but 89 percent of the

largest firms, have engaged in price competition.

Engineers are more likely to compete on the basis of price than architects, in part because 40 percent of subconsultants' bid requests are generated by the prime designer, not the owner.

Price competition is most prevalent in the Northeast (83 percent) and the Midwest, and least prevalent in the South (59 percent) and West.

Fanning recognizes four forms of price competition:

- **Straight bidding.** Selection is based on price alone, with no submission of technical qualifications. The practice is more common with engineers (36 percent) and A/E firms (49 percent) than with pure architectural firms (18 percent) or architectural/interior design firms (8 percent). Firms in the Northeast are most likely to participate (47 percent) and firms in the South are least likely (20 percent). It is slightly more common among government clients (34 percent) than among private clients (30 percent).
  - **Single envelope.** Price and qualifications are submitted together, with both factors considered simultaneously. Midwestern clients (54 percent) are the most likely to use this method. Government agencies use it much more frequently than private clients (47 percent vs. 34 percent).
  - **Dual envelope.** Firms are ranked on the basis of their qualifications and then price is discussed, beginning with the best-qualified firm. Again, the incidence is highest among engineers and in the Northeast. Government agencies are much more likely to use this technique than private firms (48 percent vs. 28 percent).
  - **Informal competition.** Price discussions precede the selection process and only those firms with the lowest fees are considered. An alternative is to submit a project to several firms and choose among them on the basis of price. Clients in the private sector favor this method (39 vs. 33 percent).
- Chart 13 shows the percentage of jobs that respondents said they actually derived from each method of competition. (These



...es are lower than those cited above because the occurrence of price competition usually requires the participation of more than one firm.)

Negotiations conducted under the Brooks Act are not considered price competition, Fanning says. The Brooks Act (Pub. L. 92-582) requires a qualifications-based system of selecting A/E services by the federal government through the public announcement of all federal contract specifications followed by efforts to establish "a fair and reasonable price" with the most qualified respondent (see sidebar).

Curiously, although the largest firms are most likely to participate in straight bidding, they obtain the smallest proportion of their work through this method. For example, 63 percent of firms with more than 200 employees say they do straight bidding, but they derive only 5 percent of their work through this medium.

After Fanning reviewed the data, he felt it was apparent that price competition is common in both government and private sectors. Further, he noted that price competition does not necessarily lower overall fee levels. Private office buildings and new roads are as subject to fee competition as any, yet they command relatively high fees.

## The Brooks Act

Under the Brooks Act's qualifications-based procurement procedure, A/E firms interested in obtaining a particular contract are ranked in order of qualifications, after which price negotiations are commenced. Should negotiations fail between the federal agency and the highest-ranked firm, negotiations are terminated with that firm. The same negotiation procedure then takes place with the second-most-qualified firm and so on down the line in order of firm ranking until an agreement is reached.

This procedure gives the federal government the opportunity to acquire the services of the most qualified A/E firm and, at the same time, guarantees a price that is both "fair and reasonable" to the taxpayers.

While the Brooks Act is still the law of the land (and has been emulated by many state and local regulations), it is not without its detractors and challengers. There have been, and probably will be again, attempts in Congress to repeal or modify the Brooks Act procedures.

The AIA endorses and continues to support the approach of the Brooks Act.

A study just released by the AIA explored alternative selection procedures used at the state level. It compared the experiences of the state of Florida (where a selection procedure emulating the Brooks Act is in effect) and Maryland (where a different system, hailed as more cost-effective, has been used since 1974). The study showed that the total cost of the A/E portion of capital construction in Maryland was, in fact, double that in Florida (13 percent as opposed to 6.8 percent). The study further showed that while Maryland's procedures were intended to consider both technical competence *and* price, in 83 percent of the last 40 projects surveyed, price was the dominant factor.

Information about the study or copies of the report may be obtained from Nancy Somerville, AIA government affairs, (202) 626-7386. —M.R.

CHART 14

### Median billing rates for design firms

|                             |      |
|-----------------------------|------|
| Principal .....             | \$75 |
| Associate .....             | 60   |
| Project manager .....       | 55   |
| Project engineer .....      | 50   |
| Project architect .....     | 45   |
| Specifications writer ..... | 44   |
| Architect .....             | 40   |
| Engineer .....              | 40   |
| Cost estimator .....        | 40   |
| Designer .....              | 38   |
| Job-site inspector .....    | 36   |
| Senior drafter .....        | 35   |
| Drafter .....               | 26   |
| Clerical .....              | 22   |

Source: Design Management Consulting, Inc.

### BILLING RATES

Median billing rates ranged from \$75 an hour for principals to \$22 an hour for clerical help—a ratio of 3.4 to 1. Chart 14 illustrates current billing rates, including labor, overhead and profit.

Significant regional differences in billing rates were reported. They were generally highest in the West and lowest in the Midwest, Mountain States and South. The highest rates were charged by architects/engineers/planners and by architects/interior designers.

The median increased with firm size. Principals in the smallest firms charged a median of \$63 an hour, compared to \$85 an hour in the largest firms. The average for large firms was \$92 an hour, indicating that a few principals were charging a much higher rate.

Fanning says 10 percent of the firms billed principals at \$125 an hour or more. Principals in some medium-size firms billed as high as \$200 an hour.

Firms primarily serving private clients billed \$5 an hour more than firms primarily serving government agencies.

The markup for outside consultants typically was 10 percent. Many went up to 20 percent and a few as high as 30 percent, Fanning says. No significant regional variations can be found except in the Mountain States, where the median markup dropped to 5 percent.



Computer pricing is particularly chaotic

REIMBURSABLES

Reimbursable expenses usually are marked up 5 percent, but little standardization appears evident. Chart 15 shows the percentage of firms that reported adding several common reimbursables to their fees.

CHART 15  
Reimbursables  
(Percent of firms that add each to fees.)

|                    |     |
|--------------------|-----|
| Travel out of town | 93% |
| Printing           | 90% |
| Testing            | 86% |
| Copies             | 65% |
| Telephone          | 56% |
| Postage/Shipping   | 55% |
| Computer costs     | 44% |
| Travel in town     | 35% |

Source: Design Management Consulting, Inc.

Again, architectural/interior design firms are the most likely to charge their clients for these costs, except for computers, where engineers take the lead. Oddly, the frequency of billing for reimbursables increases with firm size until the largest size category is reached, where the percentages drop in all expense categories.

"Users should be aware that this area is of particular importance in fee competitions," Fanning says. "Not all firms use the same factors and thus fee comparisons that do not include reimbursables might not be valid."

Computer pricing is particularly chaotic. No technique predominates.

About half the firms consider the hardware and software costs; 40 percent consider maintenance and insurance; 37 percent count supplies; 36 percent include operator labor. Fewer than a third of the respondents consider financing, staff training and space costs when calculating computer costs.

The most common billing method for computers was cost plus a markup (Chart 16). Note that a third of the firms that said they have computers did not respond to the question about billing methods.

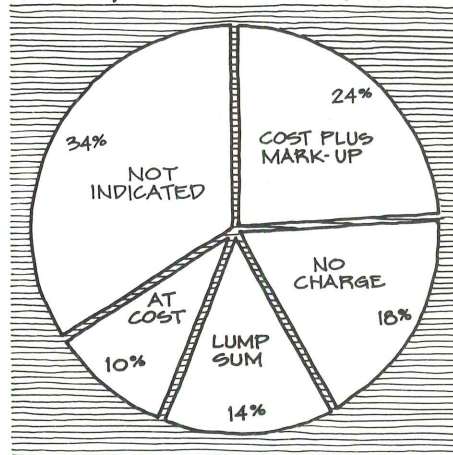
Fanning notes that firms doing government work were more likely to charge for computer time at cost or not at all, indicating that they are less able to recover a fair return on the investment.

Some 46 percent of the firms in the survey treated computer costs as both direct and indirect expenses, 32 percent considered them overhead and 22 percent treated them as direct costs.

The median billing rate for computer-aided design (CAD) equipment was \$45 an hour, not including the operator. The extremes were \$6 and \$225 an hour. For other computer equipment, the median was \$35 an hour.

CAD rates were highest in the Northeast and in private firms (both \$50/hour). Firms with 21 to 50 employees (\$48/hour), A/E's and A/Is (both \$47/hour) also did well. Firms in the West had the lowest rates, at \$25/hour.

CHART 16  
HOW A/E'S BILL COMPUTERS



Source: Design Management Consulting, Inc.

For other computer services, firms in the Northeast charged \$45 an hour but firms in the Midwest settled for \$15 an hour.

FINAL WARNINGS

Fees, profits and benefits were lowest among Midwestern firms, Fanning says. Fewer firms, by about 10 percent, marked up their subcontractors and reimbursables. Not one Midwestern firm in the survey used a markup of more than 10 percent, and fewer firms marked up reimbursables at all. Further, the highest percentage of computers in overhead were found in the Midwest.

"By not charging for those extras, you're effectively giving them away because you have to match outside firms on basic services," Fanning says. "They're going to get that markup and those computer costs in addition to their basic fee and you're not."

Firms that derive two-thirds or more of their revenues from the government have special problems. The survey indicates that 52 percent have been audited and most have been subject to arbitrary or capricious exercises of authority. Fanning refers to some agencies that appear to favor "negotiation by ambush."

Allowable overhead rates in the government range from 75 to 175 percent, with the postal service appearing both at the bottom and near the top (fees vary wildly). Fanning says 64 percent of the firms reported having limitations placed on their fees other than those specified in The Brooks Act.

One table in Fanning's study lists federal, state and local agencies that have imposed arbitrary billing rate reductions. Connecticut topped the list by cutting billing rates by 58 percent. Nine firms reported cuts by the Navy of 7 to 35 percent.

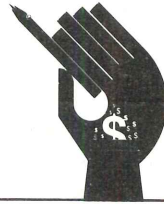
Allowable profit ranged from nothing to 20 percent, with 9 to 11 percent described as typical.

Almost half of all firms are now submitting prices based on anticipated labor rates during the course of design work, but only 25 percent say they are basing overhead on anticipated costs. The number of firms doing this increases as firm size increases.

The frequency of audits also increases according to firm size. Regions that appear most subject to audit are the Midwest and West. —O.W.



# TWO OWNERS LOOK AT FEES



Clients are becoming more sophisticated, more concentrated and more powerful. The contrast to the fragmentation of the architectural profession is sharp.

Fewer clients are building more, according to Marc E. Rubin, a consultant with Arthur D. Little, Inc., Cambridge, Mass.

These clients are gaining power from their experience, volume of services purchased, ready availability of alternative design sources, low perceived costs of switching design firms and detailed knowledge of the industry's demand, costs and prices, Rubin says.

"Today's client evaluates architects on their quality, cost and ability to control schedules. This motivates clients to use their sophistication and power to force prices down, bargain for higher quality and more services, and play one design firm against another," Rubin observes.

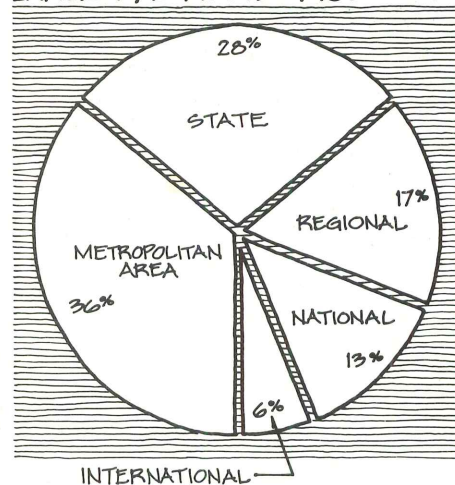
Thomas J. Eyerman, AIA, president of the Chicago chapter, points out that only 22 major developers are active in Chicago today, and they are becoming progressively more assertive in fee negotiations.

Blame for fee bidding is hard to pinpoint with them, he said. "They keep on saying, 'Who's the temptor and who's the temptee?' If an architect's willing to do it, they don't look a gift horse in the mouth."

Charts 17 and 18 show that most architects consider local business (within the state or metropolitan area) their most important client category. Chart 17, from the Little firm, shows the location of design clients; Chart 18, from the 1983 AIA Firm Survey, shows the composition of clients by type.

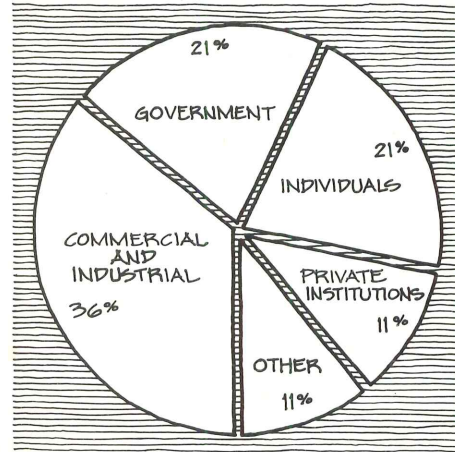
Following is an edited transcript of remarks delivered by executives of two of Chicago's largest development companies at the Chicago chapter's October conference on the compensation crisis. The speakers were

CHART 17  
WHERE THE CLIENTS ARE ;  
LARGE A/E FIRMS - 1982



Source: Arthur D. Little, Inc.

CHART 18  
WHO THE CLIENTS ARE ;  
AIA MEMBER OWNED FIRMS - 1983



Source: AIA Firm Survey

Robert J. Navratil, senior vice president of Equity Associates, and George A. Darrell, executive vice president of Urban Investment and Development Corp. Equity Associates is the development arm of LaSalle Partners. Following Navratil's text is a transcript of questions asked by architects in the audience along with the speaker's responses. —O.W.

## ROBERT J. NAVRATIL, EQUITY ASSOCIATES:

"On lowrise buildings, the average fee we expect to pay is 3.6 percent or \$2.75 per rentable square foot. The range is 1.9 to 4.5 percent.

"On midrise structures, the average is 3.8 percent or \$2.65 per rentable square foot without structure parking and \$1.70 per rentable square foot with structure parking.

"On highrise buildings, the average is 3.8 percent or \$3.25 per rentable square foot. Parking ratios differ. Other highrise developers show the same range.

"The charts (19, 20 and 21) show recent projects and their fees. They account for about three million square feet of space and about \$400 million of construction.

"There are two ways to look at fees. Historically, they've been calculated as a percentage of construction cost. But today, with atriums and energy systems, you can't focus on just that. One thing you see is that we're getting into structure parking. The percentage is different for parking.

"Renovation projects run in the 4 to 7 percent range, with reimbursables one-quarter to three-quarters of 1 percent. The fee quotes we get often exclude reimbursables. We need to know what they will be and be assured of some reasonable cap. Generally, they include blueprints and a model.



## Owners ask architects to strive for balance

"We're most interested in superior design. To get high quality, we spend 5 percent more than normal on speculative office buildings. Then we find we can command a 10-percent premium in rents.

"We want the architect to challenge us. We look for architects who have the conviction that their design is right—convictions that go beyond ego. You must sell your design to us.

"We don't look for architects to provide cost estimates. We gave up on that a long time ago.

"I have quite an extensive cost model. Developers go out and look at rents and the interest rate, and drive them backward over the lease-up and construction period. Whatever is left pays for the building. We don't look at it from the ground up; we don't have the time.

"We want our consultants to provide a coordinated effort. The contractor provides cost estimates, the architect, ideas.

"Please listen to the owner. The architect no longer can provide the drawings at the 11th hour. We want them earlier.

"I don't want to emphasize design at the expense of practical issues. When we interview architects, we look for the project manager to be a key resource, with an appreciation for design balanced with realism and field experience. We need someone who can make decisions and design on his feet.

"This is especially true in renovation. We just completed a renovation in Dallas that was successful only because the project manager spent as much time as necessary at the site, talked to the superintendent and made decisions. We put enough money in the budget to permit that.

"We also need help in start-up. Too often there's a big flurry in design and then the designers go off to do new projects and we're left there for the implementation. It might be as simple as starting the brick mason so the coursing is correct. That's the kind of thing we look for.

"We also need someone who understands mechanical and electrical design. We ask operating people to review the plans. This is the age of the 'smart building.' We must overdesign in anticipation of change."

CHART 19  
Lowrise (1 to 5 stories)

All fees and costs adjusted to 1984 dollars.

| Size<br>(Sq. Ft.)<br>(in thousands) | Total Construction<br>Cost<br>(in thousands) | Total<br>Fee<br>(in thousands) | Fee as<br>Percent | Fee as<br>Dollars/RSF |
|-------------------------------------|--|--------------------------------|-------------------|-----------------------|
| 145                                 | \$ 10,600                                    | \$ 381                         | 3.6               | \$ 2.64               |
| 47                                  | 2,600  | 106                            | 4.1               | 2.27                  |
| 37                                  | 7,800  | 147                            | 1.9               | 3.94                  |
| 161                                 | 10,400                                       | 467                            | 4.5               | 2.90                  |
| 63                                  | 4,700  | 178                            | 3.8               | 2.84                  |
| 74                                  | 5,800  | 230                            | 4.0               | 3.11                  |
| 139                                 | 8,100  | 345                            | 4.2               | 2.48                  |

Average Fee We Expect to Pay: 3.6% or \$2.75/RSF

Source: Equity Associates

CHART 20  
Midrise (6 to 15 stories)

All fees and costs adjusted to 1984 dollars.

| Size<br>(Sq. Ft.)<br>(in thousands) | Total Construction<br>Cost<br>(in thousands) | Total<br>Fee<br>(in thousands) | Fee as<br>Percent | Fee as<br>Dollars/RSF |
|-------------------------------------|--|--------------------------------|-------------------|-----------------------|
| 270                                 | \$ 18,700                                    | \$ 851                         | 4.6               | \$ 3.16               |
| 291                                 | 25,000                                       | 840                            | 3.4               | 2.89                  |
| 184                                 | 10,500                                       | 403                            | 3.8               | 2.19                  |
| 184                                 | 11,200                                       | 419                            | 3.7               | 2.28                  |
| 189                                 | 12,600                                       | 440                            | 3.5               | 2.33                  |
| 185 <sup>1</sup>                    | 14,600 <sup>2</sup>                          | 578                            | 4.0               | 3.12 <sup>3</sup>     |
| 433 <sup>4</sup>                    | 36,000 <sup>2</sup>                          | 1,500                          | 4.2               | 3.50 <sup>5</sup>     |

Average Fee We Expect to Pay: 3.8% or \$2.65/RSF

Source: Equity Associates

1. plus garage at 167  
2. includes garage  
3. \$1.64 with garage

4. plus garage at 430  
5. \$1.74 with garage

CHART 21  
Highrise (15 stories +)

All fees and costs adjusted to 1984 dollars.

| Size<br>(Sq. Ft.)<br>(in thousands) | Total Construction<br>Cost<br>(in thousands) | Total<br>Fee<br>(in thousands) | Fee as<br>Percent | Fee as<br>Dollars/RSF |
|-------------------------------------|--|--------------------------------|-------------------|-----------------------|
| 260                                 | \$ 17,800 <sup>2</sup>                       | \$ 585                         | 3.3               | \$ 2.25               |
| 667 <sup>1</sup>                    | 57,900 <sup>2</sup>                          | 2,800                          | 4.7               | 4.14 <sup>3</sup>     |
| 380 <sup>4</sup>                    | 38,500 <sup>2</sup>                          | 1,300                          | 3.4               | 3.30 <sup>5</sup>     |

Average Fee We Expect to Pay: 3.8% or \$3.25/RSF

Source: Equity Associates

1. plus garage at 241  
2. includes garage  
3. \$3.05 with garage

4. plus garage at 293  
5. \$1.89 with garage



*Q: What is your average construction cost?*

A: About \$55 a square foot plus \$6 for site work.

