# ARCHITECTURE

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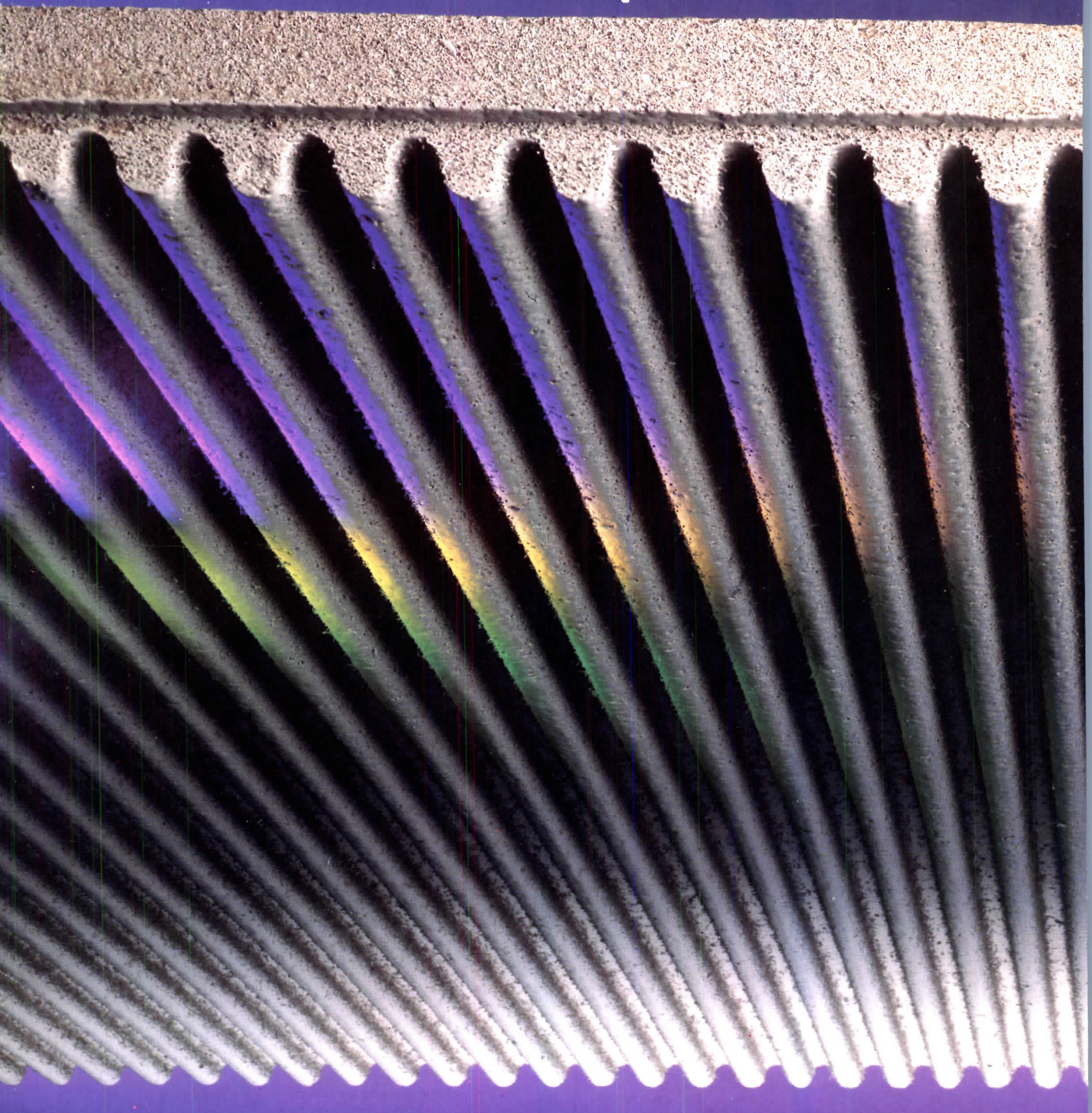

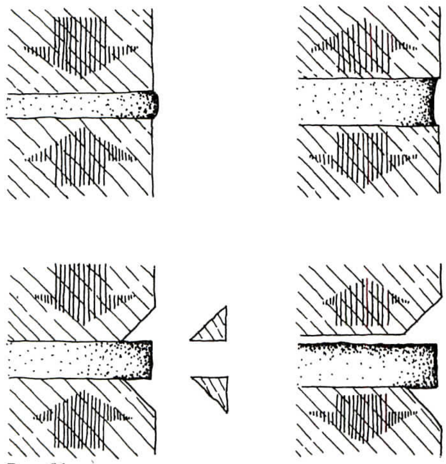

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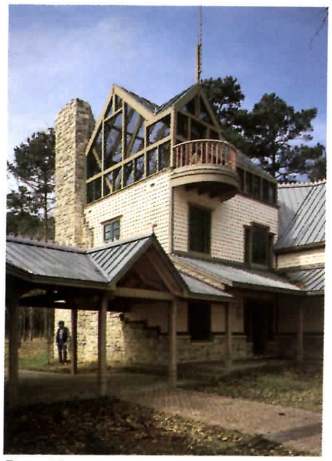

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## EVENTS

**Aug. 2-6:** Conference of the Illuminating Engineering Society, Scottsdale, Ariz. Contact: Cindi Altier, IES, 345 E. 47th St., New York, N.Y. 10017.
**Aug. 5-8:** Conference entitled "Influences on Design," Monterey, Calif. Contact: Kristina Goodrich, Industrial Designers Society of America, 1142-E Walker Road, Great Falls, Va. 22066.
**Aug. 6-8:** Society of Environmental Graphic Designers Conference, Bloomfield Hills, Mich. Contact: Sarah Speare, SEGD, 47 Third St., Cambridge, Mass. 02141.
**Aug. 7-11:** International Computers in Engineering Conference, San Francisco. Contact: A'ndrea Elyse Messer, American Society of Mechanical Engineers, 345 E. 47th St., New York, N.Y. 10017.
**Aug. 10-14:** Computer Art & Design Conference, Chicago, Contact: Bob Cramblitt, National Computer Graphics Association, 2722 Merrile Dr., Suite 200, Fairfax, Va. 22031.
**Aug. 11-12:** Symposium on Issues in Managing Engineering Data, New York City. Contact: American Society of Mechanical Engineers, 345 E. 47th St., New York, N.Y. 10017.
**Aug. 13-15:** Conference entitled "Landscape and Architecture," Providence, R.I. Contact: J. Michael Everett, RISD, 2 College St., Providence, R.I. 02903.
**Aug. 16-19:** North American Masonry Conference, Los Angeles. Contact: Susan J. Zelnio, Kariotis & Associates, 711 Mission St., Suite D, South Pasadena, Calif. 91030.
**Aug. 17-20:** Engineering and Manufacturing Conference, Boston. Contact: Nancy Flower, National Computer Graphics Association, 2722 Merrilee Dr., Suite 200, Fairfax, Va. 22031.
**Aug. 27-29:** Conference on the Esthetics of the Rural Renaissance, San Luis Obispo, Calif. Contact: Edward J. Ward, Dept. of City and Regional Planning, School of Architecture and Environmental Design, California Polytechnic State University, San Luis Obispo, Calif. 93407.
**Aug. 27-30:** Associated Landscape Contractors Conference, Portland, Ore. Contact: Rebecca Crocker, ALCA, 405 N. Washington St., Falls Church, Va. 22046.
**Aug. 29-30:** Louis Sullivan Architectural Symposium, Cedar Rapids, Iowa. Contact: David Wendell, Louis Sullivan Symposium, P.O. Box 396, COE College, Cedar Rapids, Iowa 52402.

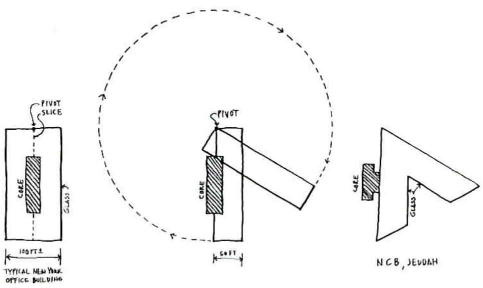
## LETTERS

**Buildings and Sites:** Three projects noted in your May issue graphically illustrate the contrast between architecture that is "of a place rather than on it" and the converse.

Charleston Architectural Group's Middleton Inn [page 166] is so carefully sited within its "Low-Country forest" and meticulously detailed that its modernist design is at home with its environs. SOM's National Commercial Bank [page 170] in Jeddah, by contrast, is so totally noncontextual that it appears as a college-level, basic design Strathmore model. Finally, Fisher-Friedman Associates' Vintage Club [page 98] sits in a man-made lake in country where all water is stolen from the Colorado River by means of aqueducts. In this instance, at some cost to the environment, the architect has created a place to be of/on.

*James T. Biehle, AIA*
*St. Louis*

**Why N.C.B. in Jeddah is *Not* a Triangular Building:** The enclosed diagram [below], while it is after the fact (like all diagrams), illustrates the relation of the plan of the National Commercial Bank to the conventional office building. [See May, page 170.] The primary fact about the design of N.C.B. is that it was not designed in elevation, but in plan. It is a building made by stacking vee-shaped plans, which were rotated every seven floors. It is a series of rotated vees with a triangular base and cap. The fact that one of the atriums has nine floors rather than seven was in response to a client request to have more floors where the atrium faced the view north. Of course if we had not liked this we would have resisted, but the point is it was the result of his request.




Only after the building was planned was it studied in elevation to determine how to handle the fenestration at the executive floor at the top. The canopy and garage were also studied in elevation.

The well in the center, which all the writers on the building insist was for ventilation, is in fact a product of the geometry of the floor plan, i.e., it is the void left when the vees are rotated. Again we accepted this because we liked it, and of course we realized it would be good from a ventilation point of view, but this is after the fact. From our point of view the great benefit of this well is it permits you to see through the building (unfortunately our photographer did not accept our suggestion to photograph this aspect).

Why do I insist upon these distinctions? N.C.B.'s completion and publication has coincided with the much touted "death of postmodernism." N.C.B. has been frequently cited for its having been designed on the basis of principles, not pastiche. This observation is correct, but by emphasizing the perception of the building as a triangular mass with the atriums "scooped out," the planning principle is missed.

To explain my involvement in this, I was the senior designer working with Gordon Bunshaft, FAIA. It occurs to me that for more information about our project, the Museum of Modern Art publication by Arthur Drexler about this project (as well as projects of Foster and Johnson) gives a good account, illustrated with an early study of mine for a building with no separate core and vees facing in all three directions, which was the initial idea, with sections, of which we drew many, and two elevations of mine drawn quite late in the design—after we had settled on the top but were still studying the canopy, which is on a separate piece of paper.