*Q: How do you pay your architect?*

A: Lump sum. We never sign a percentage contract.

*Q: Do you hire separate space planners?*

A: On speculative buildings, we start our program and then hire a space planner to represent the building. On corporate headquarters, we hire the space planner first to supply us with programming information so we can quantify size.

*Q: Are your percentages based on hard costs?*

A: They're on the base building and site work—parking lot, curbs, roads up to the building, lobby, core elements and drywall around the perimeter. Interiors and landscaping are excluded.

*Q: What changes do you make to the standard AIA contract?*

A: They're primarily to give more control to the owner. Orders to the field may be issued either by the architect or owner. Other changes relate to ownership of documents and field inspections.

*Q: What are your interior fees?*

A: Through preliminary space plans and working drawings, 45 cents per rentable square foot on a speculative building. For full service to a reasonably decisive client, \$2 per rentable square foot. Architectural and mechanical/electrical fees and extras are not included.

*Q: What is your ratio of net rentable to gross square footage on midrise buildings?*

A: We shoot for 92 to 94 percent to the centerline of glass and walls. It's basically everything you can stand on. In New York, that includes central lobbies.

### GEORGE A. DARRELL, URBAN INVESTMENT AND DEVELOPMENT CORP.:

"We're looking for good design—aesthetically accomplished and technically competent.

"Our approach to the selection of an architect is to seek a service appropriate to our needs at the appropriate price—a service performed by individuals whose talent, skills and experience match ours.

"A higher fee does not guarantee a higher profit. In our experience, some of the most competitive fees result in some of the highest profits.

"This is a very competitive business and some of you would like to believe that it will become less competitive. Our experience is that it is becoming more competitive. Each element of the budget undergoes more and more scrutiny because every one of our clients is becoming increasingly competitive. This must be passed along to all firms involved in the process.

"Some architects simply are wasteful of the fees they receive. Too much time is spent by too many people refining a design that does not accommodate the client's program, needs or budget. Architects must improve their ability to assess the needs and interests of their client. Many times the client is looking to the architect for leadership because he doesn't have the skills.

"The single greatest failure of most architects is their lack of skill in organizing, managing and running the process. Architects, their colleagues, the client and the contractor spend too much time dealing with deficiencies that come out of the documents. They are being produced in a framework that is bound to produce errors.

"We've heard some discussion about fast-tracking. In my estimation, it has gone too far. A lot of the responsibility for that is yours. Fortunately, economics is beginning to reverse the trend.

"We make our choice of architect immediately at the conclusion of the interviews. Then we select engineers using much the same process, except that we receive copies of all contracts between the architect and the other consultants to reassure us that they are compatible.

"All fees are based on consultants providing a minimum number of days at the project site. For example, on a 500,000-square-foot building we would require the architect to provide a minimum of 200 man-days in the field, plus 100 from the engineer and 150 for mechanical/electrical.

"We view the architect's services as beginning with problem definition and going on to continuous interaction at the site.

"In the 20 years I've practiced architecture, I've repeatedly found one glaring defi-

ciency: defining the problem. It astounds me how many times the finest firms in the country present some sort of design at the very first meeting.

"The first meeting should involve probing us on project requirements. I do not understand how architects can expect to have their project organized yet still go back to the schematic time and again because someone didn't understand the problem.

"It may surprise you that our opinions of architects are often established the day we make the first phone call. You'd be amazed how many people don't call us back, don't send material we ask for or don't send the proposal a day ahead as requested so we can put it into perspective.

"All that contributes to a bad first impression. Invariably, one of us in the room declares that he was thoroughly provoked and there is no way he is going to select that firm. It's a stupid reason to lose a job.

"If architects want to negotiate a good fee, they ought to come in before the interview and get acquainted with the project and the people. Several times, someone got under our skin long before the interview and had already sold us on what the fee should be before he came in with his proposal.

"Our selection process used to be to engage engineers separately, contract with each of them, and ask the architect to manage them. It was a shotgun wedding. Now, all become subcontractors to the architect, who agrees to coordinate all information into a set of documents. One of our greatest problems was to bring all systems into a coordinated set of documents and to eliminate omissions and confusion.

"Here's our score sheet for selecting an architect:

1. Involvement of the principal.
2. Design quality of the firm.
3. References from at least two clients, unless we know the firm. Former clients give us the most reliable information.
4. Quotations on a square-foot basis.

"We engage an independent cost consultant. If the final cost is more than 6 percent over budget, the architect must agree to revise the documents to bring the project within budget. We develop costs together."



## THE ARCHITECT'S PERSPECTIVE

Architects are singularly ill-equipped to deal effectively with the issue of fees. A soliloquy on the subject might go something like this:

"Unlike doctors, we do not have clients with insurance that will pay our fees. Unlike lawyers, we are rarely asked by our clients to protect them from our colleagues. Unlike some jobs, our work is not so routine or acquisitive that it attracts mostly those motivated by money. Unlike most other professions, we think nothing of criticizing each other's work in often biting tones.

"Neither training nor inclination equips us to be financiers, bookkeepers or negotiators. We're told to know our costs and to sell our value, but the value of what we propose to do depends on ideas not yet born and even if I know my costs I have ten competitors who don't and who thus will undercut me.

"We haven't quite settled whether architecture is an art, a science or a business—or all three. We sometimes neglect to send clear signals to clients that we are a profession, not a trade, and that we perform a service, not produce a product.

"We are exhorted to be better designers, managers, planners, observers, inspectors, arbitrators, administrators, technicians, supervisors, leaders—the page isn't long enough. Are we doing too much or not enough?"

Here's what some architects are saying out loud about fees. —O.W.

### JOHN F. HARTRAY, FAIA, CHICAGO:

"No method of setting fees adequately takes into account what architects do, how they do it, how long it takes or what it's worth. I chug along at \$5.50 or \$6 an hour and about every six months or so I have a million dollar idea. Good ideas come while I'm walking home, waking up in a cold sweat or in the shower. Seldom is there a time sheet in hand. . . .

". . . The best thing that ever happened to this profession was taking away our fee structure. All kinds of people were going broke at 6 percent. It isn't hard to get a handle on this, but we're victims of bad habits."



### LOUIS L. MARINES, EXECUTIVE VICE PRESIDENT, AIA:

"Good design and good business are not mutually exclusive. In fact, they are mutually reinforcing. Research into the careers of AIA gold medalists shows that good design was indeed a common characteristic, but only two of the winners were not also good businessmen. . . .

". . . Money isn't the only measure of success. Part of the rewards of architecture come from making a design not 95 percent perfect but 98 percent. . . .

". . . A lot of architects have six-figure incomes. The 75th percentile provides a very reasonable income. But we have not been very successful in transferring their knowledge and skills to those in the lower income percentiles."

### ROBERT PACKARD, AIA, ADMINISTRATOR, AIA EDITORIAL DEPARTMENT:

"People are always calling up and saying, 'My architect is charging too much. What is the right fee?' There is no 'right' fee, of course, except an adequate return on the value of the architect's services. In some cases, the architect makes millionaires of other people. The architect should share in the reward. . . .

". . . When architects work on a time basis with an open contract, they make out well. If a building gets complex, it's the hours that control the expense."

### THEODORE P. PAPPAS, FAIA, CHAIRMAN, AIA TASK FORCE ON COMPENSATION:

"Fees and compensation have to do with expectations. People with high expectations tend to succeed. Architects' self-esteem and attitude toward their abilities have a lot to do with how far they go. . . .

". . . If one paper clip is comparable to another paper clip, the buyer can shop for price. The only way to beat that game is to make the client feel he's getting a quality from his architect that no one else can give him. . . .

". . . If we ever ignore the artistic aptitude that brought us to the profession initially, we will become like everyone else and will have lost our margin of uniqueness in aesthetics, judgment, taste, visual response, emotions and all the right-brain things involved in people's preferences."

### JAMES KITTLEMAN, AIA, EXECUTIVE RECRUITER:

"Salaries cannot be lifted by elevating a compensation schedule without increases in productivity and unless fees are great enough to support it. . . .

". . . What progress has the individual made, in terms of increasing his value, either in management or business development? By age 30, an architect should know where he is headed, not just in terms of salary alone but in terms of job tasks and responsibilities. Salary will follow. What have you learned about yourself? Are you a potential business getter? Designer? Manager? Not every architect should primarily be a designer. . . .

". . . Decisions should be made by architects while they are still in their twenties regarding their ability and desire to be an individual practitioner, to succeed in a large firm or to work for a large company. Too often the awakening appears when salary limitations are seen at age 35 or 40. By then, it's usually too late. If you're not on the partnership track by 30 or 35, you'd better evaluate your circumstances and study your options because the salary curve begins to flatten."

### DONALD J. HACKL, FAIA, VICE PRESIDENT, AIA:

"Given the same fee for a similar project, one firm will make a greater profit than another because of differences in their product. For example, most firms fuss too much with their working drawings. Frequently, our job captains or project architects are not thinking about how they can put less into the funny papers and finish the job because there's



enough information there already. It's one more detail here and there, and soon we have 30 pages of details. . . .

" . . . The worst thing we can do is to wring our hands about how poor we are. The fact is that we are worth our salt. The trouble is that architects can care too much. They acquire a sense of ownership about the building they're working on. The building becomes an enormous baby to them. Then they become too willing to make enormous concessions and compromises from a financial standpoint."

**CHESTER A. WIDOM, AIA, LOS ANGELES:**

"Architects have not been responsible to their clients. They have set a mold that is difficult to break. . . .

" . . . From another perspective, it's amazing to listen to architects poor-mouth themselves. It's almost a mind-set that we're going to be poor. . . .

" . . . If we can't get a fee that covers costs and provides a profit, we'd better have a damned good reason to take the project. There are reasons other than money to take a project, but we shouldn't confuse ourselves about maybe being able to do it for less. . . .

" . . . I can make decisions not to do certain projects or not to let certain projects get out of hand. The decision to be profitable must be made by management and supported by everyone in the firm."

**THOMAS J. EYERMAN, FAIA, PRESIDENT, CHICAGO CHAPTER:**

"The original intent of the 'Chicago Statement' had been to get several major firms in the Chicago area to join in a statement of principles. We felt, collectively, that architects' compensation did not reflect their professional responsibilities or educational preparation. We also felt that while clients expect, and generally receive, quality service, they pay fees that are often insufficient but are perceived as the market rate. . . .

" . . . The ideas we developed were my own and those of my colleagues. They do not represent the public policy of our chapter or our endangered profession. . . .

## The "Chicago Statement," antitrust laws and the compensation problem

In September, 1984, the members of the Board of Directors of the Chicago chapter issued a statement that suggested, among other things, that "architects shall not provide services without compensation" and that "an architect shall not participate in any request for a proposal where fee is the sole basis for selection." Although composed by the board, the statement reflected the individual opinions of those practitioners.

Legally, these statements cannot become the policy of either the Chicago chapter or the American Institute of Architects. To encapsulate a rather complex matter in a single phrase, it is illegal under federal and state law for professional associations to attempt to regulate, by *rule or persuasion*, the competitive conduct of its members.

The AIA, and consequently the architecture profession, labors under a particular burden in this respect. In 1972 the Institute entered into an agreement with the Justice Department. This, in turn, became an order of the U.S. District Court for the District of Columbia. This order, commonly referred to as "The Consent Decree," forbids the Institute (called therein the defendant) and the Institute's "state organizations and chapters" from "adopting or disseminating, in any of its publications or otherwise, any Standard of Ethical Practice, rule, bylaw, resolution, or policy statement which prohibits or limits the submission of price quotations by members of the defendant or which states or implies that the submission of price quotations . . . is unethical, unprofessional, or contrary to any policy of the defendant."

—James V. Siena  
General Counsel, AIA

ARCHITECTURAL TECHNOLOGY plans to publish, in a future issue, a discussion of the antitrust laws and the question of compensation. Should readers have inquiries on this topic, they may call Mr. Siena. His direct line is (202) 626-7388.

" . . . The first draft would have opposed any form of fee bidding, but this was modified to counsel against participation in proposals where fee is the sole basis of selection. Several architects originally wanted fee guidelines. Ultimately, these were rejected, not just because they are legally improper, but because of the difficulty in quantifying the range of services being provided today.

" . . . The older members wanted a fee schedule, but the younger architects questioned how we would go about doing it. The days of figuring fees as a percentage of construction cost are gone. It raises the fundamental question of whether we are part of the construction industry or the service industry. . . .

" . . . A new kind of fee basis will have to be generated. Some sort of guidelines—to give people a range—might be possible next year. . . .

" . . . One way to change this profession is for the people running it to be under so much pressure from the staff that maybe 'push-pull' will happen. That's why we proposed a \$22,000 entry-level salary. But it's a backward way to push up fees. . . .

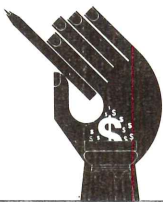
" . . . At the same time, the marginal producers have to get out. They pay their architects low wages with no benefits and that's how they make it. The consequence is that pay, and ultimately fees, are set by the losers of the profession, not the winners."



## A BUBBLING STEW OF IDEAS

So architectural fees are too low. What ought to be done about it?

Here is a summary of proposals we've heard for what the profession, schools, firms and individuals should do to ignore, minimize or solve the problem. The proposals run the gamut from thoughtful to provocative, and may even be contradictory. Perhaps the only thing they have in common is that they are being voiced publicly. —O.W.



*Recognize that high salaries and high profits are not universal goals. Some architects prefer a relaxed life style. Others would rather dedicate their lives to art than to science or business. Perfection of detail, delight in drawing and the pursuit of a concept can be as important as material rewards.*

Stop envying doctors, lawyers or anyone else. Those professions are undergoing their own rapid change, complete with familiar complaints.

*Stop talking about failure and start talking about success. If we did more to learn from those who are doing well, we would be more influential and do more good.*

Treat architecture as a business, not as a vocation.

*Know your costs. Don't accept a commission if the fee won't cover them.*

Know your costs, to be sure, but know also your value and let it be known to the client and to the public at large.

*Set fees on the basis of value, not costs. Cost-based compensation assumes equality of services, boilerplating and easily defined products—qualities like these lend themselves to fee bidding.*

Set fees on the basis of costs. Don't reduce fees without an appropriate reduction of services.

*Underpricing services in order to compete is a disservice to the client, the public and, ultimately, the profession. Honesty, maturity and integrity are necessary to attain the fee levels needed to retain the talent upon which our vitality and future depend.*

Require students to take courses in economics and management for their master's degree. Make education more practical. Stop worrying that recent graduates can't draw. Teach the value of architectural services to students because they could as easily become our future clients or competitors as our employees.

*Don't try to teach management in school. By the time a graduate gets around to needing the information, it will either be obsolete or forgotten. Do it as continuing education.*

Give students the breadth and depth they will need to reassert the role of architect as master builder.

*Abandon the notion that architecture is an amalgam of everything, but nothing in itself. Train young architects to be master designers, not master builders. Address the specific knowledge that architects have.*

Encourage mature firms to help young firms.

*Draw architects in government and industry into the mainstream of the AIA. Many of them don't perceive that the AIA accepts them fully. Architects are very hard on other architects. If they understood the problems of the practicing architect more completely, they would make better clients.*

Design to please the client, not other architects. Give clients what they want, not what you want to give them. Even a doctor begins by asking, "Where does it hurt?"

*Control the client. Don't let him add scope to the work without asking for additional compensation.*

View architecture as a business that provides professional services to clients. Clients want solutions to their building problems.

*View architecture as part of the construction industry, which sells a product—working drawings in our case. All some clients want are working drawings, as quickly and cheaply as possible. If they want more, charge them accordingly.*

Whatever your viewpoint, don't work as part of the service industry and accept payment as part of the construction industry. That's the worst of both worlds.

*Promptly raise the billing rate of principals by \$20 an hour and the pay of entry-level employees to \$22,000.*

Charge for special equipment such as computers. Mark up reimbursables and subcontractors by at least 10 percent.

*Bill copies, telephone, postage and shipping, printing, clerical help and all nonprofessional staff.*

Show the client that the billing rate is only part of the fee equation. Your billing rate may be double a competitor's, but if you can do the job in half the time, the fee comes out the same.

*If you do government work, put everything possible in direct costs and as little as possible in overhead.*

If you work in the private sector, prefer payment by lump sum. It offers maximum incentive for you to work smarter.

*Charge a straight hourly rate, as lawyers charge.*

Forget fee schedules. They're illegal, unprofessional and counterproductive. The way fee schedules are usually expressed—as a percentage of construction cost—compromises the professional position of the architect. The owner, who wants to control costs, might perceive that the architect is proposing a more expensive solution as a means to increase fees. Instead, architects



should base their fees on the value of services performed.

*Bring back the fee schedule but call it a survey. How can fees be raised unless we know what others are charging?*

Stick together! If real estate brokers can keep up their fees in a nonregulated environment, so can architects.

*Use the AIA standardized accounting system and documents.*

Stop using AIA document B141 (agreement between architect and owner). Instead, use B161 and B162. They do a better job of describing architectural services.

*Declare large political contributions and free design services unethical. Don't compete solely on the basis of price.*

Limit competition—not by closing schools and flunking applicants for registration, but by managing firms so that good people will stay with them rather than leave and open their own offices.

*Assume more of the risk. What clients want is freedom from hassle. Inspect construction. Manage construction. Damn the lawyers.*

Offer more services, especially at the construction site. Architects used to do some design on their feet, rather than trying to put everything in the construction drawings.

*Cut production costs. Drawings, specifications, etc., are only the documentation of the solution. Spend your resources solving the problem, not typing (or drafting) it up. Make full use of the economies of automation. Cut spending on production by 10 percent; put part back into better analysis of the client's problem, part into construction observation and the rest in your pocket.*

Specialize. The highest profits are made by firms that do a few things very well.

*Emphasize firm management. Only a well-managed firm can generate the productivity and cost controls required to hire and retain good designers.*

Emphasize the building sciences, such as water integrity, energy conservation and basic materials. A building that leaks water or heat wastes the client's money and damages the architect's reputation. Know building codes. We need a lot less art and a lot more science.

*Emphasize project management. Everyone knows that on-time and on-budget are the client's two primary concerns. A good architect can manage the entire process.*

Emphasize design. The contribution of architecture is value. It's what makes the whole worth more than the sum of its parts. Only quality design enables an office developer to rent a building for \$10 a square foot more than the competition across the street.

*Talk the client's language (money or its variants) not the architect's language (form, context, texture and their variants). Show the client that design, like time, is money, too. Consider quoting fees in the client's language—e.g., cost per rentable square foot.*

Document your track record in subjects that are important to clients—construction costs, schedule, energy consumption, rental rates, occupancy rates. Nobody shows pretty slides at presentations anymore.

*Lead in the changes. Strive to become the most productive and best-managed firm in town. Don't be afraid to invest in the firm and to automate.*

Protect your firm from change. Find a niche or carve one out in some non-traditional area.

*Change the format and concept of the AIA design awards. Stop honoring buildings that embarrass the client, regardless of their aesthetics. That sends the wrong signal about what architects think is important.*

Educate clients and the public regarding the scope and value of architectural services. Teach them to think value, not just cost. Educate government officials on current overhead costs.

*Educate yourself to think value, not just aesthetics. Design that does not contribute to value is meaningless to most clients.*

Take the lead in the fight against fee bidding: Stop bidding your consultants.

*Get serious about marketing. Establish networks, stay in touch with repeat clients even when they have nothing at the moment. Respond effectively to serious inquiries. Follow up. Comply precisely with requests. Handle requests that aren't appropriate by submitting additional proposals with explanations. Don't present designs before defining the problem and don't wait for the presentation to get acquainted.*

Look into renovation. It's the largest, fastest growing specialty.

*Look into facilities management, building diagnostics and other architectural services needed after a building opens. After you produce a set of working drawings and supervise construction, aren't you in an excellent position to help a client operate and maintain his building, and make needed changes?*

Know costs—production costs, construction costs, time costs, money costs, the client's costs.

*Care more about your client's problems than your own. Service is one of the things that makes architecture a profession.*

Ask for the fee you're worth. Prove to the client, if necessary, why you're worth it. Expect to share in the wealth you are creating. Show a little self-respect.

*Remember: There's nothing ignoble about serving the client. There's nothing unprofessional about making a profit. □*



# Architecture '85

BY CHARLES B. THOMSEN, FAIA

*A portrait of a profession in transition*

WHEN I BEGAN TO PRACTICE ARCHITECTURE, IT WOULDN'T have occurred to me that one of my favorite projects would be a prototype service station. A GAS STATION? A PROTOTYPE? Buildings should be individual, I thought back then, designed for the unique qualities of each site. (And each should have its individual, unique 6 percent fee.)

Well, a recent project for a prototype service station has, indeed, been one of my favorites. Things have surely changed.

Considering the magnitude of these changes led me to develop a list of five fundamental shifts that have shaped our profession.

My list contains no surprises. It is a list of realities—of the condition of practice in 1985. Quite simply:

- *Good design* is now recognized as good business too—both for clients and their architects. And, whether cause or effect, the austere modern aesthetic has given way to inventive freedom.
- *Price competition* is growing more intense. Our market has shrunk, but the number of architects has doubled.
- *CAD* has begun to restructure the way we work. Although it has not reduced labor costs, CAD has enabled firms to get higher fees and make more money.
- *Specialization* is demanded by the market more and more. Knowing clients is no longer enough to get jobs.
- *Project delivery management*, in many guises, is increasingly important. After steadily losing control during the last two decades, some A/E's are developing project management skills and recapturing project leadership.

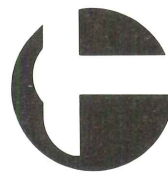
Let's look at each of these shifts more closely.

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*Chuck Thomsen is president and chief executive officer of 3DI International, a multi-disciplinary architecture, engineering and planning firm based in Houston.*

*This article was presented, as a speech, to Grassroots '85, the annual conference for AIA component executives.*

## GOOD DESIGN = GOOD BUSINESS



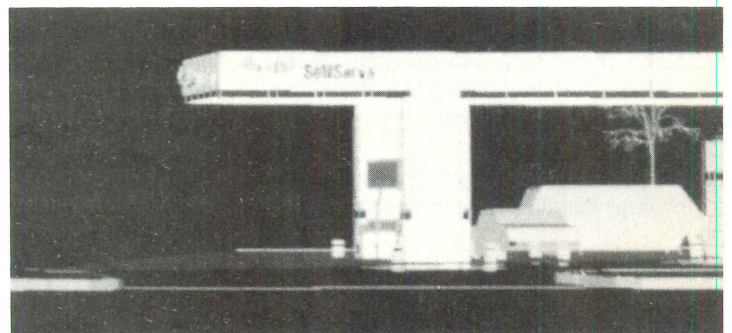
Throughout history, the rich and powerful have sought the best architecture—as a symbol of culture and prestige. That's not new. What *is* new is that developers and corporations are now buying good design, not as a status symbol, but because it is good business.

Developers are buying good design because it sells. And corporations are buying better environments to attract the best workers.

Architects have long stereotyped developers, sometimes, with great accuracy, as profit mongers, insensitive to the profundities of architectural doctrine. But the best developers now recognize and buy superb design to increase their profits. They are not modern-day Medicis and not patrons of the arts. Instead, developers buy good design to help market their products.

The developer's architect, then, is more populist than patrician, more pragmatist than idealist. And the result of this partnership is far more than frivolous cosmetics: Good architecture makes money! Hotels with great spaces, splashing water and profuse interior plantings attract guests! Office buildings that are well integrated into an urban design with natural materials, sunlit lobbies and echoes of tradition attract tenants and help them retain good employees!

During Houston's current world-class office glut—40 million square feet of unrented space—Philip Johnson's Republic Bank Center opened. It is 90 percent leased, while most of its competitors stand at 0 to 20 percent. Apparently, Texans like Neo-Northern





Renaissance architecture. Or, after three decades of glass Wheaties boxes, is it skillful inventiveness they like?

Not only do developers want architecture that sells, they want architects that can sell. Developers are asking their architects to help them in presentations to prospective tenants. Developers are buying high-fashion architecture. Name-designers have become as important to marketing buildings as they are to selling blue jeans.

Put quite simply, good design sells gas. At 3D/I, we've just finished ten prototype stations for Gulf Oil—a harbinger project. With marketing as the design's primary purpose, architectural, engineering, planning, landscape and construction management groups followed the lead of the graphics department. The firm designed everything, down to the labels on the oil cans.

Marketing wasn't the only purpose. Gulf also wanted good design to get by review boards and community groups. But here's the point: Gulf's research determined that the first station to open immediately sold 15 percent more gas than the Houston-area average for their existing stations!

Similar forces are at work in America's corporate offices. According to John Naisbitt, by the end of the decade there will be more people leaving the work force than entering it, which means the competition for knowledge workers will intensify. Corporations will look for architects who can help make offices that people like.

### PRICE COMPETITION INCREASES



Price competition is intense and growing. There are two overpowering reasons. First, unregulated competition has become the economic morality of our culture. Second, while the market is steadily declining, the number of practicing architects is steadily escalating.

Consumerism, deregulation, the consent decrees on fee schedules, the emergence of cost-conscious developers as clients and, of most importance, the proliferation of architects—all have contributed to vigorous price competition.

The state of Maryland took a mighty pendulum swing in 1974 to demonstrate "fair" A/E selection procedures. They now shortlist firms based on qualifications, then take the low bid. The Consulting Engineering Council of Metropolitan Washington polled members that had bid work in Maryland and learned that most didn't like bidding fees—69.7 percent lost money or broke even.

CEC's implied conclusion is that bidding is bad. Another conclusion is that 69.7 percent will learn the cost of doing business, find production efficiencies or go broke. Has anyone polled clients?

That more architects are chasing less business is easy to document. Non-residential construction has declined. *Engineering News-Record* reports a 1973 volume of \$31 billion and a 1983 volume of \$50 billion. But in 1973 dollars, \$50 billion is only \$23 billion, a decline of 26 percent in ten years. During that same ten years, AIA membership increased from 24,000 to 42,000. Active NCARB certificate holders almost doubled—from 13,000 to 25,000!

It will probably get worse. According to the AIA's Association of Student Chapters, there are 36,000 architecture students now enrolled in American colleges and universities.

With increasing competition, survival means giving more attention to marketing. By now it's almost a preoccupation. Founded a decade ago, the Society for Marketing Professional Services is today 4,000 members strong—a growth of 300 percent in the last three years.

A ritual has developed for selecting A/Es: RFQs, RFPs, shortlists, interviews, etc. So A/Es have teams to perform the ritual—teams that have little to do with making architecture. Selling A/E services has become a specialized occupation.

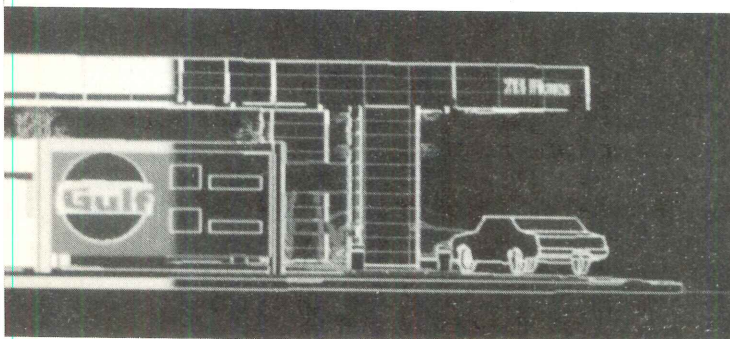
Most firms have learned that a marketing staff can find leads, maintain boilerplate, produce proposals, manage public relations and monitor sales. But many have learned the hard way that it is a fantasy to think a marketing staff can sell; clients want to talk to the people who do the work.

Unfortunately, the emphasis on marketing is resulting in the reverse of what good marketing should do. Individual uniqueness is being replaced by corporate similarity. Too many architects go to the same marketing conferences, read the same marketing books, and copy one another's texts and graphics. They all have a "Team-Of-Experienced-Professionals-Dedicated-To-Quality-While-Maintaining-Cost-And-Schedule-Control" plus a good collection of Ezra Stoller (or equal) photos.

The similarity of marketing rhetoric weakens the argument that price competition is inappropriate for choosing professionals because of their unique abilities. When everybody looks the same, the client asks, "Why pay more for little or no difference? Let's make a shortlist and then take bids."

Too much architectural marketing is banal. Few firms have learned how to differentiate themselves from their competition. As I listen, I hear too many who seem to believe that it is technique, not content, that brings in work. Yet firms with unique abilities are still chosen without competition while firms that offer common services are asked to bid more and more often. In any marketplace, proprietary products carry high markups; commodities have thin profit margins.

The successful firms think more about the content of the services being sold than the technique of selling. Figuring out how to sell the job and how to do it are one in the same. Convincing sales efforts are inevitably rooted in a creative approach to performing the job, explained by the people who will execute it.





## Good design sells gas

### CAD RESTRUCTURES THE WAY WE WORK



Almost two decades ago, in an article entitled, "How High To Rise," (*AIA Journal*, April 1965) I evangelized that "Computers-Will-Save-Us-From-Drudgery-So-That-We-Can-Spend-Our-Time-Being-Creative." I was wrong. Computers *create* drudgery. I also believed "Computers-Will-Reduce-Labor." Wrong again (usually).

What computers *have* done, though, is improve results. And the improved results couldn't be delivered manually at any cost. While CAD is not cutting job costs, it is increasing profits. But the increased profits are coming from an unexpected source.

I have heard CAD aficionados claim productivity increases of three, four, even six to one with CAD. Perhaps it is true in small samples and specific firms. But the *Financial Statistics Survey* conducted by PSMJ finally has some broadly-based numbers reflecting the productivity of CAD in architectural firms. They compared 102 firms that were using CAD to a group almost four times as large that was not using CAD. Here is their conclusion:

1. *Firms using CAD spent more to produce their jobs.*
2. *But they charged more, reduced overhead and increased profits.*

CAD firms billed \$45,448 per employee vs. \$43,750 for non-CAD firms. Yet CAD firms spent a larger percentage (36.6 percent vs. 36.3 percent) of their larger fee to do the work. Still, they reduced overhead and dropped more to the bottom line.

Expensive as it is, the hardware cost of CAD is not significant. At 3D/I we recently spent almost a million dollars to add eight more CAD stations. That's good material for an AIA cocktail party. But on analysis, the monthly amortization is equal to hiring eight people—a ho-hum event.

The people cost is significant, however. With most older, experienced architects set in their ways, many firms use CAD technicians to enter sketches produced by computer-illiterate A/Es—a duplication of effort. We need architects who can use CAD themselves.

It is a mistake to make direct cost comparisons between manual and automated processes. Here is an example. Bob Page, president of Kellogg-Rust, recently told me that his clients felt that CAD caused productivity *losses* among A/Es. Yet CAD design reduced pipe-cutting errors in the field from 5 to 1 percent. So by his calculation, design costs weren't being reduced, but construction costs, many times greater, were.

Another example: Automated project control systems (like CPM and PERT) add cost to construction. Yet the Business Roundtable reported in their 1983 "Summary Report of the Construction Industry" that they save 20 times their cost.

The cost issue boils down to this: we can't afford to ignore CAD technology.

Not long ago, I was discussing CAD with Rick Keating, partner in charge of SOM's Houston office. He said: "When several disciplines share the same graphic-design database on CAD, it saves time and reduces coordination errors. That makes it easier to do—and to sell—comprehensive services."

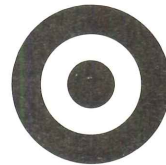
Noel Fagerlund, executive vice president of Smith, Hinchman and Grylls, Detroit, told me, "A major benefit of CAD is that the discipline requires people to better organize the production of drawings."

They're both right. Today, CAD will produce a better-coordinated, better-documented package. Already, CAD capability is required by many clients.

As CAD technology develops, it is becoming increasingly useful as a *design* tool. Here's how: The design process is evolutionary. But typically, drawings don't develop continuously. Instead, we lay down clean paper for each iteration. Plans are redrawn repeatedly as portions are changed or improved. Presentation drawings start anew. Working drawings are also begun again on blank paper.

CAD changes all this. Ideas laid out on CAD can progress from design directly into working drawings. In a desire to increase profits, there has always been pressure to finish design and start on working drawings. But the promise of CAD is the reverse. With CAD, when we finish design, we will be finished. Period.

### SPECIALIZATION NOW DEMANDED BY THE MARKET



The once master builder has turned the site over to a landscape architect, the inside, to an interior architect and the architrave, to a graphics consultant. He has decided whether to do office buildings, hotels, schools or hospitals, and he has decided whether to become most skilled at

programming, design or working drawings.

Everybody knows the market demands specialization. Public-sector clients carefully exclude all companies from selection if their 254s and 255s don't show healthy experience in the building type at hand (neatly rejecting the young firms with the new ideas).

Not quite so obvious is the realization that expertise in a building type is frequently expertise with a client type. The values, procedures and management style of developers are quite different than those of the Corps of Engineers. Consequently, the response must be different too. Firms good with one type of client usually find it hard to work for another.

As for specialization in types of service, today we see some firms specializing only in the design phase. Others are "local" experts, bringing to a team the knowledge of regional codes, politics and operating conditions. Often, "name" designers are paired with local firms, which do the working drawings. The local firms have become production specialists.

In a period of increasing price competition, the production specialist is bound to be selected more frequently on the basis of price. Meanwhile, the design specialist will be selected for his expertise.





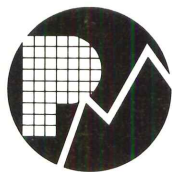
The result is further intensification. The low-cost producer must become more efficient and more competitive. The designer will invest in learning more about his clients' functional needs. Hence, more specialization.

Social and political objectives can add others to the team. Minority ownership, small-business preferences, office locations and so on have all become legitimate selection criteria. Teams are assembled to touch all the buttons.

The client corporations and government agencies add another component. With more in-house architects and facilities managers, the client is an active part of the team.

Twenty years ago, the need for specialization replaced the individual practitioner with a team of individuals. Now the team is often a team of companies. Public or private, there are few firms that can cover all the bases. Those architects who are most successful in getting work have the status and respect among their peers to be invited to join the strongest teams or to attract the best partners to their own team.

#### PROJECT-DELIVERY MANAGEMENT INCREASES



Recently a client (and good friend), scarred by many projects, gave me a hard look and said: "I've never seen a set of plans that reflected the best way to build. I don't think architects understand construction—and certainly not cost."

Harsh criticism and not universally true. But it has been a widely shared attitude and can be supported by too many embarrassments. Fortunately it is changing.

The conventional wisdom of the '70s was this: architects are a little effete—designers who add to the quality of life, but shouldn't be trusted with business. Contractors, on the other hand, know cost and are tough businessmen. Fortunately, neither stereotype stood the test of experience.

It has become clear that the run-of-the-mill GC is good at managing construction, but no help in managing information and decisions during design. They are good at estimating concrete and carpentry from detailed working drawings, and they know how to get quotes from subs, but they are at a loss until there are hard drawings and good specs. And that is too late.

Equally clear is that the run-of-the-mill architect doesn't understand the fluctuation of the construction marketplace or the economies that come from careful and strategic purchasing. And few A/Es are comfortable when there is a need for guarantees of cost or schedule.

Construction is labor intensive. Design is information intensive. Construction requires managing fabrication. Design requires managing decisions. By 1985 the truth is out. To manage design and construction the leader must understand it *all*. Half won't cut it.

Architects used to have two jobs, designer and agent. Today, design is thought of as the noble act, and construction considered a mundane task. Urged by well-meaning insurance counsel, most architects have abdicated responsibility for construction. To the same degree, they have abdicated the role of agent. The result is, many clients buy design only and pay considerably less in the process.

Everyone is finding someone other than the designer to manage project delivery. For many years the government has managed construction with the Corps of Engineers, NAVFAC, GSA and others. Today, developers, institutions and corporations have staff to manage their building programs, too. Clients with occasional building projects hire project or construction managers.

But A/Es are also selling project-management services. In the '70s, CM exploded into the construction industry. There was a lot of debate between A/Es and contractors over who should be the CM. Contractors dominated the market, but since both sides of the argument had merit, both sides produced convincing rhetoric, successful projects and prosperous CM companies.



## *Service, on the client's terms, remains key*

Though hailed by some as a panacea for all projects, the use of CM has declined with the slowing of inflation. It is now used for projects where time is crucial, or where getting a fixed price from a GC would be difficult or where there is a continuing bond between a CM and a client.

While CM has subsided, PM (Project Managers who provide programming, management and construction-administration services) has increased. Increasingly, clients are hiring professionals to represent their interests in managing project delivery. The job is to define the scope of the project, balance program and budget, hire the A/E's and contractors, and manage cost, time and quality.

Project managers are unbundling the design process. They are choosing their own specialists—not just for architecture, engineering and interior design, but for graphics, landscape, lighting, communications, and so on. They choose the best in each category and then organize them under a lead architect or manage them as independent contractors.

Often, these project managers are providing programming, management and construction administration services. The result is that the designer's services have been truncated at each end, and his leadership has been lopped off the top.

And while contractors dominated the CM market during the '70s, it appears that architects and engineers are dominating the PM market during the '80s. The fee income to A/E firms for PM and CM services grew from \$530 million in 1979 to \$1.4 billion in 1983—almost triple, in a period of four years.

The growth of PM is therefore not a threat. It is an opportunity.

### STRATEGIES FOR 1985

How does it all add up?

What seems evident is this: the tweedy, gentlemanly practice of architecture is adapting to the large, complex needs of our world. Marketing, price competition, corporate structures, specialization, management, joint ventures and so on, add up to the reality that the *profession* of architecture has come eyeball to eyeball with the *business* of architecture, and has not blinked.

I like change. And I am not disturbed by business realities. Good design, integrity, talent and dedication, all the tenets of professionalism, are also good business.

But none of us is entirely confident about our ability to adapt quickly. Unfortunately, many of my friends resist some of today's realities. Too many paradigms are based on hallowed traditions. Whether it is the evolution of a species or a corporation, survivors adapt. Here are my thoughts:

#### **Design**

Developers are a bellwether of future clients. As these tough-minded businessmen demonstrate to the world the economic value of good design, the less adventurous corporate executives will follow suit—not just for the headquarters building, but for all their projects. Eventually the public sector may catch on.