Still, I don't want to appear ungrateful. We are pleased with the AIA's honoring us with an award and with your publishing it.

*Tom Killian*
*New York City*

**Fees and Creativity:** Your article "Architects as Technological Innovators" [March, page 102] perceptively examines current technical stagnation in architecture. Given technology's logarithmic advance, materials and methods more than a few years old can needlessly restrain creativity and increase life-cycle costs.

The real issue is economic. Typical fees provide little room for new approaches. Consciously or not, architects have gradually compromised their ability to innovate as they have reduced their roles elsewhere in the building process by working for ever-smaller fees.

That architects must be more assertive in fee negotiations is reinforced in this context. Suitable fees will ensure that our responsibilities to serve clients' best interests, which may involve use of new materials and techniques, and to advance the state of the art of architecture, will not stay unfulfilled.

*Jeffrey R. Vandervoort*
*Houston*

**Amplifications:** The March article "Fabric Covers a Multitude of Buildings" (page 87), which named major players in the fabric-structure industry, failed to mention Caldwell Commercial Inc., a manufacturer of patented silicone-coated glass fiber.

Aragon, the firm that designed the Miami house shown on pages 64-67 of our April issue, is alive and well in Washington, D.C. John Ames Steffian, AIA, a principal in the firm, is now dean of the school of architecture at the University of Maryland.

The project manager for the Colby College Student Center, by Centerbrook Architects (May, page 108), was J. Whitney Huber, AIA. The design team included James A. Coan, AIA, Robert Coolidge, AIA, David Hajian, Elaine Lary, Roger Williams, and Randal Wilmot.

*Design*

# Meier Wins Commission After Competition Jury Chooses Koolhaas

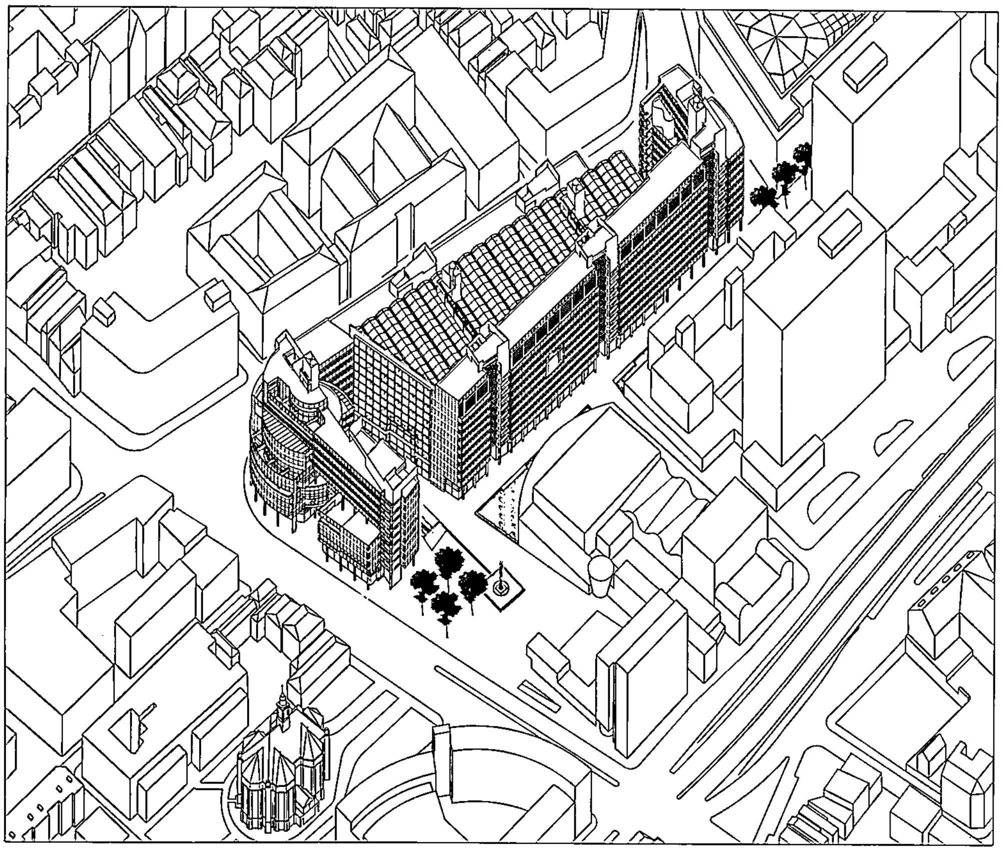
After an unusual selection process, Richard Meier & Partners of New York City has won the commission to design the new city hall complex in The Hague, Netherlands.

Meier was awarded the commission for the 80,000-square-foot political and cultural complex, to be located on a prominent site in the heart of the city, after the city council voted in his favor 35 to 9. City council approval came after an international design competition, an exhibition with a public vote, and a decision by the board of city fathers—which provided conflicting recommendations.

The invited design competition held in the early spring was won by Rem Koolhaas of the Office for Metropolitan Architecture in Rotterdam. His scheme was selected over proposals by Helmut Jahn, FAIA, of Murphy/Jahn of Chicago; a team headed by Roger Saubot and Francois Jullien of Paris with the Webb Zerafa Menkes Housden Partnership of Toronto; Hans Boot of Van den Broek en Bakema of Holland; and Meier. (Koolhaas was invited to join the competition after James Stirling, Hon. FAIA, withdrew six weeks before the proposals were due.)

After the jury recommendation, the five proposals were exhibited and visitors to the show were polled. Meier won the public vote. However, the eight-member board of city fathers was split between Koolhaas and Meier and the decision devolved to the city council.

Meier's scheme (below) has two 10-story wings connected by a large, glass-covered atrium and responds to the rounded end of the narrow, wedged-shaped site. In addition to a new city hall, the $100 million (or more) complex will include related municipal facilities, a library, and a commercial office building. In commenting on his design, Meier said, "The character and spirit of the building is defined and evoked by its architecture, by the way in which light and space are treated, not by superimposed preconceived symbols of government."



The discord surrounding the selection of Meier's scheme is the latest chapter in the ongoing saga to find an appropriate use for the downtown site, which began in 1909 when a new city hall was first proposed. After numerous proposals and a series of design competitions for the site, a city hall complex on the outskirts of the city was built beginning in the 1930s. If all goes as planned, the new municipal complex will serve as a catalyst for revitalizing the downtown neighborhood, and the existing government complex in the suburbs will be replaced by a 800-unit, middle-income apartment project by Ricardo Bofill.—Lynn Nesmith

## Graves's Whitney Addition Debated at Landmarks Hearing

Museum officials, architects, attorneys, architectural historians, and preservationists gathered in late May at a day-long hearing before the New York City Landmarks Preservation Commission to decide the fate of a proposed addition to Marcel Breuer's Whitney Museum of American Art (see April, page 20.)

The most outspoken critics of the expansion scheme argued that Michael Graves's inflated scale is inappropriate and that the addition obliterates the architectural significance of the 1966 Breuer building. However, the final decision on the proposed addition might depend not so much on the esthetic assessment of the Graves scheme or even the impact on the original Breuer museum, but rather on the question of razing a row of brownstones along Madison Avenue and whether their destruction would set a precedent for gradual disintegration of historic districts throughout the city.

The audience appeared to be split between proponents of the expansion and critics who believed the addition would overwhelm Breuer's only building in Manhattan. While a few preservationists argued to save both Breuer and the brownstones, it was the commissioners who focused on the issue of the row houses.

Graves's original scheme, unveiled in May 1985, was met with community and media criticism, prompting museum officials to send Graves back to the drawing board. The revised plan, announced in March of this year, proposes a reddish

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**Design** *from page 15*

granite component south of Breuer's dark gray granite building and of equal height. The two sections, connected by a cylindrical granite hinge, would serve as the base for a three-story, set-back crown clad in light pink granite. The new scheme has been reduced by 47 feet in height and more than 30,000 square feet, and the hinge has been scaled down.

At the hearing, Graves talked about his design intentions, programmatic requirements, materials, the eclectic vibrancy of the avenue, and his goal to "make one institution—one Whitney."

One of the first speakers, William Woodside, chief executive of the Whitney, said that a year and a half ago Graves was asked to rethink the entire Whitney and he delivered a "smaller and compact design that admirably fulfills the requirement for expanding exhibition space." He praised the design for complementing the "powerful Breuer building."

The expansion proposal must go through the rigorous review process of the landmarks commission because the site on Madison Avenue between 74th and 75th streets is within the Upper East Side Historic District, which gives the 21-year-old museum and the row of brownstones designed and built by Silar M. Styles in the late 1870s the same protection as individual landmark buildings. Four of the five brownstones have been classified as "neo-Grec styled buildings" that contribute to the overall quality of the historic district, while Breuer's museum is deemed a "styled modern building." Each would require a "certificate of appropriateness" from the commission before being destroyed or altered.

Terrance R. Williams, AIA, who prepared a historical report for the Whitney, questioned the importance of saving the brownstones, which are so "deteriorated and compromised that they contribute little" to the character of the historic district. "I don't think saving these buildings serves any historic purpose," he said.

After Williams's formal presentation, Anthony M. Tung said that, during his eight years and 2,553 review applications, the landmarks commission has never approved a demolition permit for a contributing building in a historic district. "Are these buildings a special case and deserve to be demolished?" he asked.

A "certificate of appropriateness" for the demolition—as opposed to economic hardship—could have repercussions for future historic districts. Tung expressed a fear that if the permit was approved "30 percent of all owners of historic buildings, either marginal or semi-contributing, will apply tomorrow for 'certificates of appropriateness' for demolition."

Standing by his original statement, Williams said, "Even if the original detailing on these buildings was existing, they are not an endangered species."

When Graves was asked if he considered saving the houses, he responded that "to save the facades of the brownstones is a kind of 'Disney' proposition. They would not retain the actual sense of Madison Avenue nor project the image of an institution or museum.

"I think the existing juxtaposition between Breuer and the brownstones is unhealthy," continued Graves. "We want a more compatible relationship . . . appropriate in scale."

At this point, Commissioner Elliot Willensky said, "This is not the Marcel Breuer historic district. This is the Upper East Side Historic District."

Addressing the issue of the brownstones, Brenden Gill, architectural writer, preservationist, and trustee of the Whitney, said, "I shed no crocodile tears on behalf of those woebegone orphans."

Next to speak in favor of the addition were architects. Cesar Pelli, FAIA, architect of the latest MoMA addition, started by saying that designing "an addition to a modern art museum in this city is very difficult." He praised the design for its "responsibility and creativity."

Peter Eisenman, FAIA, maintained that to deny an artist like Graves the opportunity to build this design "would be a sad commentary on the vital signs of this city." William Pedersen, FAIA, said, "The most brilliant aspect of this design is the mitigating whole. . . . Graves represents another dimension past modernism." Ulrich Franzen, FAIA, called the Graves addition the "mate for which the Breuer building has been waiting."

An equal number of well-known architects spoke in opposition to the proposed scheme. According to Edward Larrabee Barnes, FAIA, preservation of the Breuer museum is the most important issue before the commission, and the brownstones should be sacrificed to meet that goal. He recommended removing the hinge and urged the Whitney to reconsider the scheme—calling for an addition south of the original museum that would allow "each to stand in history free and clear."

Restating similar concerns, architectural historian Andrew Dolkart called for maintaining Breuer's concrete wall "to emphasize the completeness" of the building. "Breuer wanted history to judge his building as an independent entity."

In a more personal plea, Hamilton Smith, FAIA, who was Breuer's collaborating partner on the Whitney, said that if the proposed expansion is permitted "to lock the Breuer building in its lethal embrace . . . the original building is diminished and the special qualities that made it a landmark are compromised." He continued, "More contrast in massing, rather than less, points the way to a stronger concept. The unfortunate lack of contrast of massing—the equal symmetry—forms the very basis of the expansion proposal, which, like a house of cards, summits in an improbable superstructure. In my view,

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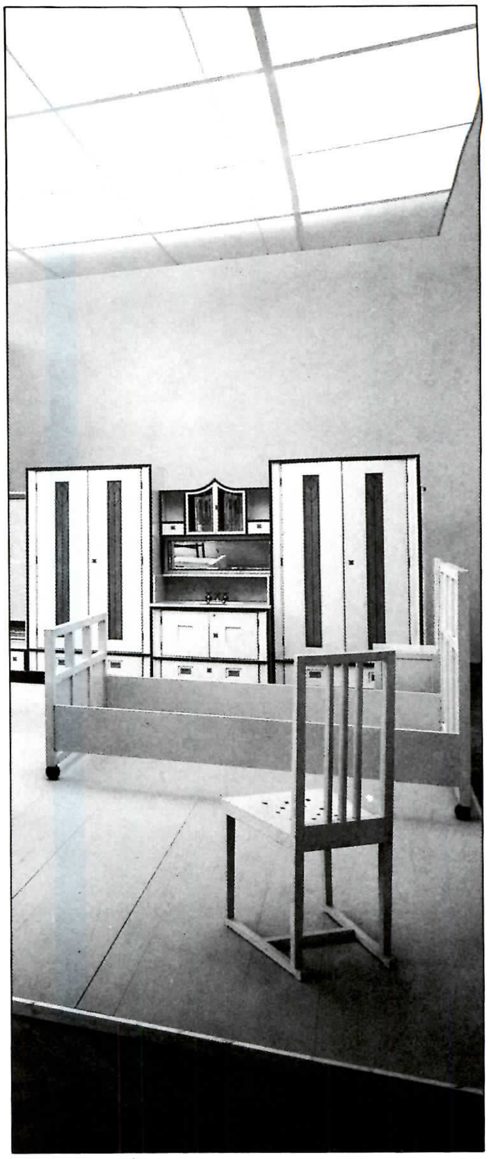

**Josef Hoffmann Exhibition.** The Austrian Museum of Applied Arts and the School of Applied Arts in Vienna had on view this spring a comprehensive exhibition of the work of the Viennese master architect.

Entitled "Josef Hoffmann: Embellishment between hope and crime," the exhibition included his furniture, jewelry, fabrics, leather, silver and metal works, glass, porcelain, and more than 300 architectural drawings from collections totaling more than 5,000.

The selection of objects and the presentation illustrated Hoffmann's continued dedication to sophisticated craftsmanship and decoration and reflected his changing approach to forms and detailing. The majority of the works in the show were acquired by the museum within the last 10 years and were on public view for the first time. However, both the museum and the school have consistently gathered the work of Hoffmann since 1908, and their collections represent the spectrum of the artist's creative activity.

The exhibition was designed by Peter Noever, director of the museum, and Oswald Oberhuber, head of the school. A 384-page catalog of the same title accompanied the exhibition.

**Design** *from page 16*

the proposed base is no more contextual than the Breuer original." Another former partner of Breuer, Herbert Beckhard, FAIA, pleaded with museum officials to abandon the current expansion plan. "The Whitney conceived by Breuer is a gravity-defying structure—a bird waiting to fly—while Graves's proposal is earthbound."

John Johansen, FAIA, warned museum officials that they are investing $40 million in a style that is out of fashion and quoted an article from the *Architectural Review:* "Postmodernism is dead—it is no more than a painted corpse." He added, "Live by the style and die by the style."

Johansen also talked about the important spatial and symbolic aspects of the Breuer building. "You don't build in front of a landmark, or you don't build on top of it," he concluded.

A vocal critic of Graves's original and revised schemes, Michael Sorkin of the *Village Voice,* said, "This building should be redesigned until you get it right." He called Breuer's party-wall building a "brilliant solution" that responds the way blocks are built in an additive way, and he said that the new building should cooperate by being located on the other side of the party wall. Numerous neighborhood groups and residents also spoke against the museum's expansion plan.

The commission voted to keep the record open to accept additional written testimony. At press time, a verdict had not been reached, and it's difficult to predict when a final decision will be made.

—Lynn Nesmith

## J. Paul Getty Museum Unveils Preliminary Scheme by Meier

Los Angeles has gotten its first tantalizing glimpse of Richard Meier's work on the J. Paul Getty Center, the future headquarters of the world's richest and possibly most secretive arts institution. When built in 1993, the center will be a 1.45 million-square-foot complex on a 110-acre site, containing a major museum as well as six other Getty operating entities and garage space for 1,550 cars.

The mid-May presentation of a six-foot-long model (right) to the Los Angeles City Planning Department showed an interesting and, for Meier, somewhat atypical arrangement of highly articulated building masses strung out along a high ridge in the affluent single-family residential section of Brentwood. However, the presentation concealed as much as it revealed and seemed to be a well-turned move in a chess game rather than a full statement of Meier's design intentions or even of the building's real relation to its context.

The occasion for the presentation was a public hearing to determine compliance with a 107-point conditional-use zoning permit granted to the Getty two years ago. It was preceded by private presentations to members of the architectural press and, in some cases, a request to attend the hearing and cheer the scheme on. While the press was encouraged to express its approval, Meier and Getty representatives stressed that the design was still preliminary, even after at least five schemes and two years' work. They said that there were no larger-scaled working models (the presentation model was at a 1:100 scale) to provide a better idea of the forms and spaces of the project.

The model, though meticulously executed, was also of limited value in depicting the project's relationship to its surroundings. The houses that adjoin the property were left off, the buildings of neighboring Loyola Marymount University were represented in an unconvincingly crude way, and the circular tower of the nearby Holiday Inn was shown about 65 percent larger than actual size. And in its press release, the Getty gave the area of the center as 505,000 square feet, a narrowly defined net figure that was barely a third of the gross. All these details, of course, would tend to make the center itself seem smaller and less obtrusive than it actually will be.

It is difficult to understand why the institution felt it necessary to employ such tactics, for Meier's design, as far as can be determined from the presentation materials, is quite promising, and Emmet Wemple's landscape design is sympathetic and complementary to it. Perhaps there was a provision in J. Paul Getty's will that the Getty conduct its affairs with the same eccentricity and intrigue that marked his own life. Whatever the reason, the Getty by now has a long history of being less than sensitive to all its public obligations. When the original museum was built in Malibu, it was allowed to operate with inadequate parking because the city agreed to classify it as a single-family residence. Its director dismissed inquiries about its cost as irrelevant. (Even now, a project likely to cost between $200 million and $300 million is coyly referred to by museum officials as "$100 million plus.")

The present mountainous site is isolated from the city fabric and not served by public transportation. It was acquired in an unannounced transaction from UCLA for an undisclosed price. (Getty head Harold Williams is a regent of the University of California, and former UCLA chancellor Franklin P. Murphy is on the Getty board.) Before a designer was retained, the Getty announced a prestigious architect selection committee made up mainly of outside members. As it happened, however, the committee did not select an architect but only devised a short list, with Williams making the actual selection. And it is clear that the Getty is not happy about the nearby residents having a voice in the configuration of what is, after all, an incompatible use in their neighborhood.

At the zoning hearing, homeowners protested the uninformative nature of the presentation and won a delay of several weeks while the Getty prepared supplemental materials for their study. The irony of the situation is that such tactics raise suspicions where none should exist. Unlike the ersatz-Roman museum in Malibu, Meier's design seems a sophisticated response to very complicated requirements. It may not be the breakthrough in his work that some people were hoping for—if anything, it may turn out to be a reprise of some of his favorite building forms collaged together in a 1,400-foot-long cluster. But it is far less of an isolated object than has been true of his previous work, possessing a critical mass sufficient to create a good sense of place, and it shows a newfound concern with shaping exterior space. This latter quality will be strengthened by Wemple's appropriately polymorphous landscape design, which ranges from unobtrusive naturalism to geometric formalism and promises to make the Getty a true Los Angeles building despite its somewhat alien architecture.—John Pastier

*News continued on page 20*

# "For beauty *and* long lasting protection, specify our unique Semi-Solid™ Stain."

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*Cities*

# Boston Conference Explores San Francisco Downtown Plan

The San Francisco Downtown Plan came to Boston in April, along with several of its authors, apologists, critics, and sometimes-beleaguered overseers. The occasion was the symposium "Boston Looks at San Francisco," sponsored by the Boston *Globe,* the MIT school of architecture and planning, and the Boston Society of Architects. But the title could just as well have been "Boston Listens to San Francisco" because the West Coast delegation did most of the talking.

A development backwater for decades, Boston is now booming with millions of square feet of new office and retail space and millions more on the horizon. One waterfront proposal, the Fan Piers, alone will add 4.5 million square feet. A 1965 master plan, which sparked the redevelopment of downtown and the waterfront, is outdated; in preparing a new one, Boston, like many other cities, is looking to San Francisco for guidance.

From afar the San Francisco Downtown Plan looks like an enlightened expression of community will that strikes a balance between control and vision. In addition to reducing the height and bulk of new office buildings, it provides affordable housing, protects historic buildings, and requires that sun, shadow, wind, and other environmental matters be addressed in designs. It is a bold and uncompromising attempt to reverse the conventional American pattern of accommodating growth first and worrying about the consequences later.

But nothing is ever what it seems. What started out as a high-minded consensus about the city's future, say San Franciscans, has deteriorated into a tense standoff between growth and no-growth factions, with the city planning department as intermediary. The need for a plan is not in question, only the wisdom of such provisions as the growth cap—an 11th-hour addition by the San Francisco Board of Supervisors that limits new office construction to 475,000 square feet per year. Developers must compete for this allotment in a so-called "beauty contest," with *their* projects reviewed by a team of advisers known as "the three wise men." No building was approved last year; round two is now under way, with a decision expected this summer.