The humanism and populism of architecture is wonderful. With luck, the profession will turn more frequently to the problem of producing a helpful, life-cheering working environment, and become less preoccupied with fashion.

#### **Price competition**

For consumers, and for the firms who face the challenge, price competition is good. It cuts out the deadwood, forces innovation and unseats the tired establishment.

Today, most architects resist the reality of price competition. But those firms that face the inevitable will run lean-clean organizations. They will sell and perform only the services their clients want, and the survivors will find ways to do more for less.

Marketing will continue to be important. But the most effective marketing asserts uniqueness. It's hard to find, but it sure sells.

#### **CAD**

*Timing* is the issue. The challenge with CAD is how much, how fast. To neglect the technology will mean losing a competitive edge. To go too fast will break us. Many smart firms have been burnt by the wonders of computers. Now they are moving, but slowly.

The application of CAD to architecture is constrained by the number of computer-literate people who can be hired or retrained from existing staff, not by hardware costs or the pace of technological development.

#### **Specialization**

The general practitioner is in a squeeze. The multidisciplinary firms will find jobs with clients who want single-point responsibility. The specialized firms will also succeed with clients who want to assemble a team, on projects that have a project manager, or with joint ventures. The in-between companies will have a tough time.

But even with the large multidisciplinary firms, joint ventures will be required to get the best and biggest jobs.

So, our competitors are our future partners. We need to treat them that way. That means statesmanship. That also means solid professional achievement. Marketing won't help much. You can't spoof the spoofers.

#### **Project delivery management**

Armed only with their traditional skills, neither general contractors nor architects are equipped to manage the entire building design and construction process. Design is one thing. Construction another. And management is a third.

The territory belongs to those who understand that management is a discipline of its own, and get good at it.

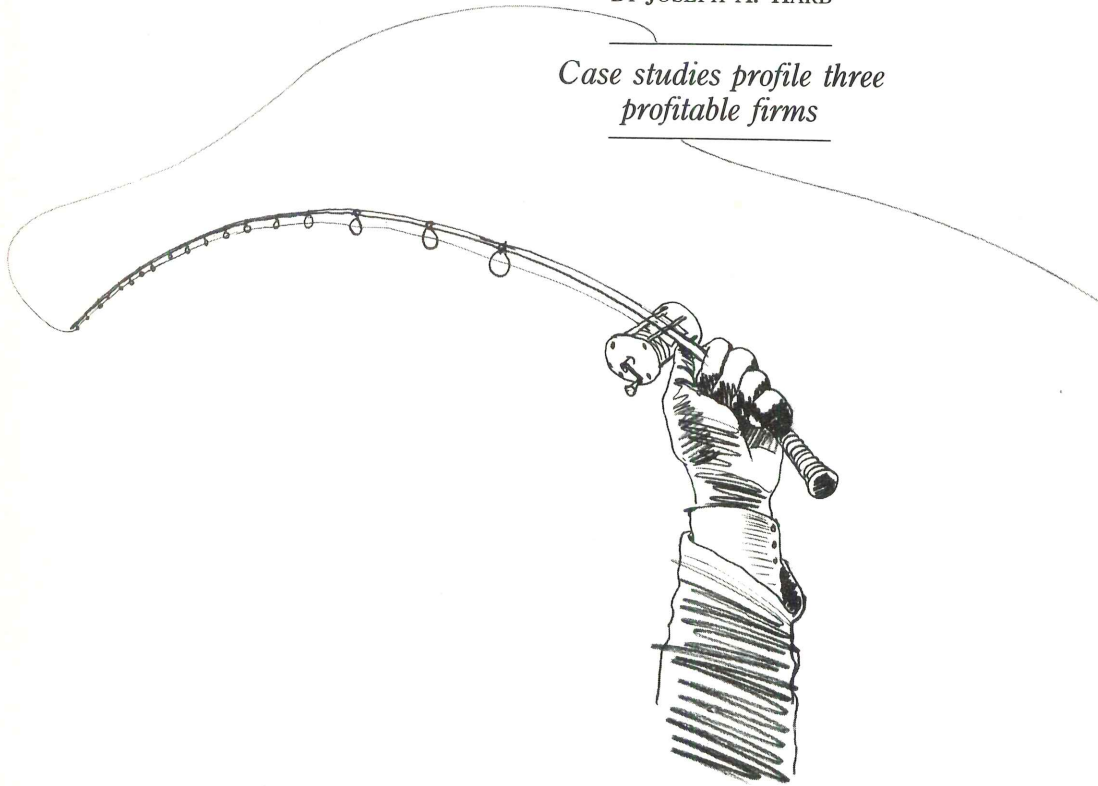
It is open to those who are interested. But it is not a casual choice. Management, like design, is a noble specialization. □



# Small Firms Market Big

BY JOSEPH A. HARB

*Case studies profile three  
profitable firms*



JUST ABOUT EVERY ARCHITECT RUNNING A SMALL FIRM HAS, somewhere along the line, tried to discover the sure-fire formula for developing client leads. If there was such a formula, the architect discovering it could bottle it, sell it and not worry about finding clients ever again.

Short of that, most small architectural firms turn to a wide variety of techniques: maintaining contact with real estate agents and groups; participating in civic organizations; holding appointive or elective offices; scanning local, regional or national publications of general and special interest; advertising; publishing articles—in short, using whatever techniques best suit their personal style for keeping abreast of developments and keeping their name in the minds of potential clients.

While these approaches can all be effective, their relative value for attracting clients depends more on the type of client being pursued than on the personal preferences of the architect. But, as some of the nation's leading experts on marketing architectural services point out, most small firms can't decide what kind of clients they want or what type of business they want to become. This, they say, is the main threat to the long-term success and day-to-day satisfaction of an architect running a small firm.

*Joseph A. Harb is a writer, living in Washington. Harb specializes in small-business and finance issues.*

*This article emerged from topics discussed at last year's AIA Small-Firm Roundtable.*

Weld Coxe, founder of the Coxe Group, a consulting organization specializing in management and marketing professional design services, urges architects to discern the difference between getting clients and developing a practice. "Because small firms generally aren't sure what kind of practice they want to develop," Coxe says, "they spend their time chasing jobs, not clients. Yet the most successful practices are built not around jobs, but around relationships."

Architects in small firms don't plan overall marketing strategies for a second important reason. They worry more about paying their bills. "Any architect who can just go out and find work makes that his marketing strategy," Coxe says.

Like many architects, Coxe is not wildly enthusiastic about "bird-dogging" or making cold calls in search of clients. "The reality is that bird-dogging is something that is not comfortable to most people," Coxe says. "Going out and seeking rejection is not something most people enjoy."

Coxe claims that what's needed is to cultivate a network of people who might one day need your services. "Targeting specific individuals will result in the development of a practice. It's an evolutionary process," Coxe says.

Another authority on the subject, Gerre Jones, a Washington, D.C., management consultant specializing in A/E services, also stresses the importance of having a formal marketing plan. "For most architects," Jones says, "marketing means doing a little bit of everything—making contacts, being active in civic groups, having political connections, making proposals, reading trade papers and so on. But, it can all be an exercise in futility without a marketing plan.



### *Personal contact is always the start*

Developing a plan should be a first step for any firm. For a small firm, it might be only a four- or five-page outline. What's important is that it map out where the firm is and where it wants to go."

Jones acknowledges that each firm will ultimately develop its own method of marketing based on the personality and preferences of its principal(s). "One firm's success may rest on relationships developed with members of a particular trade organization. Another firm might find that a waste of time. Some firms make a conscious decision to go after design awards. This can be effective since it indicates the respect of your peers and competitors," Jones says.

Developing a specialty, Jones adds, is crucial to building a successful practice. Architects with a specialty don't have to work as hard at marketing, because clients seek them out. Reaching that point, Jones repeats, requires a marketing plan—a clear picture of where you want to go. "Without a marketing plan, what you have is a seat-of-the-pants plan."

While most people in the industry agree that small firms need to develop different tactics and specialties than large firms, there is no consensus on just what those tactics and specialties should be. For instance, many point to residential work as a good market for small firms. Small firms are often better positioned to get contracts and give proper attention to these smaller projects. However, according to Coxe, too much emphasis on residences can hurt a firm in the long run.

"Single-family residences are principal intensive," Coxe explains. "The client wants to deal directly with the architect, not an assistant, so a small firm has to limit the amount of residential work it takes on if it wants to grow."

Nevertheless, residential work certainly accounts for a large percentage of small firms' fees. According to the 1983 American Institute of Architects Firm Survey, 16 percent of all firms' revenue came from single-family houses, and another 11.3 percent from multi-family residences. The actual number of jobs involved in producing those revenues is probably a larger percentage because a house costs far less to build than commercial, industrial, institutional and other projects.

What all this means is that small architectural firms have special and conflicting interests to consider in developing job leads and assuring the long-term success of their practices. Principals must juggle day-to-day financing, cash flow, general design, project management and business organization, all the while employing some type of strategy to keep job leads coming in.

To come up with a strategy that works, architects inevitably listen to experts, read tracts on the subject and combine their learned knowledge with their basic instincts and personal preferences. Sometimes, as Herman Hassinger, a Moorestown, N.J., architect puts it, "all the good planning in the world can't replace dumb luck." But for most small firms that are long-term successes, dumb luck is most often a by-product of hard work.

Following are three examples of architects with small firms who are successfully competing in the marketplace. They each have their own way of developing leads, based on different areas of specialization. All are trying to simultaneously maintain their current business

relationships and grow into specialized areas—chasing clients instead of chasing jobs.

### THAT PERSONAL TOUCH

It was 1973 and Michael T. Newman was looking for clients—any clients. Because he wasn't finding them in his hometown of Shreveport, La., he got into his car and drove to Center, Texas, a small town about 60 miles southwest.

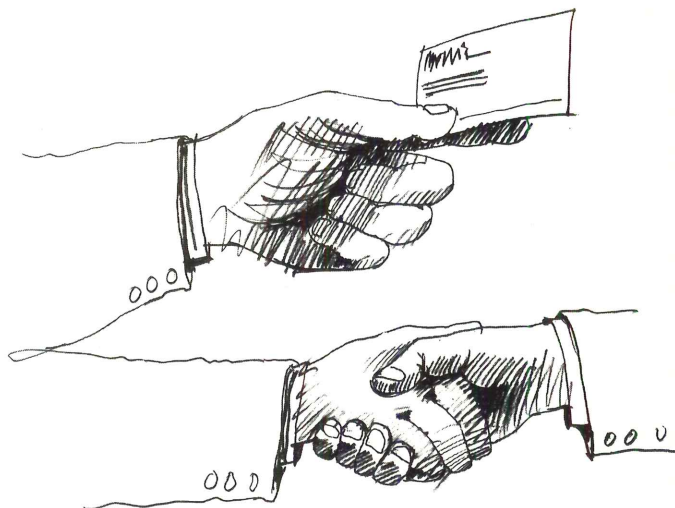
"If you want to know what's going on in a small town, your best bet is to go to a banker," Newman says. "In Center, there were two banks across the street from each other. I walked into the one that looked, from the outside, like it needed more work."

The bank was Farmer's State Bank. Newman asked to speak with its president. "I didn't expect to do anything more than introduce myself, make contact for five minutes and drop off my card," Newman says. Instead, he wound up talking with the bank's president, Jack Motley, for about an hour.

"It was very rare that somebody just walked in off the street like that," Motley recounts. "But I enjoyed talking with him. He said he needed work, and he impressed me."

"I told him I was starving," Newman says.

Two months after that meeting, Newman got his first commission from Farmer's State. It was a small job redesigning some bank space. Over the last ten years, Newman has worked for the bank on a regular basis, and now works with the newest bank president—Jack Motley's son, Luke.



Newman won't usually make unannounced visits, but often will call a company and ask for an appointment or just walk into an office and leave a card after a quick hello. "That way, when I call someone back on the phone, we have an image of each other, and from then on it's a business relationship we can develop over years," he says. "What I'm looking for is to establish communications so that when something comes along, the company knows we're available and can do the job."



Newman, who is currently remodeling the Farmer's State Bank's main office, prefers the "soft-sell" approach. "I never want to put a potential client on the defensive," Newman says. "The very next project may be confidential or already earmarked for someone else. That's not the point. What I want to do is build confidence for the future. It's not a question of pushing to get the next job, but of letting a potential client know you'd like to work for him some time."

At the same time, Newman points out that such exploratory meetings can provide critical market research, even if they don't lead directly to a job. "I tell them I'm an architect, and ask them about their business and what people in their industry need."

*"He told me he needed work," Motley recounts.*

*"I told him I was starving," Newman says.*

Newman stresses the importance of looking ahead. He tries to find out which companies are successful and growing and therefore might eventually expand. He may make his initial contact with a company several years before it is ready to start on a new structure. "When they're ready, they know us," Newman says.

The personal form of enterprise-research that he practices is, Newman admits, "not a really efficient technique." He has never written a formal marketing plan, but believes that he's developed one intuitively. "I suspect that most small firms know what they have to do to succeed and know what a marketing plan could do for them, but they just have it in their heads and have simply never committed it to paper," Newman says. "That's how I feel."

Having established a basic client list, Newman is now trying to move away from his personal method of developing general contacts toward building a practice in certain project areas. "Our focus is now on small commercial office buildings, small medical facilities and upper-class residential buildings," Newman says. He tries to limit his search to non-residential projects in the \$500,000-\$1,500,000 range, and residences of \$150,000 and up.

Perhaps the most striking change in marketing direction for Newman, though, was his decision to hire a marketing specialist in the summer of 1983. The marketing specialist also performs interior design work for the company but her chief responsibility is helping Newman devise an effective, coordinated marketing program. "She's made a difference," he says.

Newman has begun special mailings. A mailing-list company was unable to help him, but his marketing staffer produced a list of 3,000 names, broken down by category into smaller groups. She pored through phone books, lists of past clients, directories of people involved in professions that interested Newman, and other resources. "I can now do special mailings to bankers or brokers or medical managers very easily," Newman reports.

The marketing specialist has helped in a second way: getting work from the federal government. Newman used to submit proposals for government work, but would just barely get the applications in on time and would invariably leave some part incomplete. Now they're finished promptly, and the quality of the forms has improved. The firm has since been contracted for a project at Barksdale Air Base.

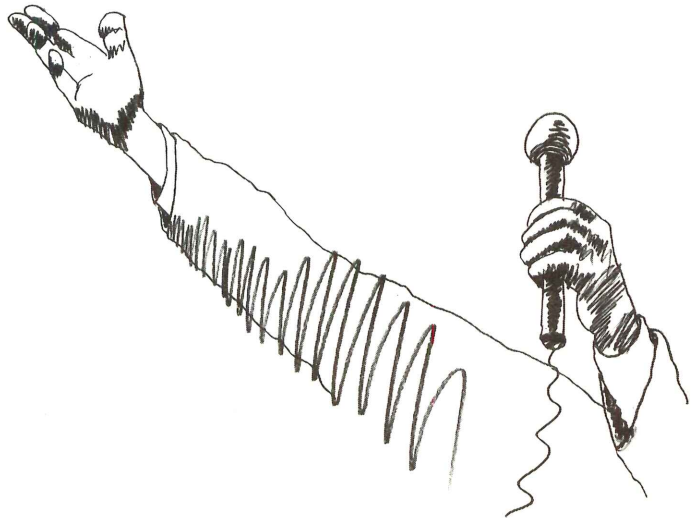
Has having a marketing specialist paid for itself? "No," Newman says, "but that's not how I'm looking at it. It's an investment that I have to make in the future of my business if I want it to grow."

Newman's firm, the Newman Partnership, numbers 15, including five registered architects and seven other technical employees. His penchant for "driving around town and seeing what's doing," continues to pay dividends. For instance, a plot of land in the area, on a hill overlooking a lake, has long appealed to Newman as a "spectacular" home site. One day, he went to the local courthouse and did a title search to find out who owned the property. It was a couple, and he called them and said that he felt they had a great location, and he'd like the opportunity to work with them when they were ready to build on it. Six months later, they called him back. Now he's doing preliminary work with them for what will probably be a \$400,000-\$500,000 house.

#### CONVENTION-AL WISDOM

Robert M. Morris Jr., specializes in audio-visual facilities. About 40 percent of his work is as an architect and consultant on audio-visual facilities—theaters, sound systems, screening rooms and the like. Most of his work now comes in by referral, but he's long been an expert at getting client leads through his participation in conventions of specialized groups.

In 1981, Morris was walking up and down the exhibit aisles at the annual convention of the National Audio-Visual Association. He became aware of a man following him. "I thought he was going to try to pick my pocket. He made me somewhat nervous," Morris recalls.





## *Friendship, knowledge and involvement all build trust*

"Eventually, he stopped me and asked what an architect was doing at an audio-visual convention—he had been trying to read my badge, which identified me as an architect."

The man was Robert Martin, manager of visual communications for Petro-Lewis Securities Corp., Denver. Martin and Morris talked and discovered that Petro-Lewis might someday need Morris' help.

After the convention, Morris maintained contact with Martin and Petro-Lewis. Eighteen months later, Petro-Lewis's visual communications department hired Morris for a 35,000-square-foot project including offices, a graphic arts production department, photo labs, television studio and sales theater. Later he also worked in collaboration with Gensler & Associates, the large interior design firm. Out of that first meeting in the aisles of the exhibit hall, Morris wound up with a contract that spanned almost two years and a commission of six figures.

Since that 1981 convention, Morris has learned to effectively pitch his firm to other potential clients. He started by taking a booth at the 1983 NAVA convention, which he estimates drew 15,000 people.

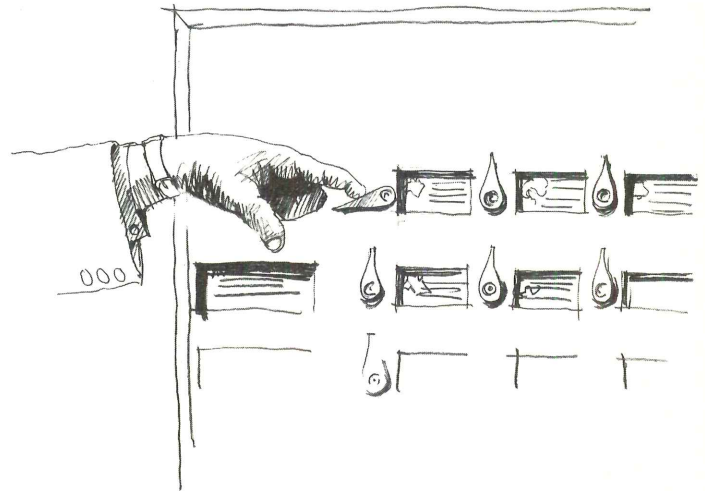
"I had attended these conventions for six or seven years, and I never saw anyone exhibiting anything like what we specialize in," Morris says. "It finally struck me that we had a unique design service to offer these people."

Morris distributes brochures and leaflets to convention attendees. The first brochures were produced in-house, but he now has them done by a professional graphics specialist. "The brochure and the materials are very important . . . the people attending are very visually oriented," Morris says. "If you have a two-bit handout, you're not going to have the same impact as you would with a coordinated graphics presentation." He gives partial credit for his heightened respect for the importance of good graphics to Ernest Burden and Burden's books on visual presentation and marketing.