Critics of the cap argue that by rationing office space the city has skewed the real estate market, driven up construction costs, and forced businesses to the suburbs. "The beauty contest is the worst part of the downtown plan," said Charles Graham of London & Edinburgh Trust, a competitor last year. "It pits one area against another. But it won't last long. Once we get politics out of the plan we can have something very positive for the future of San Francisco."

The cap's defenders reply that it was a rational response to the egregious overbuilding prior to the plan and to the continued grandfathering of large projects after it was adopted. They insist, however, that the cap is not antigrowth but merely a quantification of the real market's own projections about how much office space will be needed in the future.

"We were saying that the essential component of the downtown plan was the right of something else to survive besides vast office development," explained Sue Hester, a lawyer for San Franciscans for Reasonable Growth.

Nearly as controversial are the provisions for drastically reducing the bulk and height of new office buildings to make them more compatible with older buildings and with the surrounding landscape. Ornament and street activity are in, pompous plazas and mirror glass are out. Anyone familiar with the blank hunkering towers built in downtown San Francisco in the 1960s and early '70s will probably sympathize with this desire to make downtown buildings svelt and decorative. But to others the new zoning envelope amounts to an arbitrary prescription for a postmodern skyline.

"You'd have to have one hell of a development package to get an International Style building approved in downtown San Francisco," observed Ed Logue, Hon. AIA, former director of the Boston Redevelopment Authority and the organizer of the conference.

But San Francisco planning director Dean Macris insisted that style is incidental to safeguarding the civic purpose of architecture. "Our job is to represent the public in a process in which it has not been well represented. The idea that architecture has a privileged life, not to be tampered with by anyone, seems to us all wrong."

The reaction of Bostonians to this debate was understandably cautious. Boston is not as large or as wealthy a city as San Francisco, nor has overbuilding been an issue until recently. The idea of a growth cap, therefore, struck the natives as an invitation to rigor mortis rather than a prescription for urban vitality. Of far greater concern was the possibility of social polarization as a consequence of rapid urban growth. The reasonably amicable relationship that now exists between neighborhood groups and city hall could easily collapse without a program for sharing the new development wealth.

"We have a nice balance here now," noted Tunney Lee, chairman of the planning department at MIT. "We have to be concerned with creating opportunities across the board so that there isn't a big gap economically between the highly paid office workers and the service people."

For better or worse, San Francisco has decided what kind of city it wants to be, while Boston is only beginning to ask the question. "We're where San Francisco was five years ago," said one panelist. The San Francisco plan spells out the rules of the real estate game for everyone, providing the clarity and predictability that developers say they want even more than favorable treatment. And it does so with rules, not mere guidelines.

Boston, on the other hand, has a long tradition of design review but no document that codifies its expectations. All downtown projects are reviewed by the Boston Redevelopment Authority, which approves or rejects them according to criteria that many developers complain are arbitrary at best and politically colored at worst. City officials have promised to correct this situation in their new plan, though they haven't yet explained how.

Like San Francisco, Boston clearly covets a sense of direction rather than the giddy feeling of being out of control. (Houston and Los Angeles may be the only cities that thrive on the latter.) But like most cities Boston also wonders whether it can legislate the kind of future it wants. San Francisco obviously thinks it can, and with its Downtown Plan may show the rest of the country how to make that viewpoint prevail.—David Dillon

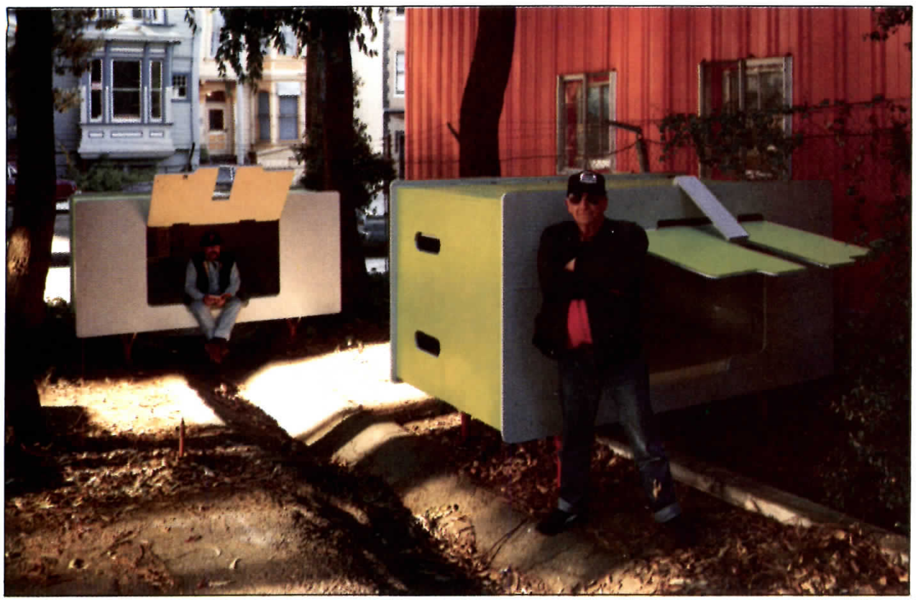
## Architect Designs and Builds Prototype Homeless Shelters

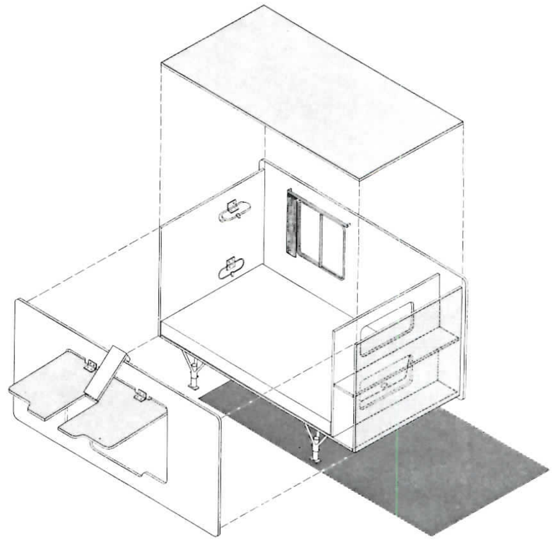
They may not be the answer to sheltering the nation's homeless, but "city sleepers," designed and built by San Francisco architect Donald McDonald, FAIA, are now providing clean and dry refuge for a few of the architect's indigent neighbors.

McDonald recently completed a new building for his practice and noticed a number of homeless men sleeping in an adjacent parking lot. By talking with them, McDonald discovered that what they wanted most was a warm and safe place to sleep that would offer protection from harassment by gangs, police, and area homeowners. "Everything else they could take care of," McDonald says, stressing that his shelters are not intended as substitute housing for the unemployed or involuntarily homeless. City sleepers are for those who have opted to drop out of society and decline aid that would alter the life style they have chosen, McDonald explains.

What McDonald designed for them is

*continued on page 23*





*Above, located adjacent to McDonald's office, the first two city sleepers and residents. Right, axonometric of the compact urban shelter for the homeless.*

an oblong, plywood box four feet square in section and eight feet long, entered through a side hatch that swings up and can be propped open as a canopy. The architect says he wanted to make the shelters big enough for one person but small enough that they could be warmed with body heat. The interior has a four-inch foam mattress for sleeping comfort and insulation. There are two hinged vents and a sliding glass window with a screen. There is also a shelf and a locker. Each city sleeper rests on four inverted automobile jacks that can be adjusted for uneven terrain. Two prototypes, built for $800 apiece (out of McDonald's pocket), are occupied next to his office.

McDonald says he would like to build 100 more city sleepers, placing them in groups of two and three on unused city and state property. "There are hundreds of acres of land under freeways in San Francisco," he says, "and a lot of people are sleeping there now. The idea is to put the shelters where people are already—just exchange their place on the ground for a city sleeper." McDonald has set up a nonprofit corporation to solicit donations to build more shelters.

Meanwhile, the San Francisco city government has neither condoned nor hindered McDonald's efforts. The California department of transportation informed the architect that if no city permits were issued for the city sleepers they would have to be removed, but no action has been taken. McDonald is now meeting with city officials to ensure that the shelters will remain.

McDonald says he would like to hear from other architects who have developed small-scale, inexpensive shelters for the homeless, so that ideas can be pooled and traded. His mailing address is: 165 Page St., San Francisco, Calif. 94102.

—Michael J. Crosbie

*News continued on page 24*

# DEATHS

**Richard D. Butterfield, FAIA,** senior partner of Butterfield & Associates in West Hartford, Conn., and the Butterfield Partnership in Farmington, Conn., died in May at the age of 78. He designed more than 26 schools throughout New England. He also designed the master plan and numerous campus buildings for Quinnipiac College in Hamden, Conn. Butterfield received his bachelor's degree from Dartmouth College and his master's in architecture from Yale University. A member of AIA since 1949, he served as president of the Connecticut Society of Architects.

**Robert O. Clements Sr., AIA,** chairman of California's oldest architectural firm, Clements & Clements, died in May at the age of 69. Clements's firm has designed more than 110 buildings on Wilshire Boulevard, and he was responsible for two-thirds of them. He was a founder and a director of the Architectural Guild at USC, where he received his architecture degree.

**Julian H. Harris, FAIA,** was a sculptor and professor emeritus at Georgia Institute of Technology, where he had earned his bachelor's degree in architecture. He studied sculpture at the Pennsylvania Academy of Fine Arts in Philadelphia. His work was displayed at the High Museum of Art in Atlanta in 1933, 1940, and 1969, and pieces were shown at the Museum of Modern Art and Rockefeller Center in New York City. Harris was 80 when he died early this year.

**Thomas T. Hayes Jr., FAIA,** partner of Hayes-Howell & Associates Architects in Southern Pines, N.C., died unexpectedly in late May. Hayes received his architectural degree from North Carolina State University in 1951.

**Paul M. Heffernan, FAIA,** joined the faculty of Georgia Institute of Technology in 1938 and directed its architecture school from 1956-79. Heffernan designed the Bush-Brown, Gailey, and Heffernan buildings on that campus between 1944 and 1954. He received the Eugene Dodd medal from Harvard University, the Paris Prize from the Society of Beaux-Arts Architects, and an AIA award for the Price Gilbert Library. Heffernan earned his bachelor's and master's degrees in architectural engineering from Iowa State University and a master's in architecture from Harvard University. He died in April at the age of 78.

**Roslyn Lindheim, AIA,** a professor of architecture at the University of California at Berkeley, developed a humanistic approach to hospital design, vividly portrayed in her design of the Planetree unit in Pacific Presbyterian Medical Center in San Francisco (see April '86, page 68). Throughout her career, Lindheim sought to counter what she called the "disturbing trends" in hospital design—an emphasis on technology and efficiency to the detriment of personalized patient care and a noninstitutional atmosphere.

Lindheim was an expert on health and environmental factors in hospital design. She was the first architect named to the Institute of Medicine of the National Academy of Sciences, in 1971. She is known for her leadership in renovating Montefiore Hospital in the Bronx, New York City, and for her work in hospital projects in San Francisco, Los Angeles, Iran, Israel, Sweden, England, and Canada.

A native of New York, she attended Radcliffe College and the school of architecture at Columbia University. In 1951 she joined the firm of Wurster, Bernardi & Emmons and later the firm of Stone, Marraccini & Patterson. Lindheim joined the Berkeley faculty in 1963. She died of cancer on May 5 at the age of 65.

**Benjamin K. Ruehl, AIA,** received his architectural degree from the University of Michigan in 1923 and then opened his own firm, Ben Ruehl Architects, in Spokane, Wash., where he practiced for 50 years. He died in May at the age of 87.

**Martin C. Schwartz, AIA,** a native of New York City and a Washington, D.C., architect since 1974, died on May 21. Since 1981, he had been affiliated with the firm of Clark, Tribble, Harris & Li, and in his early years with Howard, Needles, Tammen & Bergemdoff. Schwartz received his architectural education at M.I.T.

*News continued on page 27*





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**Architectural Reference Guide**
The 1986 edition of *The Architectural Index* references ARCHITECTURE, *Architectural Record, Builder, Interior Design, Interiors, Landscape Architecture, Progressive Architecture, The Journal of Architectural Education* and the last issues of *Architectural Technology* and *Solar Age,* as well as *Professional Builder,* the successor to *Solar Age.* Articles are listed under project type, architect or designer, and location. Copies are available for $18 from The Architectural Index, P.O. Box 1168, Boulder, Colo. 80306.

**Student Design Competition Winners**
Marta Canaves, Marta Nejia, and Herman Lopez of Florida International University won $5,000 and first place in a design competition sponsored by the American Institute of Architecture Students and the American Life and Accident Insurance Co. of Kentucky. Second place prize of $3,000 went to David G. Arkin, University of Minnesota; and third place prize of $1,000 went to Carlene Nolan-Pederson, Montana State University.

**Product Design Awards Competition**
The Resources Council has set Sept. 18 as the deadline for an interior furnishings product competition. Products must have been made available for sale between June 1, 1986, and July 31, 1987, to be eligible for entry. The entry fee is $100 for members and $175 for other firms. For more information, contact the Resources Council, 200 Lexington Ave., Suite 227, New York, N.Y. 10016.

**Concrete Design Awards**
Prestressed Concrete Institute is sponsoring a design competition open to all architects and engineers in the U.S. and Canada who have designed buildings using precast or prestressed concrete. The deadline for submittals is July 31. For more information, contact Dawn J. Myers, PCI, 175 W. Jackson Blvd., Chicago, Ill. 60604.

**Veterinary Hospital Design Winner**
A joint design by Sharon Moroz, a student at the school of veterinary medicine, Louisiana State University at Baton Rouge, and Rodolfo Barrio, an architecture student at LSU's school of architecture, won first place in a student design competition for a veterinary hospital sponsored by Hill's Pet Products.

**Brunner Prize Winner**
James Ingo Freed, FAIA, a partner of the firm I.M. Pei & Partners, New York City, was awarded the 1987 Arnold W. Brunner memorial prize in architecture from the American Academy and Institute of Arts and Letters.

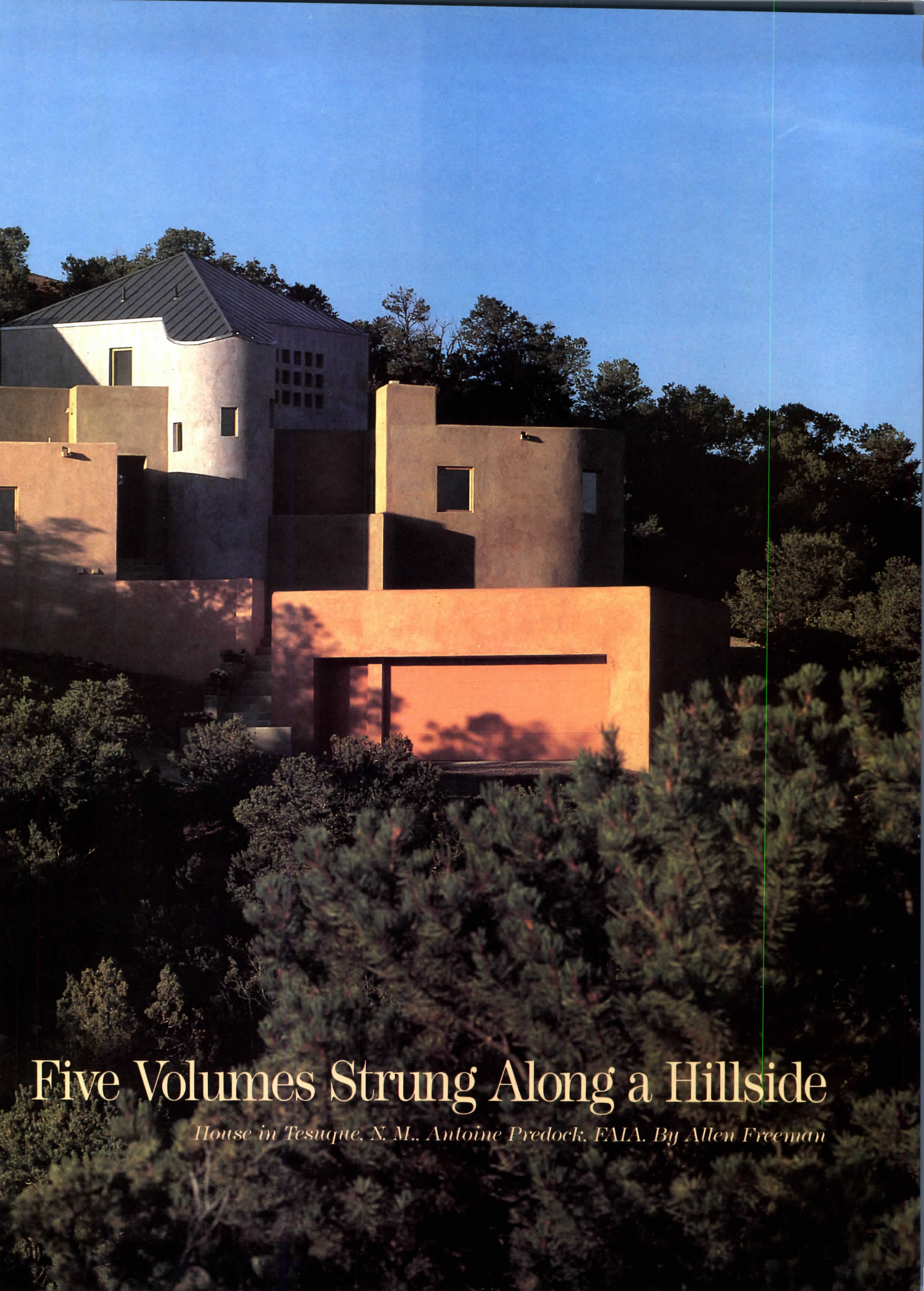
*News continued on page 29*

# ARCHITECTURE

This issue is unified by a focus on residential work, but it is otherwise quite varied. It includes a poignant news report on one architect's very personal approach to the problem of the homeless. It also includes a collection of architect-designed birdhouses that one is sorely tempted to call flighty.

It presents, on immediately following pages, a set of varied and mainly elegant houses. They are followed in turn by a sobering discussion of the faltering national effort to house the poor. The basic conclusion is that, not only are we not adding to the supply of low-income housing built up over the last half-century, but a variety of factors are producing a net reduction in that supply—even as demand, and poverty itself, increase.

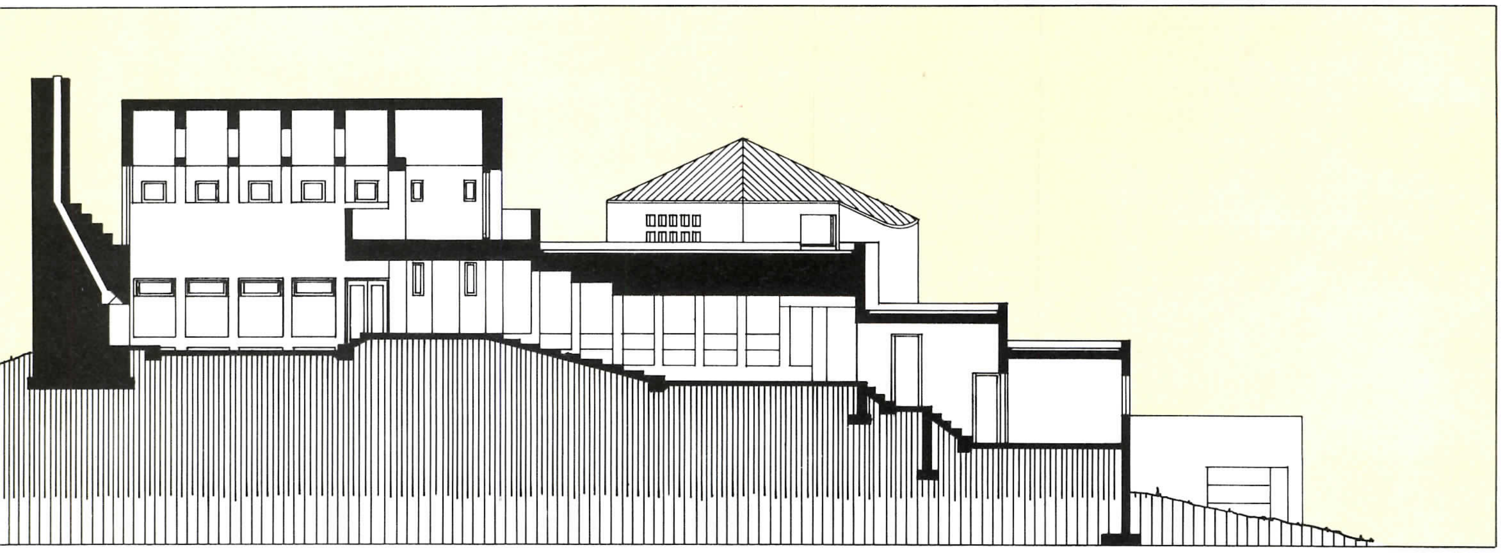
A more encouraging effort is reported in this month's Technology & Practice section as part of a package on seismic design. It is the amazingly swift and sensitive reconstruction of entire neighborhoods all but destroyed in Mexico City's 1985 earthquake.—*D.C.*



# Five Volumes Strung Along a Hillside

*House in Tesuque, N. M., Antoine Predock, FAIA. By Allen Freeman*

*Previous spread, the ensemble from a nearby rise (photograph © Robert Reck). Facing page, a tight view of some of the same elevations. Left, semi-detached chimney at the end of the living room; below, a rear view. Walls are stucco on wood frame.*



There's less here than meets the eye: only about 2,300 square feet of house. Architect-illusionist Antoine Predock, FAIA, pulled apart five main volumes—living room, master edroom stacked over dining room, kitchen, second bedroom, nd garage—staggering, elevating, and twisting each so that none ligns with another in section or plan. He painted each piece a ifferent color, the lower ones light earth tones, the upper ones ky tones of lavender and silver-gray, and set the ensemble into he hillside near its crest, so that a line of trees halos the roofs.