Morris, who also belongs to the Audio Engineering Society and the Association for Multi-Image (comprised of members of the multimedia industry), does not confine his lead-recruiting activities at conventions to brochures and handouts. His booth also includes two sets of photos—one showing equipment and facilities to interest users of the A/V systems and rooms, and the other showing buildings and structures, aimed at representatives of architectural firms. (Morris estimates that about 40 percent of his work is as a consultant to other design firms.)

After the NAVA convention, Morris gets a printout of registered attendees. He culls out those with such titles as vice president for corporate communications, director of marketing, etc. "These people are potential clients," Morris says. "I'll follow up with them and with anyone that actually visited our booth. I'll also make a note if they don't need anything now but may have a project going in six to eight months." Morris will be working like this during the AIA convention in June.

Morris, who devotes about 20 percent of his time to marketing, is taking steps like Newman in Louisiana to diversify his marketing efforts and focus on specific clients. "In the past couple of years we've



tried to zero in on client types—architects, and audio-visual end users such as training departments and television groups within corporations—and give them a specific rather than a general message."

Morris also surveys past clients, preparing a seven- or eight-page questionnaire for them to fill out two months to a year after a project is completed. He'll call the client to let them know the questionnaire is coming or even conduct a personal interview if it can be arranged.

Unlike Newman, Morris has not hired a marketing specialist. He runs a "two-man show," he says, and never thought about it seriously enough to investigate it in any detail. "It takes six months just to educate a draftsman around here, so it would take even longer with a marketing person, I think," he says.

### A TASTE FOR POLITICS

Ronald D. Hansche of Reinke, Hansche, Last, Inc., in Oshkosh, Wis., is responsible for most of the marketing in his nine-person firm. "Because we're small," he says, "everyone has to be involved in developing leads."

Several employees are active in the local YMCA, and virtually everyone is involved in some local, regional or state organization. One member serves on a museum board, another on a local planning board, and others are active in church organizations. "Anything that gets the firm's name out in the public eye is important," Hansche says, "and just keeping your eyes and ears open is the key. Every little bit helps."

Like the other architects, Hansche's firm has never drawn up a formal marketing plan. "I've got a good idea of what we want to do without a formal plan, although I have considered writing something up," he says. "We might launch some type of direct-mail program—and to do that, we would need a plan to determine who we want to address and what we want to accomplish."

Hansche has been involved in local politics since the late 1960s, when he was appointed to the Oshkosh Planning Commission. In the



early '70s, he got involved in neighborhood groups and, in 1973, he won election to the Winnebago County Board of Supervisors.

Being active in local politics is a good way of developing contacts and client leads, but Hansche's case also points out the hazards of public service. He resigned from the Winnebago County Board of Supervisors in 1976 because his firm was bidding for a six-million-dollar police and jail building, and some of the board members were on the commission in charge of selecting firms for the project.

"I might have been able to stay (on the board), but the potential for the appearance of a conflict of interest was there," Hansche says. As it was, his firm wound up not receiving the commission.

For over five years Hansche has served on the city of Oshkosh Community Park Board, an appointive position requiring only about four hours of his time each month. During this period, he also donated some design time to the parks department. His firm has since performed a substantial amount of parks work for the city, which he attributes to his membership on the board.

Hansche's firm is another example of a company that has built itself up and is now trying to develop a specialty. After long being interested in the local, general-interest market, they're now looking at specific markets such as condominium projects for the elderly. "We see that as a growth field, and we have a track record. We've done three projects recently, all of which were the direct result of repeat-business for owners who had previously hired us for other health-care projects," Hansche said.

To target non-profit, elderly-care facilities, Hansche recently obtained a list of the membership of the State Association of Homes for the Aging. He went through the 200 names on the list and eliminated those operating in geographic areas he wasn't interested in, including Milwaukee, where he feels there is severe competition. He came up with about 10 to 15 names which looked good and will try to cultivate these people in the future.

Hansche, like many other architects, says it's just not possible to say with certainty which jobs are due to which personal contacts. "When I had just left the county board and still knew everyone on it, that was an advantage." He says he still knows some of the county commissioners, but it's not possible to say that he gets or doesn't get particular jobs because of those contacts.

The firm also relies heavily on certain publications and keeps in touch with general contractors. "We follow our local newspapers very closely, looking for any news of new construction or of zoning changes that often precede new projects," Hansche says. "We also follow a state publication on the construction industry called *The Daily Reporter*, a regional publication, *The Western Builder*, and the *Commerce Business Daily*." Keeping in close contact with general contractors has been a good idea because, "they know what's going on in the area."

## COMMON THREADS

As these examples indicate, there are a multitude of ways to develop client leads. One of the few common threads that weaves through almost all techniques is the effort to get the name of the firm out in front of its potential customers even before a project is begun.

Alan L. Hansen of Kerns Group Architects in Washington, D.C., perhaps sums it up best when he says: "Really, what's important is making friends and developing mutual trust. The whole idea is to form the network, spread the network and stay in touch with the network. It's just like farming: The first thing you've got to do is prepare the soil and plant the seeds." □



All illustrations: Stanley Stark

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# DESIGN GUIDELINES FOR GFRC PANELS

BY BERT G. HUNTINGTON AND CRAIG G. HUNTINGTON

*Glass-fiber-reinforced concrete, used in cladding panels, offers a strong, lightweight alternative to conventional precast concrete. It also requires special design detailing, as indicated on these pages.*

**F**IBERGLASS, WITH ITS HIGH TENSILE strength, light weight, non-combustibility, good chemical resistance and reasonable cost, is a remarkable building material. Fiberglass has benefited roofing felts, shingles, insulation, ceiling panels and architectural fabrics. Now, another significant application has become prominent—reinforcement in exterior concrete cladding panels.

Panels made of glass-fiber-reinforced concrete (GFRC) achieved practicality following the development of alkali-resistant glass

fibers in the late 1960s. Today, GFRC panels are taking the place of conventional reinforced concrete in many applications.

The advantages of GFRC can be substantial. Weighing an average of 14 psf, panels are typically one-third to one-tenth the weight of precast concrete panels. Transportation and erection costs are consequently lower. The weight differential also permits the use of a lighter, less expensive structure and foundation. Because costs for GFRC and conventional panels are comparable, this reduction in structure can be a decisive reason for using GFRC. This is true particularly for recladding projects, where existing structures often force architects and engineers to contend with stringent weight restrictions.

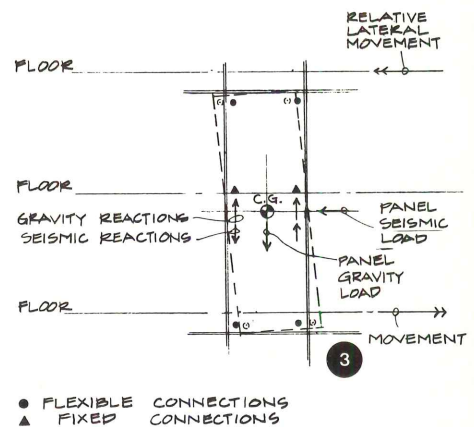
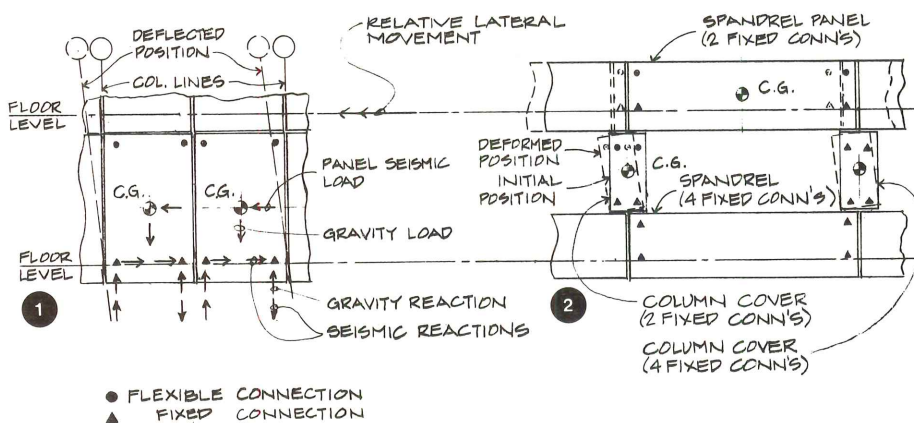
Lateral loads are reduced with GFRC as well. This is particularly important in areas with seismic activity.

GFRC panels are available in the same colors and textures as concrete panels, and surfaces are generally more uniform, with fewer blemishes. And while concrete is brittle

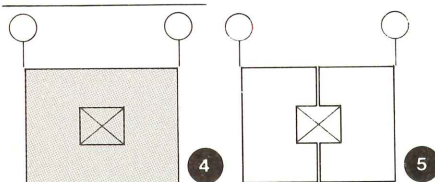
and chips or cracks when struck, GFRC typically powders upon heavy impact. This permits minor field corrections of misfit GFRC panels to be made with a power saw. Corrections to conventional precast panels often entail recasting.

Because GFRC panels are relatively new, their life expectancy remains unknown. All indications, however, suggest that GFRC will hold up at least as well as conventional reinforced concrete.

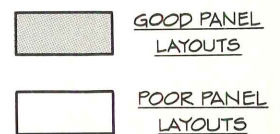
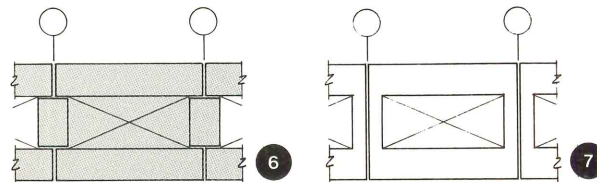
Most architects, engineers and contractors still have insufficient experience with GFRC panels to incorporate them into a design with full success. Too often, panels are detailed only for typical cases. And, because panel contracts are commonly let after structural detailing is complete, panel fasteners must often be retrofit in the field to accommodate overlooked conditions.



**SMALL OPENINGS**

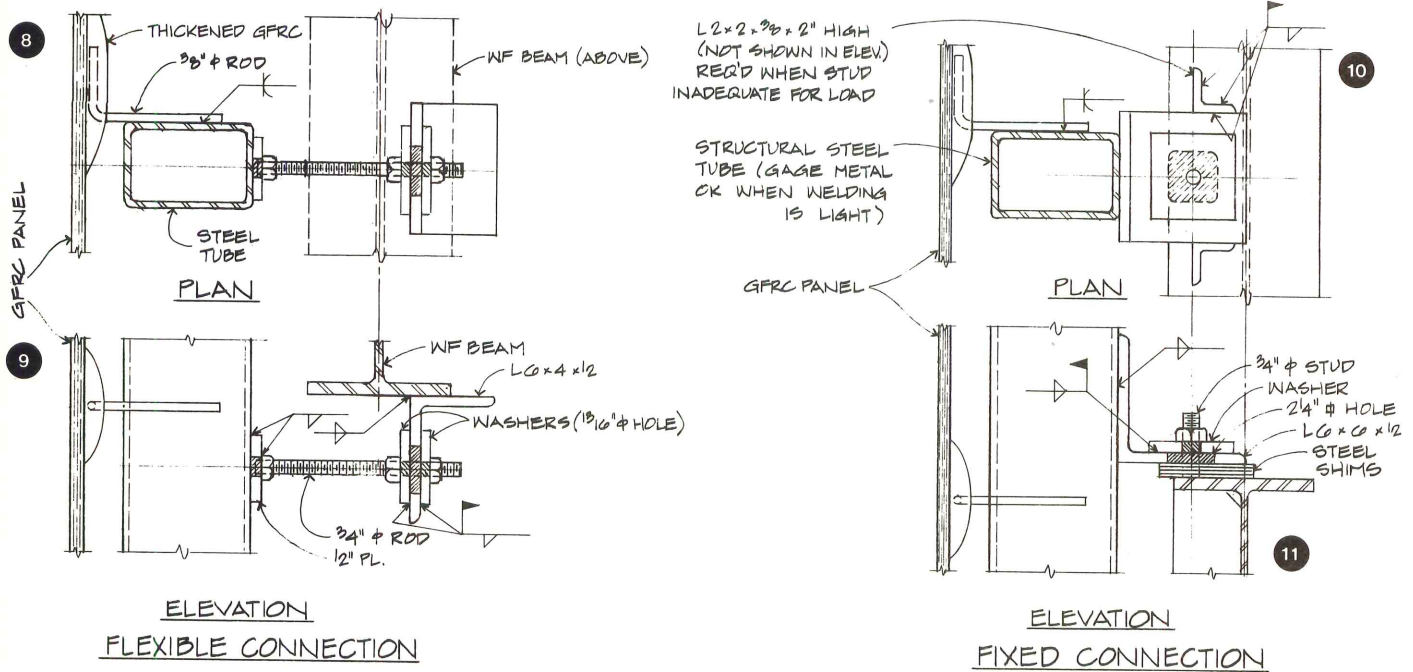


**LARGE OPENINGS**



*Bert G. Huntington and Craig G. Huntington are principals of Huntington Design Associates, Inc., a structural engineering firm in Oakland, Calif.*





## PANEL LAYOUT

GFRF panels may be configured to accommodate a wide range of applications, spanning vertically between floors (figs. 1 and 28), horizontally as spandrel panels (figs. 2 and 25) or employed as column or beam covers (figs. 2 and 27).

The typical panel is attached to the structure with two fixed connections and one or more flexible connections that accommodate lateral movement resulting from wind or seismic loads (figs. 1 and 2). Loads perpendicular to the panel face seldom govern the design, as they are shared approximately equally by the four supports. Seismic loads parallel to the face, however, produce horizontal loads on the fixed supports and a vertical load on one fixed support that adds to the gravity load.

Column covers deflect with the column, and fixed connections may, therefore, be used both top and bottom.

Because tall, narrow, floor-to-floor panels (fig. 3) are subject to large, vertical seismic loads on the fixed connections, such applications should be avoided. When panels extend through two floors, fixed connections are best placed at the middle floor, as near to the panel's center of gravity as possible.

This avoids large, overturning seismic loads. (Joints are generally about 3/4-inches wide with flexible caulking to accommodate thermal movement.)

As with column covers, long spandrel panels deflect with the beam, and therefore all connections may be fixed. To accommodate shrinkage and the effects of temperature change, however, the fixed connections on one end of long spandrel panels should be slotted.

Because GFRF panels are not intended to carry significant structural loads, small windows or other openings should occur entirely within one panel. For larger openings, panels should be configured so that they are least affected by any movement of the structural frame. The panel configurations in figures 4 and 5 are, respectively, good and bad layouts for small openings. Similarly, figures 6 and 7 show good and bad panel layouts for large openings.

## CONNECTION DETAILS

Figures 8, 9, 10 and 11 illustrate typical fixed and flexible connections for joining GFRF panels to steel building frames. Typical connections seldom govern all conditions, however, and ingenuity is often required in detailing. The architect or engineer

preparing the working drawings must be clear enough in the detailing to enable the contractor to accurately estimate, bid and construct.

One general goal is to arrange fittings so that panels can be erected and secured as quickly as possible, limiting expensive crane time. Panels may be plumbed, faired and adjusted after they are placed to compensate for inaccuracies.

The stud and rod shown in figures 8 and 9 allow the panel to be secured in just this way. Studs are generally adequate framing for all imposed loads. If not, the connection may be reinforced with steel angles or plates welded to the clip in the field (see fig. 10).

Connections should be devised to allow for about a 3/4-inch adjustment of panels in all directions. On panels spanning between floors on post-tensioned concrete slab buildings, twice this allowance may be required to accommodate the vertical deflections created by post-tensioning.

According to the Prestressed Concrete Institute's "Recommended Practice for GFRF" (see references), weatherproofing joints in GFRF panels generally requires sealants that can tolerate movements of  $\pm 25$  percent of the joint-width specified. Joints in



*Fabrication process permits varied designs*

larger panels, with their even greater tolerances, will generally call for sealants having a lower-than-normal modulus.

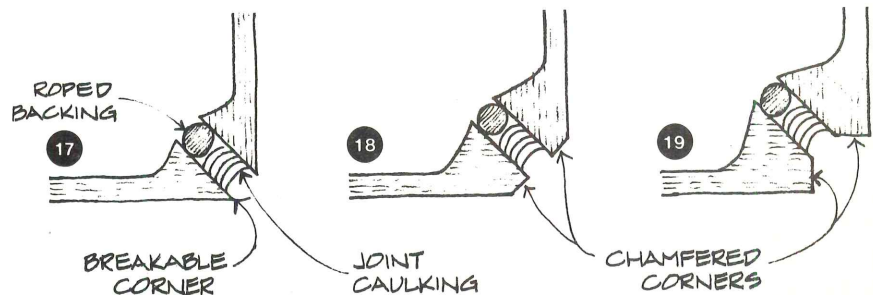
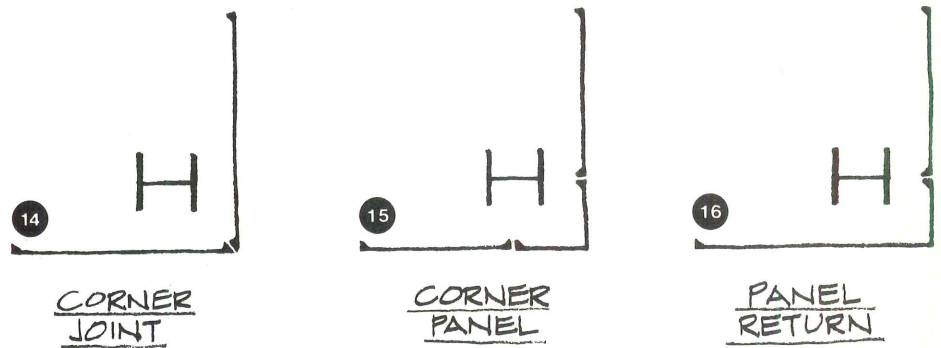
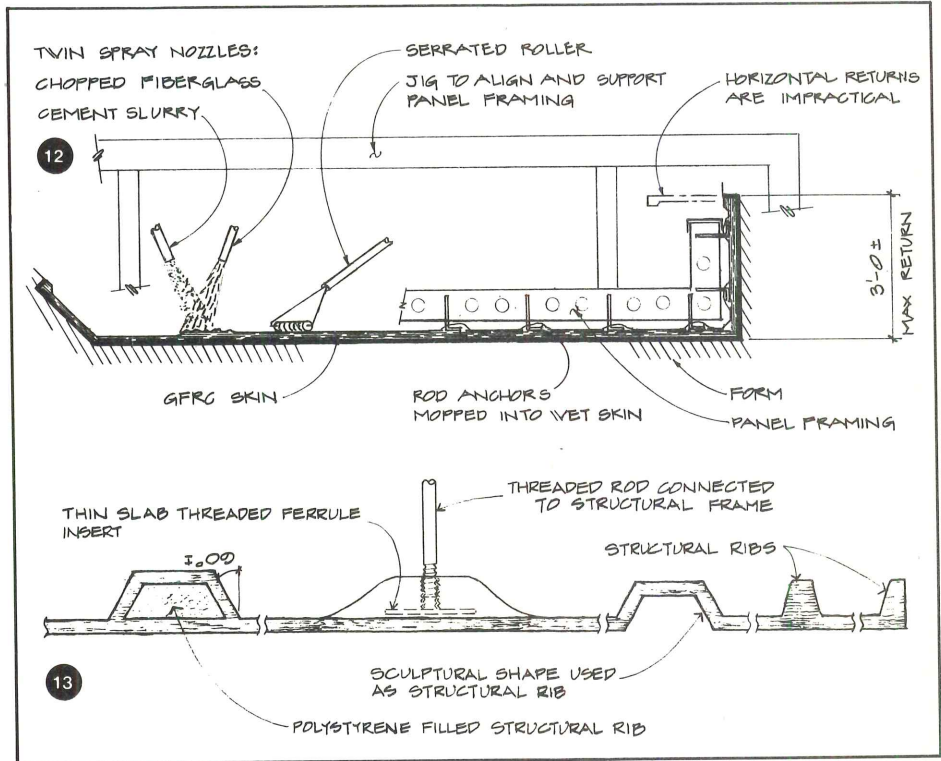
Recommended sealants are polysulfides, urethanes, silicones or other high-performance one- or two-part sealants that meet federal specifications. PCI's guide suggests using sealant backup rods. They assure good adhesion of the sealant to joint surfaces and proper sealant depth. The backup rods also prevent adhesion of the sealant to the base, or inside, of the joint, by acting as a bond breaker. Polyethylene or non-gassing polyurethane foams are common materials for backup rods. Sealant manufacturers will often recommend specific backup rods.

**WORKING WITH GFRC**

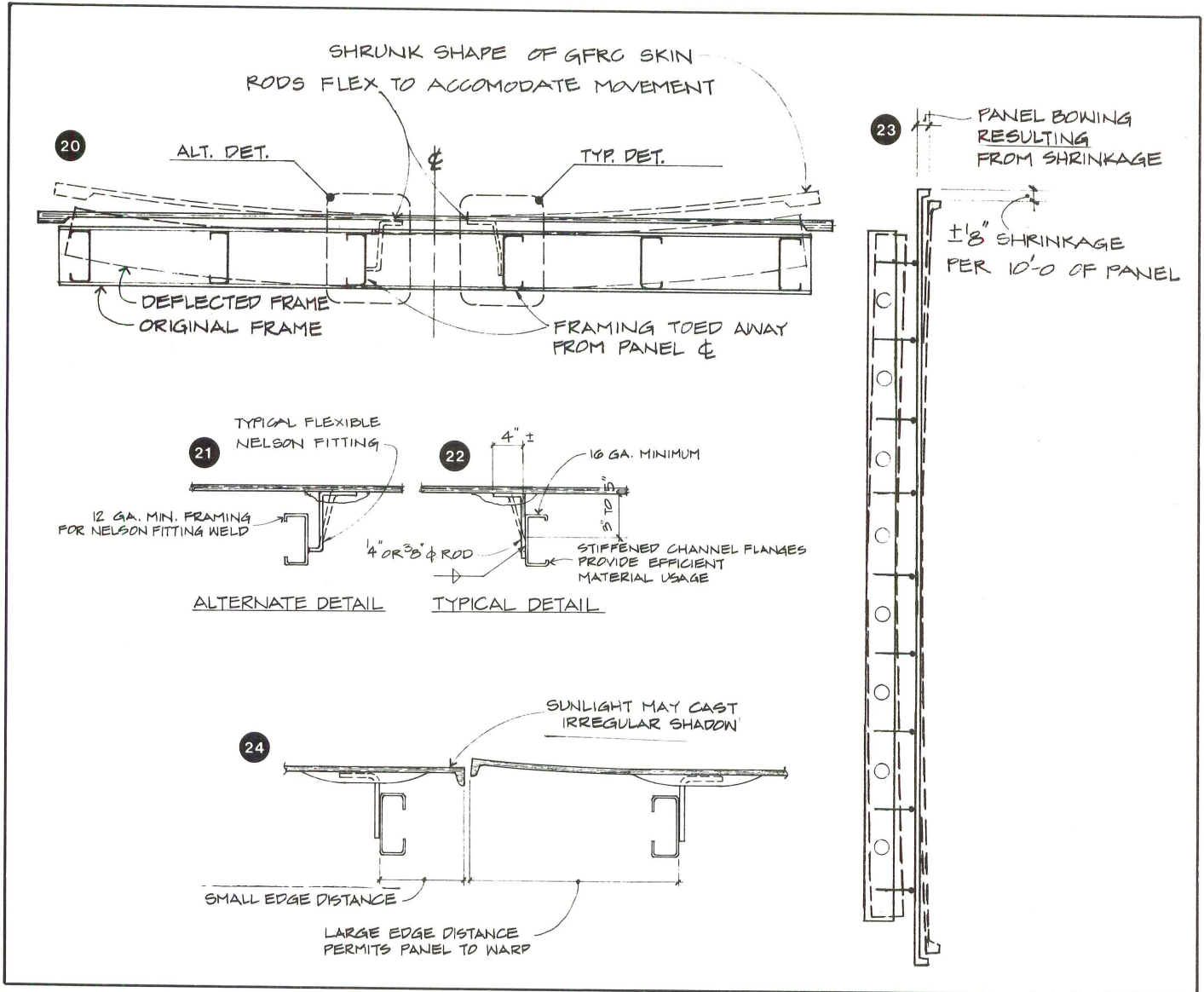
Production of GFRC panels requires a concrete- or plastic-coated plywood form conforming to the outside configuration of the panel (fig. 12) and a corrosion-resistant metal supporting frame, which is fabricated concurrently. The face of a panel is formed first, by spraying cement and sand slurry on the form along with strands of alkali-resistant, multi-filament fiberglass, cut in lengths of approximately 1½ to 2 inches. This mix is then blended with a serrated roller to embed the fiberglass and compact the mix. The slurry is applied in several layers until the required thickness and density is obtained. Panels with varying properties for different applications can be produced by altering the composition of the mix.

The primary mix-variables are water-cement ratio, porosity, density of the composite mix, amount of inert filler (sand), fiber length, fiber orientation and type of cure. For high cured-strength, and to permit forming of vertical returns on panels, fabricators prefer to keep water content of the slurry as low as their spray equipment will allow.

During manufacture, the steel framework is affixed to panels by placing it against the wet GFRC in a jig and mopping the rod anchors into the back face of the panel. Considerable fabricating flexibility is afforded by this process. On small panels, for instance (fig. 13), GFRC ribs or tubular sections may replace the steel framework entirely. Without special care, however, the ferrules embedded in the panel may telegraph through the skin and discolor the outside face of the







panel. The flexible fabricating process also enables the forming of small vertical returns, as shown in fig. 12. Large vertical returns of two feet or more, however, are problematic, as they slump and run. Horizontal returns at the top of vertical returns are impractical for the same reason.

The small, vertical returns simplify the formation of corner joints, which are difficult to make or hold and align properly if configured as shown in figure 14. A separate corner panel or a panel return from one of the building faces is a better design (figs. 15 and

16). Simulated joints may be used if desired, for appearance.

If corner joints are for some reason required, they should be chamfered to avoid the sharp friable edges shown in figure 17 and to permit joints to be easily caulked (figs. 18 and 19).

### DEFLECTIONS

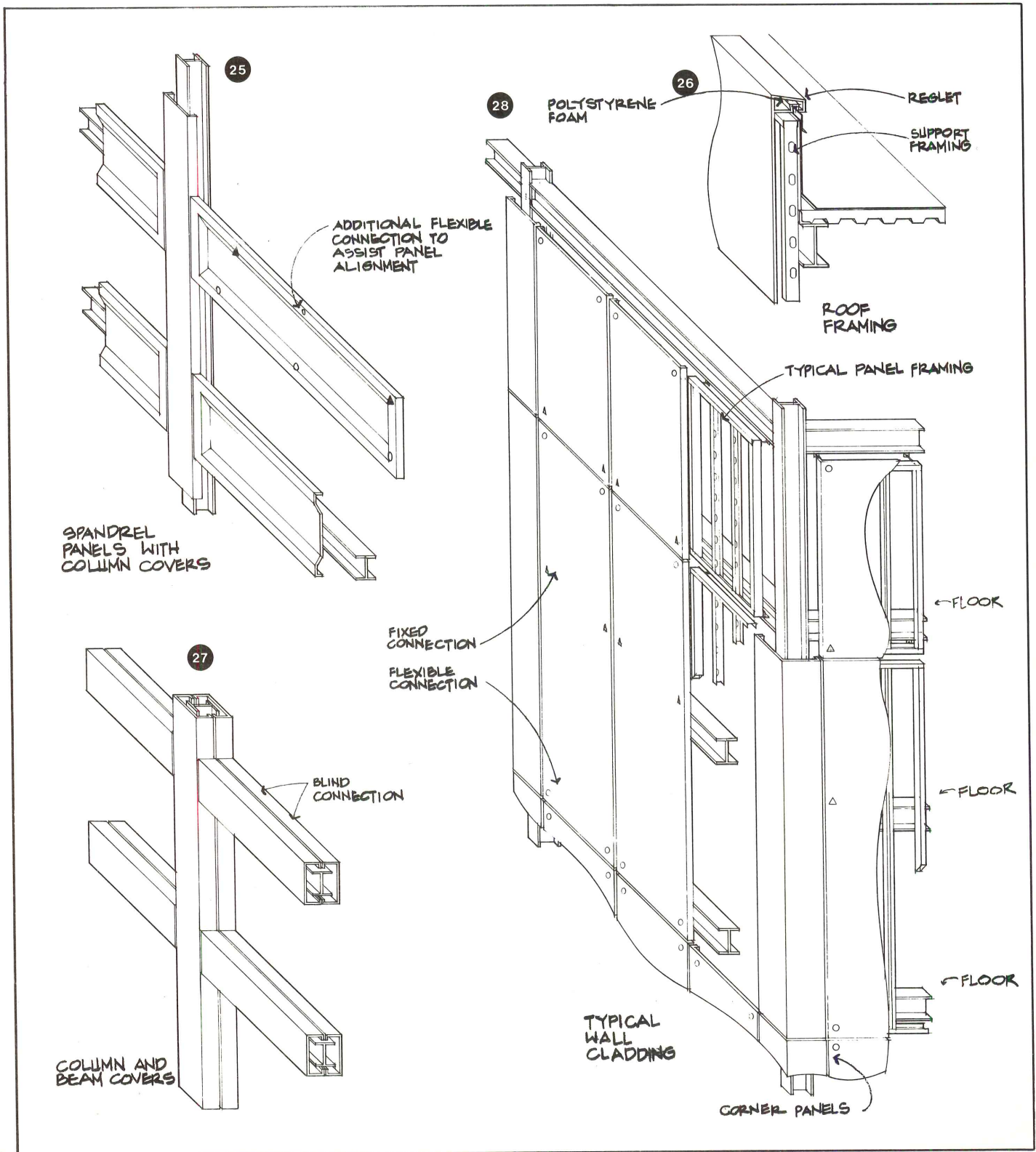
The earliest GFRC panels were limited in size because of fears that excessive shrinkage in the rich concrete mix used would cause cracks or failures. Today, panels

as long as 25 to 30 feet are not uncommon. For these panels, however, forms are lengthened  $\frac{3}{8}$  to  $\frac{1}{2}$  inch to compensate for the shrinkage. Skin attachments are made flexible and toed away from a panel's centerline, also to accommodate deformation (fig. 20). Such a flexible arrangement is the Nelson fitting shown in figure 21, which is used with heavier-gauge framing; the stiffer, conventional fitting is shown in figure 22.

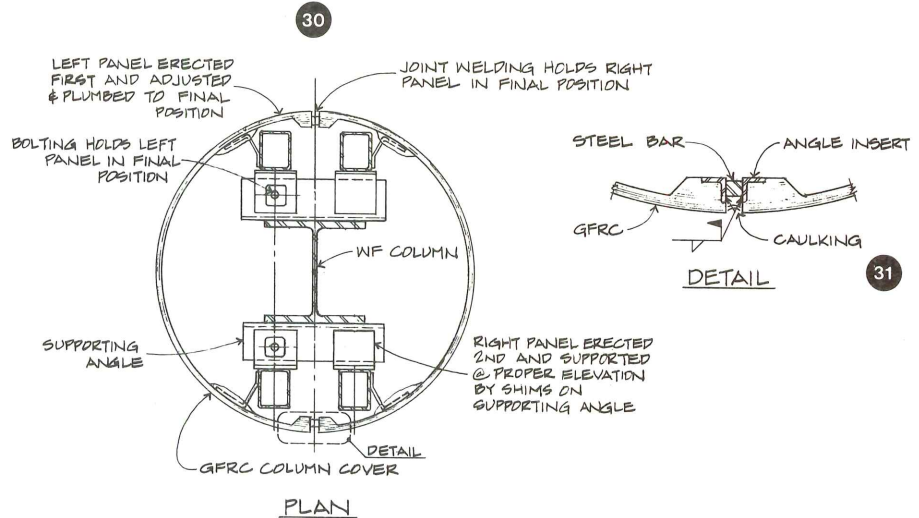
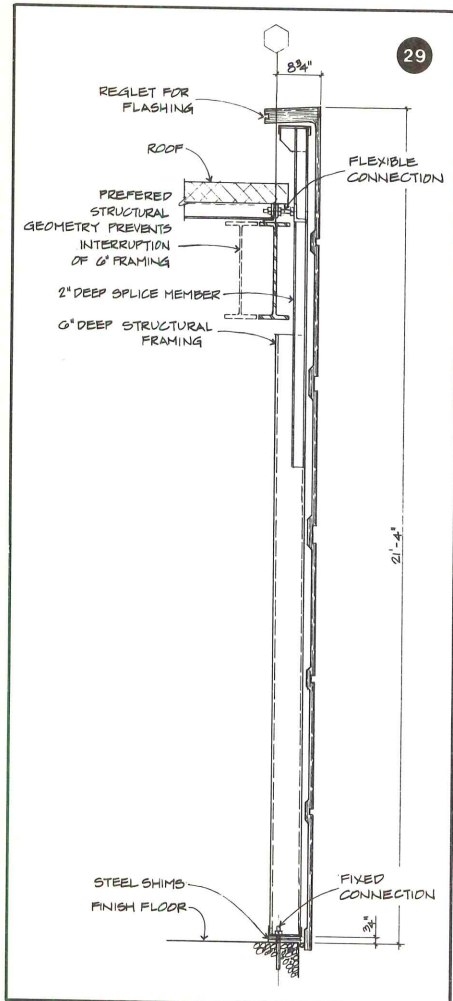
A panel framing that is resistant to deformation, and hence, bowing of possibly an inch or more (fig. 23), must be sufficiently



Room required for panel framing







stiff. And because framing-stiffness varies as the square of the depth, ample room between a panel's skin and the structural framing is necessary for a successful design. Where greater strength and stiffness is desired without increasing framing-depth inordinately, gauge-metal tubing or structural tubes are often used.

Because GFRC panels frequently have a sandblasted or textured surface, slight deflections or pans near the center of the panel are hardly noticeable. However, when adjoining panels deflect differently where they meet at the joint (fig. 24), the discrepancy under certain light conditions can be glaring. These deflections may be minimized by locating panel edges within a few inches of a framing member (shown at left in fig. 24).

### COMMON APPLICATIONS

GFRC panels serve a range of applications: Fabrications include sculpted spandrel panels or window panels (fig. 25), a parapet with horizontal, polystyrene-stiffened return and galvanized reglet for roofing (fig. 26), column-to-column and beam-to-beam covers (fig. 27), and wall panels and corner panels spanning one or two floors (fig. 28). Note location of flexible and fixed connections in figure 28, indicated by circles and triangles, respectively.

### SPECIAL DETAILS

In the interest of adding a few square feet to the floor area, designers often allow too little room for panel framing. Figure 29, for example, shows a wall section from a single-story building constructed on a site with several open acres on all sides. The architects left only two inches for panel framing. Moving the exterior panel-face out several inches would have accommodated the 6-inch framing required and avoided the complicated and expensive splicing of framing material.

For panels that encircle a column or beam (figs. 30 and 31), blind fasteners are often required. This entails securing one panel to the beam in the usual manner and blind-welding the closing panel to the first panel. The sketch shows how. Metal inserts in the

panels are best kept to a few inches in length; longer inserts could cause cracks in the panel from shrinkage. If access to the structural column is anticipated, blind connections are best positioned at the ends of the panels. □

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# AFFORDABLE CAD: WINTER UPDATE

BY OLIVER R. WITTE

*Improvements to affordable computer-aided design systems continue to accelerate.*

*Since the last report (Fall 1984), all six software vendors included in the continuing evaluation by ARCHITECTURAL TECHNOLOGY have updated their programs, and by the time this issue is published most of them will have introduced still more powerful versions.*

*ARCHITECTURAL TECHNOLOGY plans to publish a complete re-evaluation of affordable CAD systems later this year. Nevertheless, change has been fast and significant enough to warrant an interim report. —O.W.*

**T**HE LATEST ROUND OF CAD SOFTWARE improvements enhances the speed of the programs and sharpens the resolution of the video displays. Also, the new releases are more convenient to use and include improved routines for extracting and reporting information for use in estimating, bills of materials and the like.

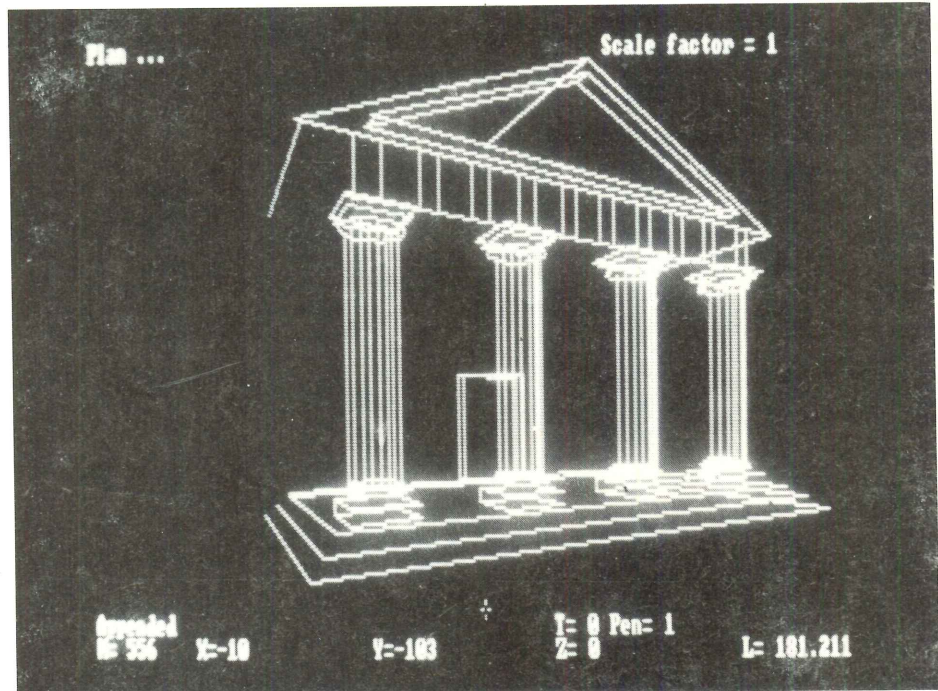
Equipment manufacturers have kept pace by introducing improved computers and peripherals. The big news is the introduction of faster microcomputers by IBM and competitors such as AT&T. None of this magazine's evaluators have tried their CAD programs on these new machines, however.

IBM also is introducing a higher-resolution graphics board and monitor. No CAD software vendor supports them yet, but like most IBM products, they are expected to set new standards.