Then he shrunk the pieces and left no clues. The front door night have given the scale away, but he sucked it in, between he turret and the blocky piece of the second bedroom, making t read as a void. Similarly, he recessed the balcony door at he end of the large basilican form, segmented it vertically, and artially concealed it behind the parapet. And he scaled down he windows, punched them in, and positioned them to imply reater internal division than exists.

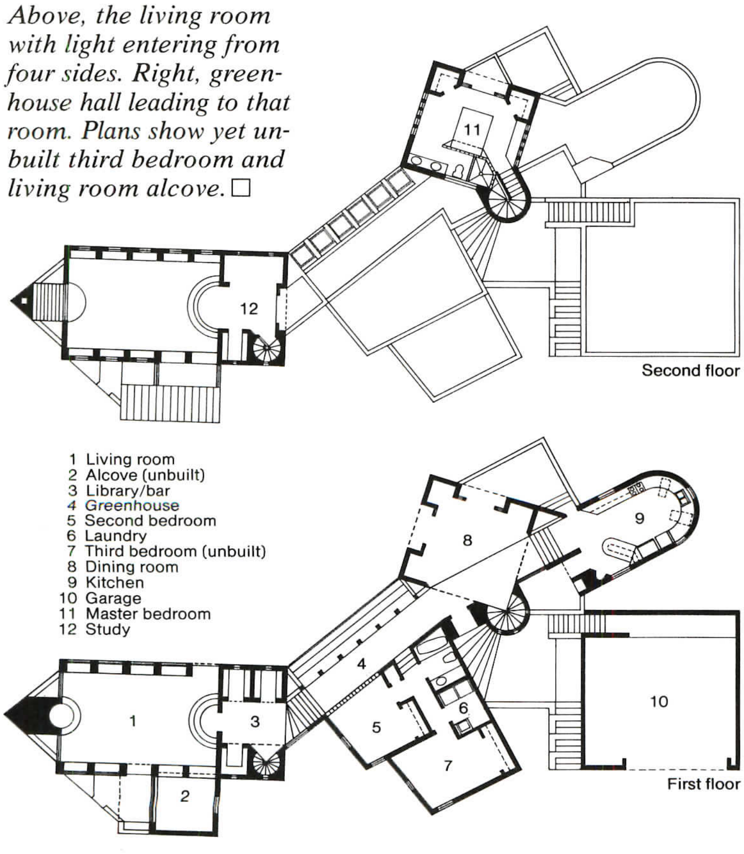
Located in the piñon- and juniper-covered hills of northern New Mexico in the rural settlement of Tesuque (pronounced *ee-súe-que*) just north of Santa Fe, the pieces bear resemblance o nearby vernacular houses and the ensemble to villages in the ills of northern Spain, where Predock spent time as a student. But the whole is slightly abstracted, like a stage set.

The house also reflects the theatrical bent of Predock's clients, one of whom performs semiprofessionally as a soprano in operettas and musical comedies. Her husband is an amateur musician (and professional attorney). Their living room is a musical stage that fills the silvery, gable-roofed piece at the south end. Resembling a miniature recital hall made bright with daylight entering all four sides, this double-height, 18x30-foot room is ideal for intimate musical performances. At the rear, a balcony/study projects above the connection to the rest of the house; the "stage" wall opposite consists of a fireplace and three large windows, two of which flank the chimney and frame views into the hills. The third window is directly over the fireplace, and through it you see the chimney stepping up and away from the house. At certain times of the day, depending on the season, the sun hits this inward-facing stucco wall and turns it into a lovely indirect source of daylight. The steps add a little mystery.

If the living room resembles a basilica, the master bedroom recalls a castle keep. The central elevated room, it is reached by tightly wound stairs in the turret. From the bedroom's windows and balcony, the architect framed views of the Jemez Mountains, lights of Los Alamos, and fragments of the house itself.

Adroit, picturesque, theatrical—the house in its setting is smaller than perceived yet larger than life.

*Above, the living room with light entering from four sides. Right, greenhouse hall leading to that room. Plans show yet unbuilt third bedroom and living room alcove.* □




# Highly Sophisticated 'Cabin in the Woods'

*House in Door County, Wis., Hammond Beeby & Babka. By Lynn Nesmith*

This year-round vacation house by the Chicago firm Hammond Beeby & Babka captures both the airy spirit of a summer house on the lake and the cozy feel of a cabin in the woods. Moreover, the front and back elevations of the house reflect its dual personality.

The context is Wisconsin's Door County, a long and narrow peninsula with a rocky shoreline interspersed with sandy beaches. The wooded landscape, dotted with farms, cherry orchards, and romantic waterfront communities settled by Scandinavians more than a century ago, is a haven for Midwesterners who for years have flocked to the shores of Lake Michigan in summer and now in increasing numbers visit the region in winter for cross-country skiing and other cold-weather sports.

The approach to the house and its generous nine-acre site is by a curvy, unpaved road through a heavily wooded area sparsely populated with other vacation houses. The first view of the house is a trio of gables reaching for the sky and an irregular grouping of a bay window and three smaller openings, which define the service areas and the children's bedrooms.

John Syvertsen, AIA, principal in charge (although no longer with the firm), borrowed freely from the details and forms of the local farm vernacular and clad the 2,700-square-foot house with cedar siding left to weather and with bright barn-red vertical battens. The red is repeated on exterior window and door trim and under the eaves of the gabled roofs.

These informal, shed-like volumes set slightly off balance don't prepare one for the broad and open symmetry of the waterfront elevation, but the two are decidedly complementary.

Facing the lake, a central, sweeping stairway leads to an open deck and the central focus of the house, a grand living space reminiscent of old summer camp porches. Set atop the house is a covered sleeping/observation porch off the master bedroom.

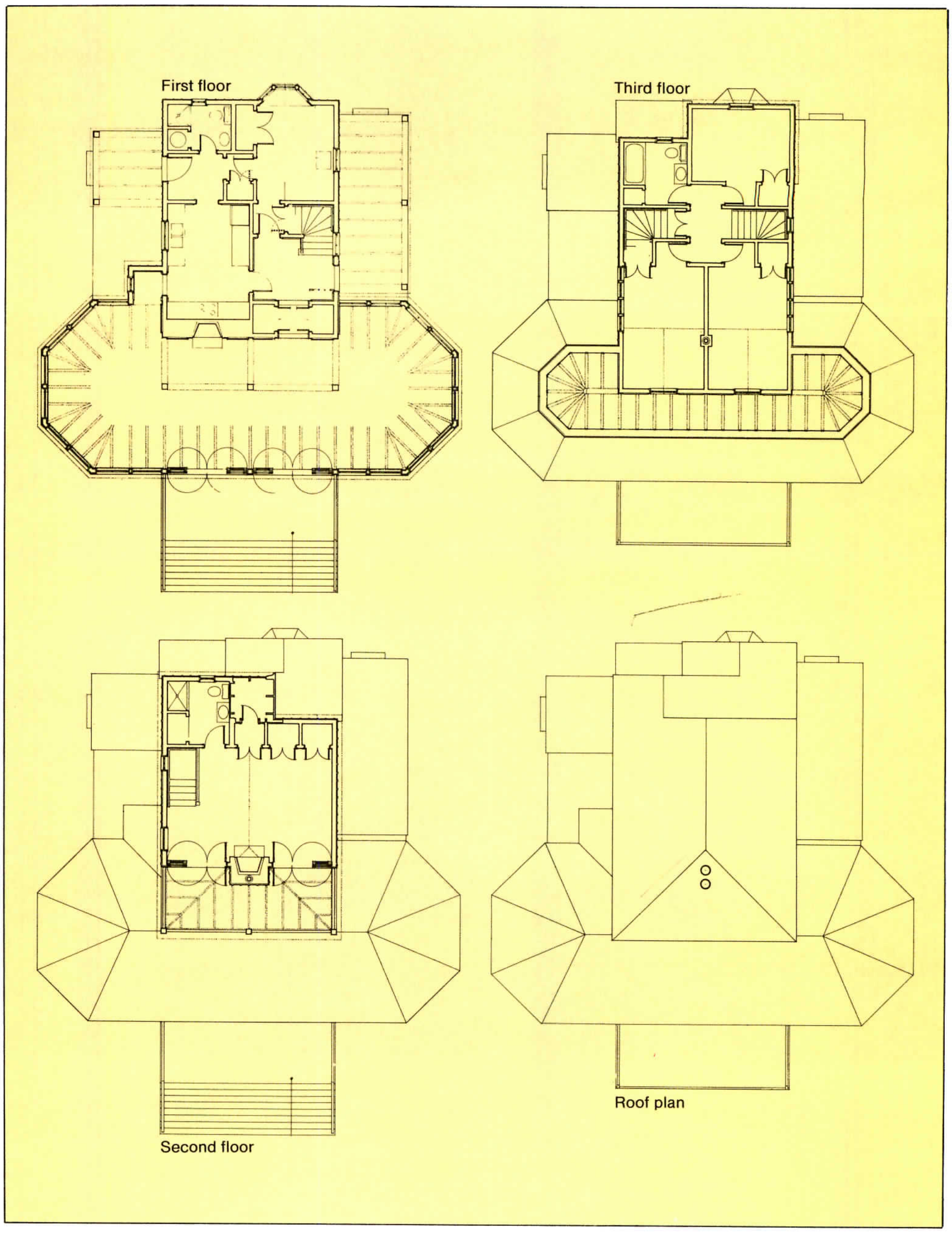
The great room, which measures almost 40 feet from end to end, is wrapped with continuous double-hung windows providing three exposures. The unusual site orientation, with the shoreline facing almost due north, forced the architect to slightly tilt the house to maximize views to the lake while maintaining southern exposure for the room.

Inside, the sloping ceiling with pine trusses, vertical board wainscoting, and pine flooring all respond to the rustic and rural context without literally quoting a style of the past. The dining and sitting areas in the great room encourage a variety of activities simultaneously. The second-floor children's bedrooms, with apple-green walls, project into the space to create a cozy nook facing a friendly fireplace. The oversized diamond windows open to provide the children with their own observation points.

With its shed-like volumes, varied roof forms, and indigenous materials, this house resembles the nearby farm complexes, which have evolved over time. Yet what at first seems a chaotic organization ends up a total composition.

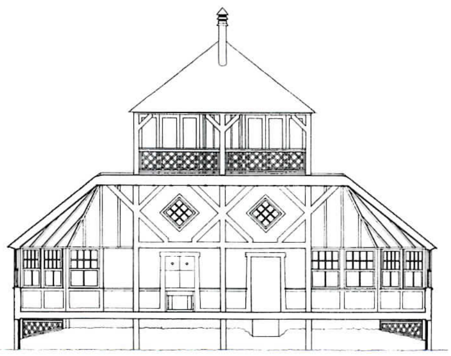
*Above, the site's natural rock outcroppings and the balanced lakefront elevation. Above right, asymmetrical entry facade; right, side elevation reveals the happy coexistence.*

Photographs © HNK/Howard N. Kaplan




*Right, the parents' private retreat, the third-floor master bedroom and porch, has sweeping views through the treetops to the lake. Opposite page, above, interior detailing is meticulous throughout, including chamfered pine door and window trim, painted wainscoting, and the smiling hearth; below, glass doors and bands of windows flood the great room with natural light while creating the spirit of an old-fashioned screened porch.* □

Photographs © HNK/Howard N. Kaplan



North-south section

# 'Miniaturized, Fairy-Tale Castle'

*House on the Severn River, Md., Bohlin Powell Larkin Cywinski.*
*By Andrea Oppenheimer Dean*

Photographs by Christopher Barone

The brothers Grimm seem to co-exist here with old Maryland families and latter-day Gatsbys. The southern part of the site—a mostly deciduous forest, hushed and bathed in filtered light—could be the setting for a fairy tale. At its northern edge, the site forms a high bluff that drops to the Severn River, whose sloping shores are dotted with the private docks of colonnaded houses, some recalling antebellum plantations.

In spirit, this house north of Annapolis, Md., is kin to another that the architecture firm Bohlin Powell Larkin Cywinski completed in 1981 for Norman Gaffney (see Mid-May '81, page 175). It was a deceptively simple yet sophisticated rendition of a house as seen through a child's eyes or altered by childhood memories—full of soft edges, skewed axes, scale distortions, and allusions to times past. The clients for the Annapolis house, in fact, chose BPLC as architect because the Gaffney house seemed to "have qualities of an old house though it was new, looked uncomplicated and clean, yet childlike."

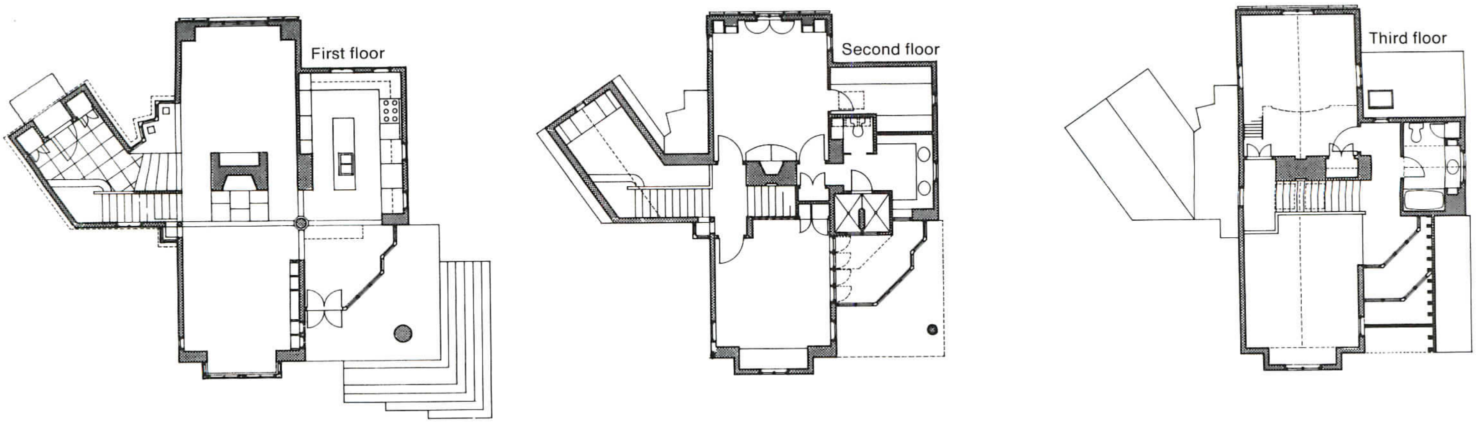
The entry elevation resembles a miniaturized, fairy-tale castle or an exaggeratedly tall, elaborate cottage composed of angled elements—a little, red-roofed, gabled entry mass attached at a diagonal to a very tall house form from which yet another appendage twists off to the west. The main purpose of these axial nudges is programmatic—to give a variety of diagonal views of the site and river.

A taut skin of vertical redwood boards resembling stucco prevents a too cute look, while accordion-like glazing on one side of the little entry house and green lattice on the adjoining tall mass are reminders that this charmed fantasy in the woods is also of its own time. The lattice, which steps out as it approaches the base, helps ground the elongated wall supporting it and in time will be overgrown. But mainly, it perks up an otherwise slightly awkward wall, and, like one or two similar devices on the interior, ends in calling attention to a minor flaw.

While the entry elevation is diminutive in scale, the north facade, overlooking the water, is grand and formal in a quirky way. It is marked by a high, glazed porch tucked at a cant (to gentle its corners) under the eaves of a steep roof, which is stiffened by a sturdy green truss and supported by an oversized yellow column. Peter Bohlin, FAIA, explains that, like other houses on the Severn, this one wanted to make its presence felt from the water. Unlike (but still reminiscent of) nearby traditional houses that face the river with long, colonnaded verandas, this one uses a tall, narrow porch and a single column to call attention to itself. At night the glass porch resembles a huge lighted beacon.

Like the exterior, the interior combines coziness with contemporaneity. At the entry a stair with cottage detailing and a little square window rises with a pause at the second-story landing—where there is another single yellow column—and climbs to the third-floor eaves, revealing perhaps a surfeit of variously angled shapes. To the left of the entry, down half a flight, under the exposed ceiling beams of the north-facing living room, a win-

*Left, the house's tall, unconventional porch with its single column faces the river. Right: top, south elevation with separate entry volume; below, view from northwest.*

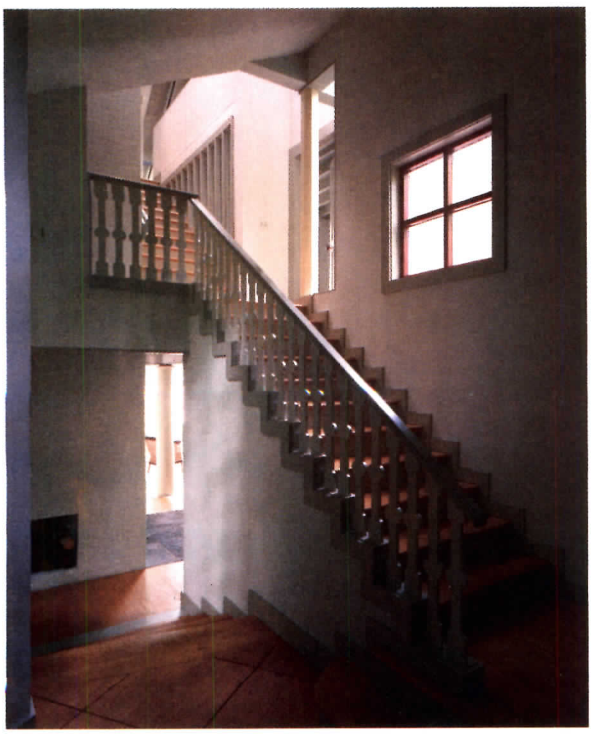



dow frames a sliver of the adjoining glazed porch and the water beyond. There are plenty of perspectives and movement, and the spaces, as in a modernist plan, are open, though delineated by gray-painted boards that contrast with the yellowish pine flooring. But as in a traditional plan, the living areas are centered on and anchored by a fireplace, whose chimney rises on one side of the stair to make its presence felt upstairs as well as down.

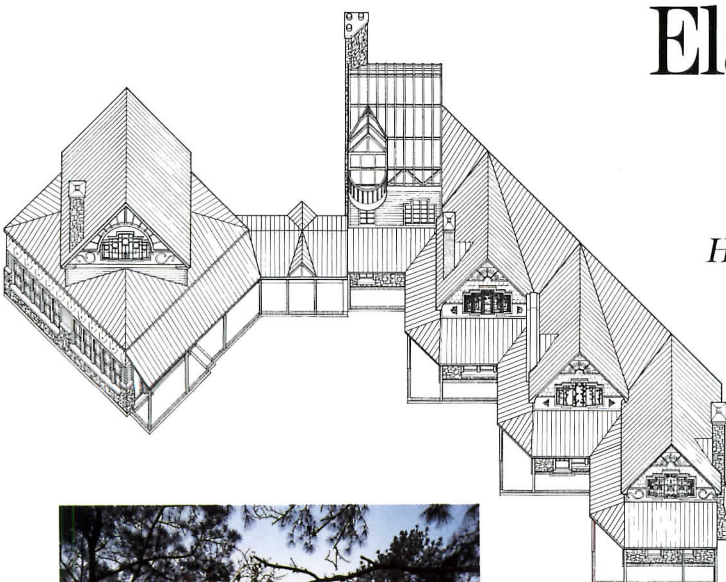
The second and third floors have two rooms apiece, and, as at the Gaffney house, interior windows bring in light and give a feeling of connectedness between rooms. In the second-floor study, for instance, a large stepped opening overlooks the stair and chimney, while a smaller one links with the living room. Across from the study is the master bedroom, where a lowered ceiling with exposed beams shelters the bed. Adjoining it are remarkable washrooms: twin showers, each with a window overlooking the river; two sinks separated by a window; and a paneled water closet.