Prices generally have remained firm for CAD software and peripherals but have softened for older-generation computers.

The small- to medium-size architectural and/or engineering firm is now recognized as a significant market, and new products address their needs specifically. Standards are emerging for the exchange of graphics between computers. VersaCAD and AutoCAD tout their ability to exchange drawings with mainframe CAD programs. Software vendors are working to develop or improve symbol libraries and 3-D capability.

The 14 evaluators who produced the Fall article have taken somewhat different paths. Those who seem to have jumped the most



enthusiastically into the CAD age are working with VersaCAD, AutoCAD and, to a lesser extent, MicroCAD.

Charles Newman, AIA, a VersaCAD evaluator, says he has generated enough new work to add two architects, two more computers and a \$17,000 Hewlett-Packard plotter. He claims he seldom draws by hand any more. But two other evaluators tell us that CAD has had no impact on their practices, and that their systems have fallen into disuse. The rest report intermediate levels of progress integrating CAD into their work.

Here is a summary on the status of each of the programs evaluated in the Fall issue, as of January 1985:

## AUTOCAD

The current version is 2.0. It represents the most significant improvement so far in the fastest-selling CAD program. AutoCAD doubled its number of installed systems from 5,000 in June to 10,000 by the end of the

year. Sales are approaching 2,000 a month, according to the vendor, Autodesk of Mill Valley, Calif.

Daratech, a CAD research firm, estimates that AutoCAD has captured 25 percent of the PC-based CAD market and forecasts that it may soon pass CADAM to become the most widely used CAD software in the world. CADAM, a product of IBM, has 13,000 active workstations, according to Daratech.

AutoCAD 2 features object snap, dynamic dragging of objects, displayable line types and isometric grids. It improves the handling of symbol or object attributes—text items that specify such information as name, cost and power consumption. Extracted as a database in any of three file formats, they can now easily produce a bill of materials, an analysis of energy consumption or other reports for further manipulation by programs such as Lotus 1-2-3 or d-Base.

The new version runs faster and includes



optional symbol libraries and a mainframe communications package.

Layers are organized better and may be named. Dimensioning, especially dimensioning of an angle or a radius, has been improved. Portions (windows) of drawings can be named and saved, facilitating the creation of symbol libraries. The choice of lettering has been expanded. Editing, scaling and mirroring have been enhanced.

The manual, a weakness of most affordable CAD systems, has been improved to make the program easier to learn and use.

Coming this winter is AE/CADD, a front-end system featuring customized menus and other conveniences intended to adapt the program to architectural use. Neeley/LaFrano Architects, San Francisco, developed this architectural template.

The intent of AE/CADD is to make drawing with AutoCAD architecturally intuitive, according to Dennis J. Neeley, AIA, vice president of the firm. For example, dimensioning is done first and drawing second. Another example: the template establishes routines to permit automatic insertion of a door in a wall, with prompts for size, hinge and direction of swing. Anticipated cost for AE/CADD is \$1,000.

### CADPLAN

The current version is 1.45. For high-resolution (640 × 400) screen display, the Conographics card (\$1,000) and the Electrohome ECM-1301 monitor with digital interface (\$1,555) are recommended by the vendor, Personal CAD Systems, Los Gatos, Calif. By comparison, the standard IBM color equipment provides a screen resolution of 320 by 200 pixels.

Ellipses, polygons, mirroring, calculation of irregular areas and free-form curves now are standard. The new version also allows curved objects to be textured. And it permits placement of a node at the endpoint of an arc, making possible precise connection with another arc or a line.

The dimensioning routine has been changed to do more, more easily. Examples: Measuring diagonal distances between interior walls and extending parallel lines.

Database extraction has been improved and simplified. It is also now explained better in the manual. The program now ignores

symbols specified in the search but not found in the drawing.

Considerable work has been done on plot routines. CADPlan added a menu option to automatically plot a drawing as large as the available sheet. Before beginning to plot, the program reports the scale so the user can decide whether to accept a slightly smaller drawing for the sake of getting a more rational scale. Plotting part of a drawing now goes faster because the program is instructed to ignore anything outside the specified window.

### VERSACAD (E-2000 JR.)

The current version is 3.1B. It now supports either one or two screens (in color or monochrome), a mouse, a wider variety of digitizers (including all models by Kurta and Summagraphics) and the new \$5,000 plotter by Houston Instrument, the DMP-52MP with 14 pens. For high resolution color with the IBM computer, the Conographics Color 40 board and the Electrohome ECM-1301 monitor are recommended.

VersaCAD is a product of T&W Systems, Huntington Beach, Calif. Its licensee, Carrier Corp., Syracuse, N.Y., calls the version of VersaCAD that runs off the IBM XT the E-2000 Jr.

Among the new computers supported by the software are the Sperry and the AT&T. With the Intel 8087-2 co-processor, they run the program twice as fast as the IBM XT and offer a larger screen with greater resolution for the same price.

Although VersaCAD runs on the IBM and Apple (and clones), it performs best on a Hewlett-Packard computer. A recent price break has brought the cost of a complete HP-based system to \$24,000 (compared to \$16,900 for an IBM-based system), based on prices quoted for sale by T&W.

Version 3.1B corrects for aspect ratio (so a circle looks like a circle on the screen) and permits a point to be considered an object. A demonstration program is also now available.

Both T&W and Carrier have expanded their symbol libraries, already the best in the field.

VersaCAD's routine for graphics interchange has been improved, as has its ability to handle text.

The program interfaces with Images, a

finite element modeling package for structural analysis. And a new routine permits a large drawing to be archived on multiple floppy disks.

The next release, Version 4.0, is due out for the IBM XT and AT in February. It was available for the Hewlett-Packard in December. The IBM version will solve VersaCAD's major handicap, a difficult start-up due to its unusual disk operating system. Version 4.0 will use the IBM standard, MS-DOS.

Other major improvements have been made to the database extraction routine (including a simplified but more powerful bill of materials) and 3-D drawing. The need to touch the keyboard has been eliminated (except to enter text). The new version will include a word processor so text can be manipulated for a drawing, the same as for a letter.

Group editing will also be much improved. The new version allows lines to be inserted in any combination, including parallel and extended. X and Y axes can be scaled independently. A routine called equation snap will permit the user to go precisely to a vertex or any point. Example: It will trace a circle or ellipse dynamically. Dimensions may be entered and manipulated in many combinations, including feet and inches.

To make CAD easier to learn for beginners, T&W has introduced what it calls its entry-level system (\$495) and a series of ten videotapes (\$495).

Evaluator Newman, who reviewed VersaCAD and AutoCAD, maintains his preference for VersaCAD. He says it is superior in its handling of menus, symbols, attributes and plot specifications.



## More systems permit solids modeling

### MICROCAD

The current version is 3.34, released in November. It supports high-resolution color using Electrohome and Vectrix monitors.

The new software and the new generation of microcomputers enables the program to run faster. It's easier to generate ellipses and rotate circles and spirals. The menu can be placed on the digitizer and selected with the stylus.

Symbols are easier to extract and save in libraries in the latest version. An ortho function is now available.

Two modules have been added. One does volume calculations (\$250) and the other produces bills of materials (\$250). Version 3.34 interfaces with SAP86, a finite element analysis program for structural engineering. A quarterly newsletter for users has been launched.

Another module, Enhanced Drafting, is to be introduced at the start of 1985. It will support the new virtual device interface (VDI), a standardization protocol that facilitates matching programs with peripherals. Other features of the module include layering, rotatable cross hatching for better shading effects and automatic dimensioning. It will support a wider range of digitizers (including those by GTCO and Kurta) and plotters (including Hewlett-Packard and Houston Instrument).

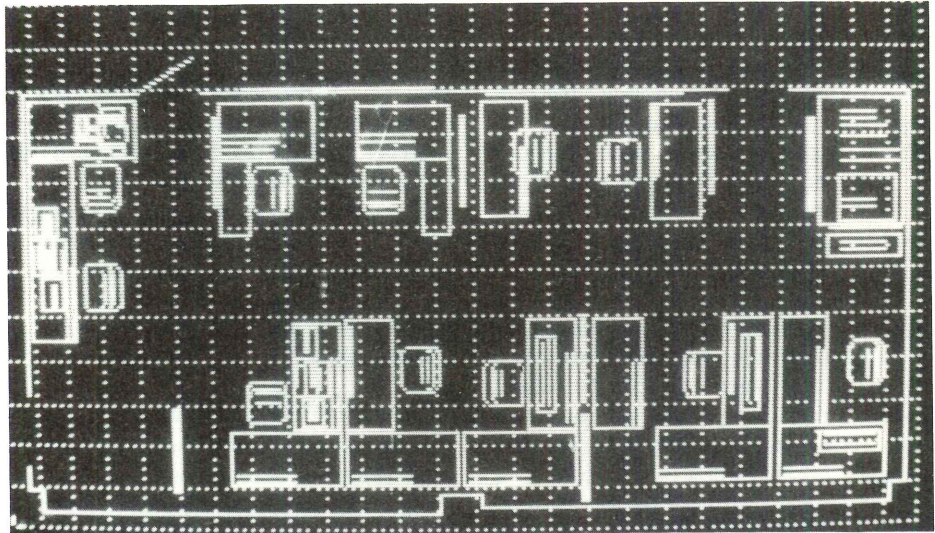
By spring, MacroCAD is expected to be on the market. It will provide solids modeling (instead of wire frame) and programmable macros.

The San Francisco vendor has changed its corporate name to Imagimedia Technologies, from Computer Aided Design.

Evaluator David J. Engelke, AIA, who reviewed MicroCAD and AutoCAD, says he is considering using both—the former for 3-D perspectives and modeling and the latter for drafting.

### ROBOCAD

CAD2, Version 11 is current. The most recent improvements were auto-dimensioning (automatic generation and placement of lines and arrowheads), automatic cross hatching and three-point arcs.



The next major improvement will be a version that runs on the Apple IIc.

CAD3, which will run on 16/32 bit computers, is scheduled to be introduced this summer.

RoboCAD currently runs only on the Apple IIe or Apple II+ computers. The program is a product of Robo Systems, Newtown, Pa.

### DRAWING PROCESSOR

DP II, Version 2.1, is current. Drawing Processor, by BG Graphics, is the only program that has been updated twice since our Fall report. Comments apply to Version 2.0. Version 2.1 was just being released at year-end and was not available for evaluation, although the vendor says it has been rewritten to run more than five times faster, display high-resolution color and support a mouse.

Evaluator Robert C. Robicsek compared Drawing Processor and AutoCAD and found that the latter was clearly superior in virtually every function.

Nevertheless, Drawing Processor is attractive because of its low price and because it is easy to use. The Drawing Processor manual, already good, has been improved with better illustrations and a well-documented list of commands. It does an excellent job of explaining CAD to novices,

Robicsek said. The manual also provides clear diagrams of cable pin connections.

DP II permits menu commands to be customized, multiple layers and autodimensioning (with, unfortunately, an excessive number of keystrokes). Further, DP II supports more peripherals. Other additions include a newsletter and a 30 minute self-running tutorial (\$25).

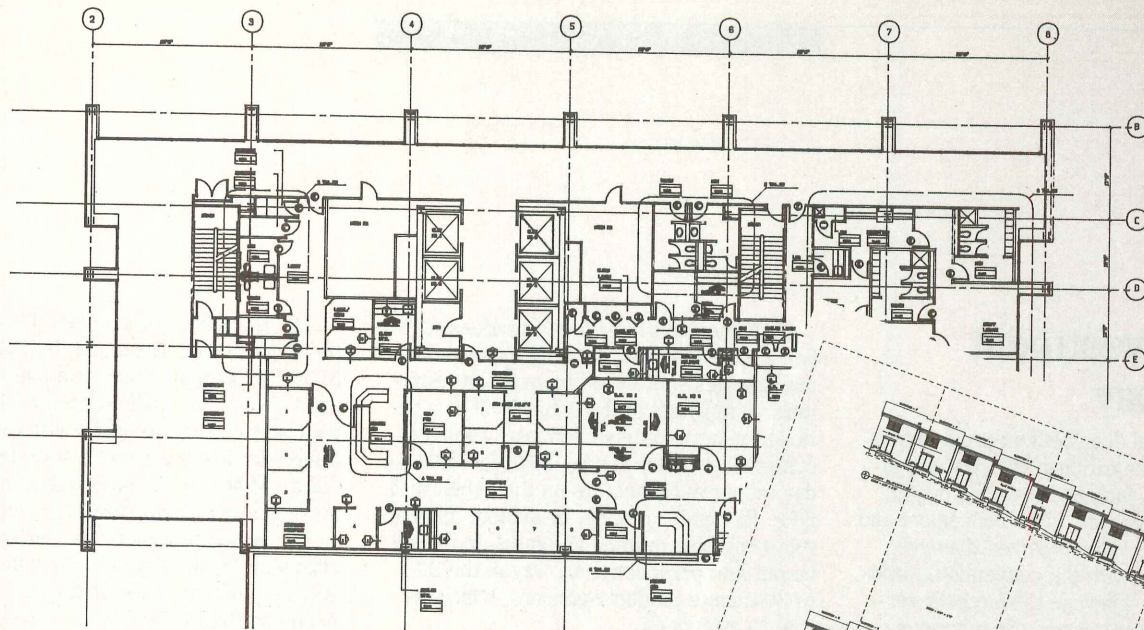
The price remains the lowest of the affordable systems, but its sales have also been the slowest.

The program still uses the cumbersome pen-up/pen-down commands for line generation and the block commands remain rather awkward.

An orthogonal mode is not yet available. With the "tolerance command," a user may attempt to snap to a grid, but the method seems less than satisfactory. Also unavailable are isometric and perspective drawing modes, bills of materials and symbol libraries tailored for architects.

The vendor is trying to make the program more appealing to architects, but it remains best suited for general drafting. Although Drawing Processor shows promise, it is several updates behind the leading affordable CAD packages, according to Robicsek. □





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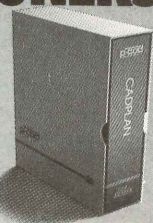
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## Value investment by the bay

The professional development programs on tap for this year's national AIA convention (San Francisco, June 8-13) will be bigger, longer, more compact, more convenient and cost less for the value received than ever before. Coupled with the convention's products exhibition—likewise the largest ever—the seminars, lectures and consultations scheduled in the Moscone Center add up to a full plate of innovative practice and management ideas.

A full Saturday's worth of professional development programs are scheduled for June 8th, from 8:30 to 5 p.m. These all-day workshops are drawn from the AIA's nationally-sponsored workshop series, available for the first time to convention-goers. Subjects of the five workshops are CAD, negotiating better compensation, architect as developer, financial management and time management. To participate in the Saturday series, however, you must pre-register.

Also new at San Francisco is a series of seminars slated for Sunday afternoon, along with "sunrise" consultation sessions (7:15-8:15 a.m.) Monday through Wednesday. These early-bird consultations explore the federal and international markets, the how-to of winning presentations, designing for the electronic office and the evolving needs of tomorrow's architects, among other topics.

The convention's professional development series ends with a first-time-ever cluster of six seminars on Thursday morning, June 13. Topics include "smart" buildings, barrier-free design, the dynamics of the development planning team, controlling the spiraling costs of professional liability, the usefulness of micro-CAD and emerging opportunities for new services in the growing field of facilities management.

The "stats" of this year's convention are impressive. The professional development "faculty" comprises more than 30 architects, clients, educators, consultants and scientists. There are 34 professional development programs, 42 consultations and five full-day workshops. Paired with the 15 hours of special San Francisco case studies, the convention's educational offerings total over 100 programs—double the educational opportunities of last year's convention.

On the exhibit-hall floor, attendees will find a varied display of new products and technologies showcased by over 200 exhibitors. A highlight of the exhibit will be a series of generic-product seminars running continuously from Sunday through Wednesday in four mini-theaters on the exhibit-hall floor. Skylights, roofing, insulation, lighting, repro and blue printing and much more will be put into perspective by way of the 20-to-30-minute product seminars, which are free to attendees.

This year's professional development program also addresses the tight schedule of AIA members. Single-day registration will be available to every member of the profession. For a schedule of the convention's 200-plus hours of professional interest programming, contact the AIA convention department, telephone (202) 626-7390.

—Ray Rhinehart

## Indoor air evaluated

*Indoor Air Quality, An Architectural Primer*, succinctly presents the complex subject of indoor air quality to architects.

The 20-page booklet defines key pollutants and discusses abatement strategies, energy considerations, regulations and legal issues. It also provides a glossary and sources for further reading.

For copies, send \$5 to Paula Knott, AIA Foundation, 1735 New York Avenue, N.W., Washington, D.C. 20006, or call (202) 626-7439. —J.B.G.

## Performance/ payment bonds ready

Two separate bonds, a performance bond and a payment bond, have recently been published under the designation AIA Document A312. The document is the product of seven years of joint efforts by The Surety Association of America, The Engineers Joint Contract Documents Committee, The Associated General Contractors of America and The American Institute of Architects.

A unique feature of these documents is that they can be used with other AIA documents or with appropriate non-AIA documents.

Although customarily issued simultaneously and under one premium, the bonds are not a single document. Each must be executed separately.

AIA Document A311, the 1970 edition of the Performance Bond and the Labor and Material Payment Bond, continues to be issued. A311 must still be used in government contracts since it complies with the federal Miller Act and the various state-legislated "Little Miller Acts," substituting for mechanic's lien laws on government projects.

The notice-provisions for perfecting claims under the payment bond in the new A312 differ from those in the A311 payment bond and the Miller Act. It is expected that the A312 version will be used in all contexts where Miller-Act provisions are not required.

With regard to the performance bond, in contrast to A311, the contractor does not have to be in default for the surety to be obligated on the A312. A312 provides for a conference between the owner, contractor and surety to attempt reconciliation. If the owner subsequently declares the contractor in default, the newer document offers the surety the option, with the owner's consent, of financing the completion of the construction contract by the contractor.

—Cheryl Terio

## Roofing materials guide available

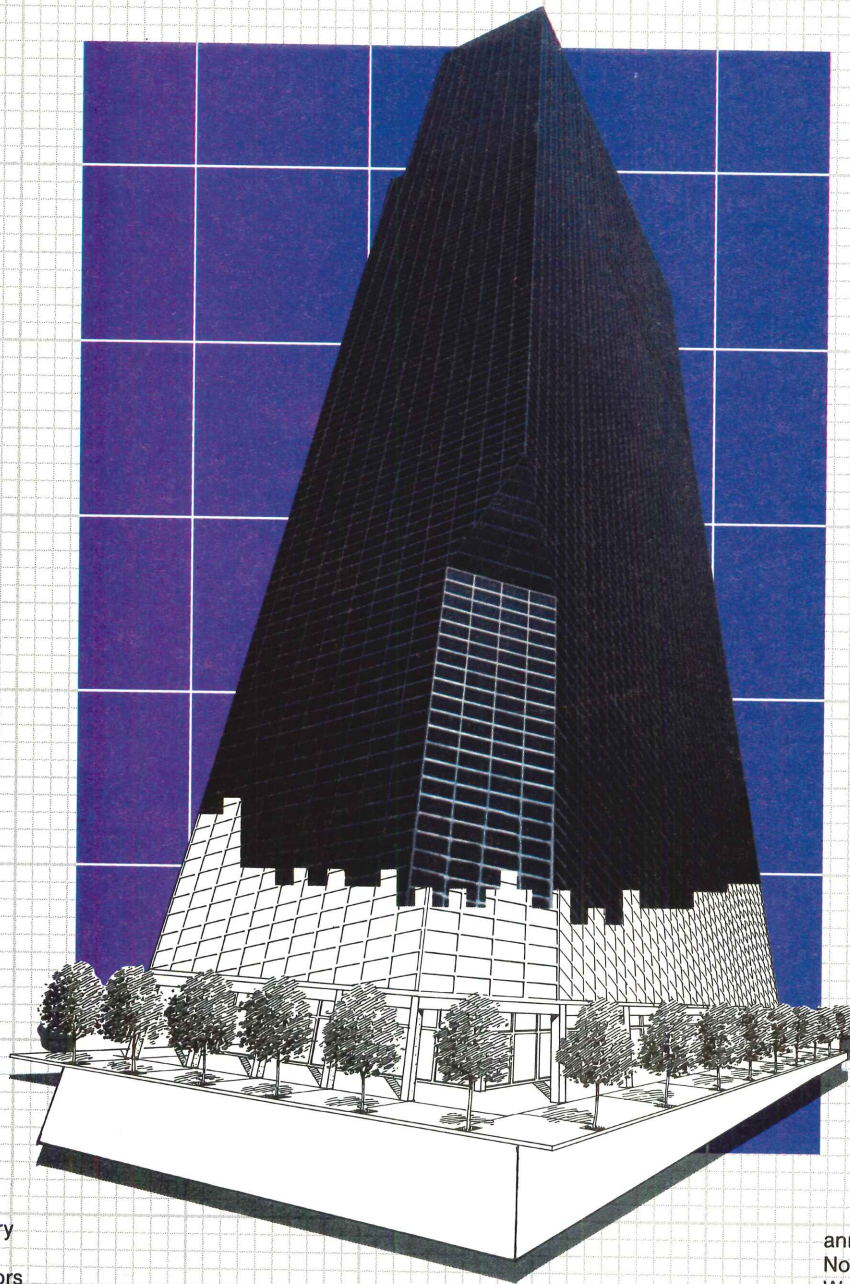
Aid to architects wishing to evaluate commercial roofing products is the *Commercial, Industrial and Institutional Roofing Materials Guide*. The 160-page volume, published by the National Roofing Contractors Association, presents concise data on several hundred roof membranes and an equal number of roof-board insulations. Information is structured to permit assessment of generic classes of roofing materials, such as PVC, EPDM and modified bituminous membranes, as well as specific products within generic classes.

Also included is information on required substrate, slope, method of adhesion, flashing materials, warranty and technical data on material properties for each product. Contacts for further information are listed as well.

The guide, in its sixth edition, is available to architects at an introductory price of \$22. It may be ordered on letterhead accompanied by a check from the National Roofing Contractors Association, 8600 Bryn Mawr Ave., Chicago, Ill. 60631. —J.B.G.

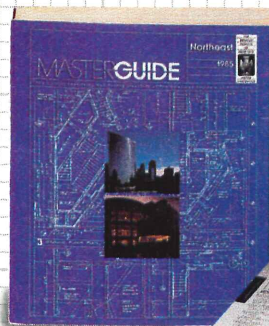


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## Code research made easier

A new computer code search and analysis service for architects, the result of two years of research and testing, is available from the Louisiana Institute of Building Sciences, a non-profit research corporation created by the Louisiana Architects Association, AIA.

Participating architects can mail or call in building project data from a simple one-page checklist and the LIBS computer will report requirements of the NFPA-101 (Life Safety Code) and the Standard Building Code. Plans are in the making for similar computer code searches and analyses of the BOCA and the Uniform Building Codes.

Architects who participated in testing the service to determine its accuracy and usefulness report that the service dramatically reduces the laborious and costly task of code research and improves code conformance.

Annual membership fee for the service, called Codesearch, is \$30. Information is available from the Louisiana Institute of Building Sciences, 521 America Street, Baton Rouge, La. 70802. Their telephone is (504) 387-2359.

## Beyond kitsch: energy comes of age

Because AIA's "Energy and Redesign" conference in Boston last November ended on a Saturday morning, only true aficionados remained in the audience to hear *Boston Globe* critic Bob Campbell deliver his provocative closing remarks. "Architecture that lacks an ethical basis is kitsch," Campbell said.

As examples of "energy kitsch," Campbell cited the prototypical passive-solar Vermont ski house—where the owners save a little on fuel oil but spend a lot on gasoline; and a windowless office building in Tampa that reaps energy savings by depriving occupants of daylight.

Who is at fault was the subject of a lively debate in which the audience suggested that the press encourages "kitsch" by glorifying form above holistic function. Campbell placed more of the blame on architects and also suggested that only they could initiate ameliorative changes.

Fortunately, precious little kitsch found its way into the presentations at the conference. Many of the participants observed that

energy redesign projects have at last "come of age"—the combined result of the revival of the rehab market and the growing body of experience in energy design within the architectural profession.

My favorite project, and one also endorsed by proceedings editor John Cable, AIA, was David Bennett and David Ejjadi's (BRW Inc., Minneapolis) Thresher Building renovation/adaptive re-use in Minneapolis. Here, Bennett has refined the "light tube" techniques he first tried on the Civil/Mineral Engineering Building at the University of Minnesota. Cable, who used to be in charge of building-energy-conservation research at the Department of Energy, termed Bennett's new approach to optically-beamed sunlight "a real breakthrough," because costs are coming down.

Copies of the conference proceedings are available (for \$30 postpaid) from Publications Fulfillment, AIA Service Corp., 1735 New York Ave., N.W., Washington, D.C., 20006. Make checks payable to AIA Service Corp.

—Karen Haas Smith

## Manual on project management ready

*Project Management Manual*, the final volume in the AIA Practice Management Committee's series, *Managing Architectural Projects*, is now available (112 pages, \$18 AIA, \$20.00 non-AIA).

The manual, which was written by David Haviland, dean of the School of Architecture at Rensselaer Polytechnic Institute, is intended to help architectural firms improve the way they deliver projects to clients, leading to better projects and greater profitability.

The three other volumes in the "Managing Architectural Projects" series are: *The Effective Project Manager* (42 pages, \$10 AIA, \$12 non-AIA), *The Process* (112 pages, \$18 AIA, \$22.50 non-AIA) and *Case Studies* (36 pages, \$7 AIA, \$8.50 non-AIA).

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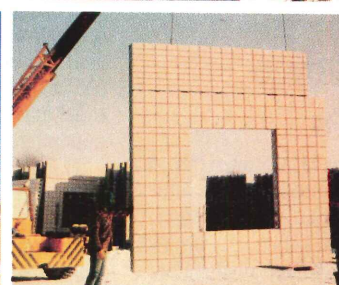
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## ASHRAE forms health committee

The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) is forming a standing committee on environmental health issues whose charge will be to integrate findings of indoor air-quality research conducted by government agencies, associations and universities.

Research goals for the new group include exploring the relationship between health-effect agents and HVAC equipment, determining whether control of humidity reduces certain pollutants, evaluating the application of ventilation as a solution to indoor air pollution, and reviewing the temporal dynamics of indoor air quality. Another important research focus will be the development of diagnostic evaluations to permit more accurate measurements of air quality.

In addition, the committee will evaluate the relative efficiency of alternative techniques for improving indoor air quality, including filtration, condensation, precipitation, sorption and improved maintenance procedures.

ASHRAE has also published Standard 62-1981, "Ventilation for Acceptable Indoor Air Quality." Further information can be obtained from Steve Comstock, telephone (404) 636-8400.

## Training for office administrators

The Society of Architectural Administrators is now completing the production of its new nationally-sponsored program, "A Training Seminar," the third in a series of educational programs targeted at the design profession. National Education Committee Chair Terry Bolender, of Leo A. Daly & Associates in Seattle, estimates that the new seminar will be available for purchase early in 1985.

"A Training Seminar" assists architects in training their professional administrative staff. It explains, to managerial and technical personnel, the responsibilities of support staff and the challenges they face. The seminars are also intended to help employees in

new and not-so-new support capacities understand how their work fits into the total team effort of an architectural firm, and to strengthen skills in leadership, public speaking and staff training.

For further information on these and other SAA-sponsored programs, contact: Terry Bolender, National SAA Education Committee Chair, c/o Leo Daly and Associates, 200 Cedar St., Seattle, Wash. 98121.

## Coping with codes

Dealing with the three model building codes, NFPA's Life Safety Code and some 3,900 state and local codes can be confusing. This was a starting-off point for participants in the AIA's annual education conference on codes sponsored by the AIA Codes and Standards Committee (now the Building Performance and Regulations Committee). The meeting took place last October in Austin, Texas.

The presentations, delivered by experts from all facets of the codes process, emphasized that this complex system requires increasing attention and participation from architects.

Though far from perfect, the system of three model codes, according to the speakers, is better than one code written and administered by the federal government. Bob Fowler, AIA, of Abilene, Texas, commented that a federal code would result in "a totally unresponsive and unwieldy bureaucracy." He added that the current codes system is capable of being "both a responsive and effective mechanism for insuring safe and durable buildings at a reasonable cost."

But J. Armand Burgun, FAIA, partner of an international firm specializing in hospital design, commented on the problems that arise from "layers" of building standards, administered by the federal government on down to local offices.

Burgun also cited the expanding role of building codes as further complicating the architect's job. While codes and standards were originally conceived to protect the health and safety of the occupants of a building, they now also regulate environmental conditions, sanitation, minimum room sizes, energy and many other factors.

Another problem in the present code system, committee members pointed out, is that because of the increasingly interpretive

nature of current building codes, even experienced, well-educated architects have begun to feel the threat of liability. While performance-based codes may heighten risk further, architects in general, and AIA policy in particular, prefer them because of the flexibility they permit.

Fire protection engineer Tom Jaeger, P.E., said that it will be ten years before fire-safety requirements are performance-based. He urged architects to improve their record in attending code hearings in order to work for performance-based codes. He also warned of the price: "You can't have it both ways—performance codes mean more liability (for the architect)."

The crux of the liability question was highlighted by Hollye Fisk, AIA, Esq. "The law presumes that a reasonably prudent architect will comply with applicable building code provisions," Fisk said. He pointed out that the law holds compliance with building codes as a "non-delegable duty," which means that if a building official approves a design that is found to be in violation of the building code, the architect may still be liable.

But mere compliance with building codes may not be sufficient. Fisk reminded the audience that codes are established to provide a minimum standard of safety. "The simple fact that you comply with a building code provision does not mean that you can't be found liable."

Ralph Rowland, FAIA, 1984 Committee Chairman, summarized what regulatory trends mean to practicing architects by advancing these recommendations:

1. Learn and understand the code and code development systems. Apply pressure to insure that competent people administer the codes and participate in the writing of the model codes.
2. Identify early on the specific codes and official interpretations that will apply to a project as well as the enforcement official and the appeal process.
3. Study applicable codes. Where there is ambiguity, obtain an interpretation from the authority having jurisdiction. The code official may be reluctant to give this interpretation in writing, but confirm your own understanding of the interpretation by letter to the code official.
4. To discover any potential code violations or disagreements—and to alert the building official to the scope, character and

*continued on page 86*



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continued from page 84

time schedule of the project—preview preliminary drawings with code officials as soon as design has been approved.

5. Question consulting engineers and interior designers about code compliance at every phase of design.

—M. Stephanie Stubbs

*AIA's newly-formed Building Performance and Regulations Committee (formerly the Codes and Standards Committee) will provide members with information about its new program structure on request. The committee also encourages comments and suggestions from AIA members. Contact: Joel "Tick" Vicars, director, (202) 626-7456.*

## Architects cautioned on ceiling loads

Architects cannot rely solely on minimum requirements in ASTM and other industry-consensus standards for design and selection of metal suspension systems for plaster ceilings, warns the AIA Service Corporation. The need to re-evaluate design criteria and construction practices, according to AIA/SC, is demonstrated by the collapse of a suspended portland cement ceiling in a public facility in 1983.

The collapse was caused by the failure of metal tabs rolled into a metal floor deck above the ceiling. Wire hangers supporting the ceiling were attached to these tabs.

Although the contract documents required inserts or anchors for hanging the ceiling,

tabs were substituted as an alternative and were not disapproved, despite metal deck drawings warning that load-carrying capacity of the tabs was inadequate for the hangar spacing provided.

The manufacturer of the metal deck features a note in its product data and shop drawings advising against using deck tabs for attaching hangars that support plaster ceilings. This note recognizes that the load-carrying capacity of tabs requires much closer hangar spacing than is normally provided.

A close examination of ceiling loads and load-carrying capabilities may reveal that minimum requirements are not appropriate for all projects. Contact: Roscoe Reeves, AIA/SC professional systems division, (202) 626-7372.

—Pete McCall

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## ZONING AS LITERATURE

BY JOHN F. HARTRAY JR., FAIA

WE SUPPORT POETS AND DRAMATISTS to explore our highest aspirations, philosophers to investigate abstract ethical problems and historians to document our acts of heroism. The questions we really care about, however, are usually turned over to lawyers.

This is why zoning ordinances make such delightful reading. They describe our baser instincts and motives and can be thought of as the soap operas of environmental design. They are also usually written in an endearingly pompous style that is reminiscent of Gilbert and Sullivan patter songs.

In our attempts to create an earthly paradise we leave a trail of legislation that documents our sense of social hierarchy, spatial order and our behavioral preferences. Best of all, the codes provide detailed lists of the things that bug us.

Zoning is more expressive than architecture because it is not delegated to an elite class of positive thinkers. It is a purely negative art form, and so the entire society is equipped to contribute to it. We may not all agree on a program for paradise, but Dante, Milton and Reverend Falwell would concur that the first step is to get rid of the devils. Listing those things which we wish to exclude from our lives can be very revealing. If the Samoans had written a zoning code, Margaret Mead would have had very little to do.

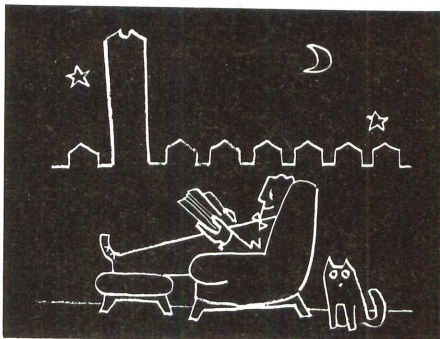
An anthropologist reading the Chicago ordinance would immediately recognize the city as a down-to-earth settlement of working-class people, who would be likely to choose unpretentious chieftains like Richard Daley or Harold Washington. The largest single-family lot considered by the ordinance is 6,250 square feet. This may have seemed an estate to the people who settled the city, but it doesn't provide much room for fox-hunting. It explains a lot about Chicago politics. Republicans need more grazing area.

In addition to designating the intervals at which houses are spaced, most codes define the relationships among their occupants. The taboos vary with the community.

A Chicago family consists of "... one or more persons each related to the other by blood (or adoption), together with such blood relatives' spouses, who are living together in a single dwelling." They may be accompanied by domestic servants and "not more than one gratuitous guest."

In addition to a desire to keep mothers-in-law off the premises, this wording shows that Chicago is not interested in alternate life styles. It should be admitted, however, that the Vanderhoff family in the play, "You Can't Take It With You," would have fit within the Chicago definition once the surplus gratuitous guests had married the daughters. A family structure that allows for farce is probably broad enough for the midwest.

Denver limits the occupancy of dwelling units to "... humans to sleep, cook and eat," and there are suburban communities where up to five unrelated individuals can call themselves a family. Washington, D.C., allows six, and will raise the number to fifteen in the case of religious communities which are left undefined. This situation seems



to provide almost infinite possibilities for litigation. The law industry manufactures its own raw materials.

Some suburban codes celebrate the bounty of other sectors of the economy by insisting that large scale consumer goods be kept out of sight. Americans should be proud to have laws which state that, "No recreational vehicle or boat parked in a residential district shall exceed ten feet in height excluding the mast."

These same communities are even more preoccupied with the commercial messages which accompany consumerism. The Denver ordinance defines something poetically called

a "wind sign" which directs attention to itself by "... being fastened in such a manner as to move upon being subjected to pressure by wind or breeze," much like the leaves of a quaking aspen. Fifteen percent of the Deerfield, Ill., ordinance concerns signs. It prohibits them from moving, flashing, being painted on walls, erected on roofs, or attached to trees. It also limits the size of the lettered area but not the overall size of the sign itself. A legal loophole may be available to skywriters with highly maneuverable aircraft.

Of course, finding the loopholes is most of the fun.

The Chicago code compensates for the modesty of its density requirements by allowing unusual opportunities for upward mobility. Anyone who studies the fine print can build a Sears Tower. Added floor area within buildings is traded for scraps of vacant outdoor space, which we call plazas. These spaces are needed in any case to provide hand-holds on model bases during design and as locations for construction shacks. Later, if they become sources of embarrassment, we fill them with prosthetic sculpture.

The convoluted descriptions of zoning premiums in the Chicago ordinance make it a useful primer for greedy children, but zoning is not always wholesome. Parental discretion is advised for the Washington, D.C., ordinance which describes adult amusement or entertainment with a degree of anatomical precision which would induce prurient lust in a bucket of wet spackle. The Denver ordinance is also rather risqué.

Because of their reliance on precedent, lawyers describe sin with no more originality than full time pornographers. There are, however, interesting regional differences in the manner of dealing with it. In Boston, everything gamey is concentrated on one street in the literary and theatrical equivalent of a toxic waste dump. Denver, on the other hand, favors dispersal: "... not more than two may be established, operated or maintained within 1,000 feet of each other."

Given sufficient time and continued demand, this will result in a triangular packing of imaginary five-hundred-foot circles. Out of their centers, light from pairs of disreputable retail establishments will shine like bloodshot eyes. Late at night, when most of Denver sleeps, the pattern generated by its insomnia and frustration will be quite beautiful. □

*Hartray is a partner at Nagle Hartray Assoc., Chicago, and teaches at the Illinois Institute of Technology.*



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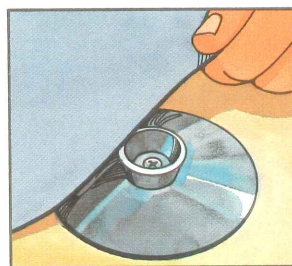
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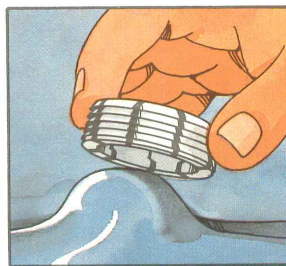
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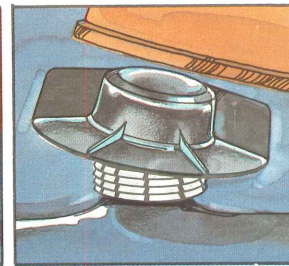
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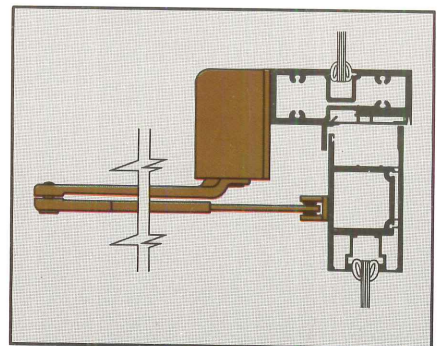
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