Summarizing the virtues of this deceptively modest house is the third-floor guest room. It is a simple space in shades of gray with yellow and green accents. Treetop views in three directions appear through cozily low, square windows over whose painted frames is suspended a loft. Leading up to the loft is a wooden ladder with a vaguely nautical, gracefully curved yellow metal rail, which at its top gives way to a handsome wooden balustrade with a yellow accent. The space feels like country without fuss or sacrifice of sophistication, a result largely of its ample but modest scale, deft proportions, and artful detailing. □

*This page: stair with cottage detailing, living area and porch, guest bedroom. Across page, porch as nighttime lantern.*



# Elaboration of Regional Building and Crafts



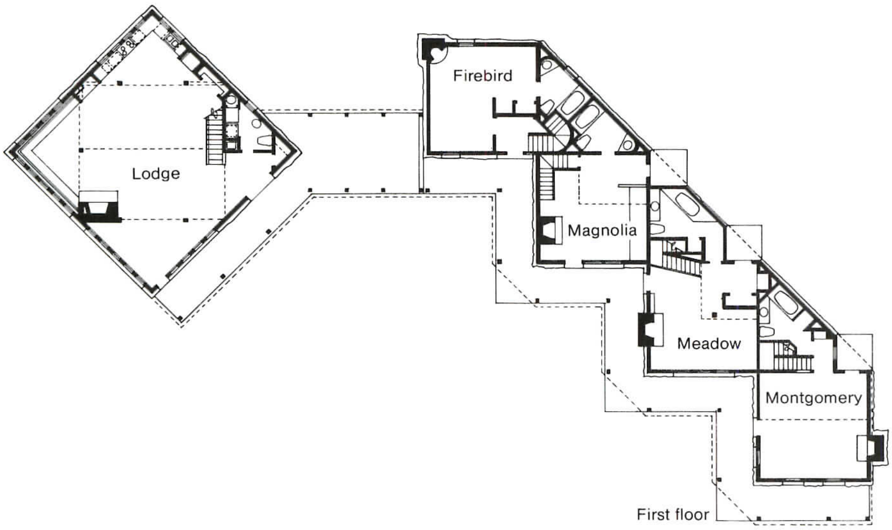
*House near Houston, Clovis Heimsath Architects.*
*By Allen Freeman*

Deep in the hearts of many Texans, local lore and culture rank close to free enterprise, as illustrated by this private retreat celebrating regional architecture and crafts. It is engaging if overloaded.

Designed by Clovis Heimsath Architects of Austin for a prominent Texas couple, Fire Meadow, as it is called, is located 50 miles north of Houston, where the exurbs thin out and pine forests still grow thick, on a 5,000-acre ranch with exotic species of deer, coveys of wild turkeys, and quarter horses. The owners asked Clovis Heimsath, FAIA, first to restore a 100-year-old farmhouse and then to build this retreat on another part of the acreage, just inside the tree line on a gentle slope above pastureland and a man-made lake. They wanted accommodations on the ranch for annual extended-family reunions at Thanksgiving and for occasional church gatherings.

Fire Meadow's precedent is the Western dude ranch, where separate sleeping cabins attend a lodge for chowing down and socializing. Heimsath laid out the lodge and the four cabins on

*Above, left, and axonometric, the front elevations zigzag among the trees. Right, the back side with corner limestone chimney.*




a superimposed double grid, with one axis rotated 45 degrees. The rotation is expressed in the lodge's square, second-story form that rises from a larger, square, one-story base, and in the diagonally oriented, sawtoothed front of the companion building comprising four sleeping suites laid out side by side.

Each suite opens onto an open porch whose standing seam metal roof zigzags in front and then crosses 25 feet as a breezeway to the lodge, where it skirts one of the four elevations. An awkward transition occurs where the porch ends abruptly at the corner of the house, as if the next elevation faced the side yard. Especially with the lodge rotated 45 degrees, this "side" elevation is prominent from the front, where the porch profile seems out of place and unresolved.

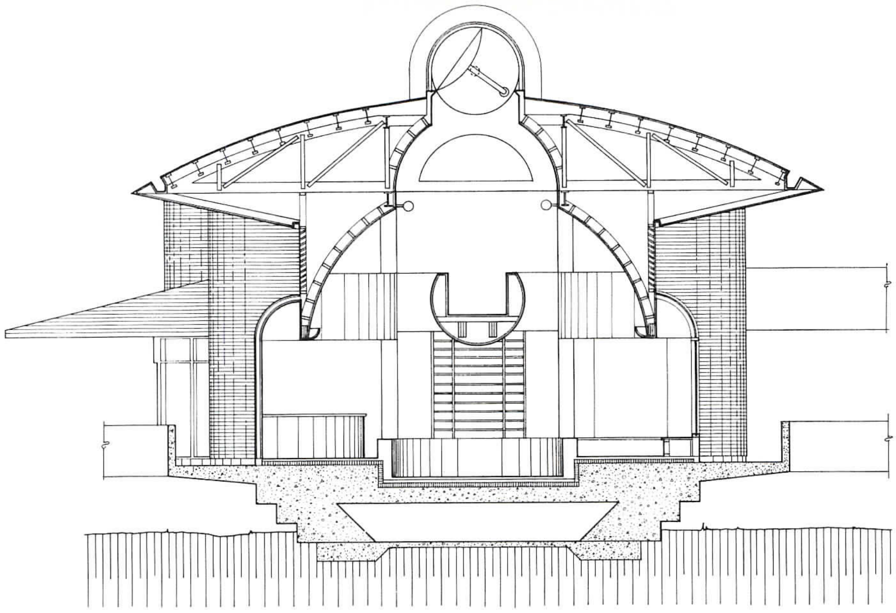
Cladding for both buildings is cream-colored clapboard with brown painted framing, scalloped shingles, brown decorative tile, white stucco, and limestone. Accenting all this are bargeboards, comb ridges, and chamfered porch columns, all found on Texas farmhouses. The limestone base is typically Texan too, but Heimsath stairsteps it up one corner to meet a chimney in an untraditional way, forming the two handsomest elevations on the dwelling.

Seeking to individualize the four suites, the owner named them for nearby communities and Heimsath then tailored an identity for each based on strands of Texas's past: Hispanic, Southern colonial, arts and crafts, and early settler. Each suite has a different plan, all have bathrooms shoehorned into odd, interesting spaces along the rear elevation, three have lofts, and the fourth a rooftop screened porch. Heimsath's partner and wife, Maryann, designed five-part stained glass windows for three of the suites and the lodge, and coordinated all of the handcrafted work.

As with the suites, the ground floor of the lodge is appropriately open and homey. It focuses on a freestanding limestone fireplace whose chimney rises into a corner of the rotated second story, where there is a small bedroom loft.

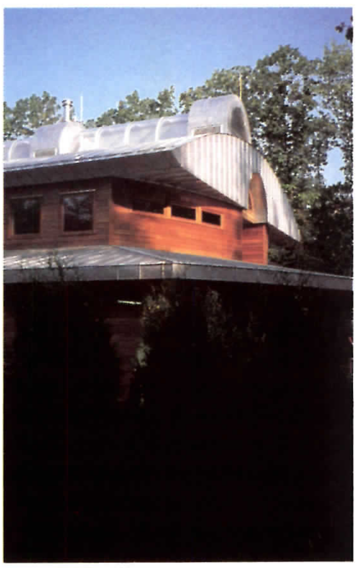
Fire Meadow's architectural interest lies neither in purity of concept nor in pristine execution, for it veers close to pop kitsch ("Four Flags Over South Texas") and the finishes that are not handcrafted are routine. But it is a spirited synthesis. □

*Above, each suite's interior has a separate identity based on Texas's past. Clockwise from top: the Firebird (Hispanic), Montgomery with Texas flag (early settler), Magnolia (old South), and Meadow (arts and crafts). Right, fireplace in lodge.*



# Architectural Jazz and Solar Ingenuity

*House in a Washington, D.C., suburb, Jersey Devil. By Michael J. Crosbie*



It's called the hoagie house—a private residence of heroic proportion, commanding the highest hilltop in a suburban Washington, D.C., county. This house defies easy categorization. It is a mysterious, inscrutable invention of no discernible "style," at a time when knowing the rules of style and how to break them distinguishes an accomplished architect. This architecture is not about architecture. It's a three-dimensional Rorschach test. What do you see? Boats? Spaceships? Bridges? Submarines? They're all methods of conveyance, and the hoagie house has the power to transport us outside the realm of architectural convention.

It was designed and built by Jersey Devil, a quartet of itinerant architects whose members include Steve Badanes, John Ringel, Jim Adamson, and Greg Torchio. For the past 15 years the devils have raised houses with such monikers as snail, helmet, silo, airplane, and football, so the hoagie appears in good company. At 10,000 square feet, comprising a main house, a gate house, and a guest house, the hoagie is their largest creation to date, taking three years to complete.

In the past the devils have made the sketchiest of plans or a quick study model, camped out on the building site, and figured out the details as they went along, keeping the design open enough for on-the-spot improvisation—a sort of architectural jazz. Because of its size and complexity, the hoagie house demanded lots of drawings and myriad subcontractors for such things as the reinforced concrete slab and the steel structure. But the devils were there every day, orchestrating the trades and the dozens of artisans they invited to lavish this house with handcraft.

The client—a high school classmate of Badanes's—hired a private detective to find the architect, who lives wherever he happens to be building. There was nothing out of the ordinary in the program to serve the client, his wife, and their four daughters, except that it be a large house and informal. The devils were given full rein and a seven-figure budget, allowing them to be as creative as they wished.

The six-acre site is wooded and hilly, its summit edged by a rock outcropping running north-south and skirted by blossoming mountain laurel. As the program requirements filled the plan, tight site restrictions pushed the hoagie out over the cliff, prompting the devils to create a spectacular cantilever that appears to hover above its corbeled pedestal. To ascend the summit, one follows a winding drive that passes below the cantilever and heightens the hoagie's mystery.

The main house is connected to its sibling buildings—the gate house and the guest house—via tubular bridges that follow the outcropping. These smaller buildings were used as dress rehearsals for the main house, places to experiment with materials and test a prototype of an experimental skylight device called the Roto-Lid. The gate house (a caretaker's residence) is a cozy apartment cantilevered over a one-car garage, while the guest house is an outlandish fusion of curves and decks—one apartment above another, accessible by a wiggle of stairs.

These two buildings employ just about every imaginable curve and were ideal for exploring different cladding techniques. The roofs, like those in the main house, are terne-coated stainless steel that will mellow into a dusty gray. The natural cedar siding is conventional clapboard used in an unusual way. Because clapboards taper in section, they bow like a frown when applied to a convex surface. Each curved clapboard had to be cut like a smile so it would appear dead level when installed. It would have been easier to use vertical siding, but that would have ruined the hoagie's streamlined sweep.

To keep the house's interior flexible enough for impromptu design, the structure is a steel frame with a cantilevered roof.

*Across page, hoagie house's central skylit corridor in view looking west toward master bedroom suite, with Roto-Lid positioned to admit direct sunlight. At right in photo is a curved glass office. Above left, detail of southeast corner.*


© Kenneth M. Wyner

*Above, south side, with guest house at left, connected to the main house via a tubular bridge. Right, Roto-Lid positions for winter day, winter night, and summer day. Detail photo shows Roto-Lids with mechanical equipment housings in between.*

This allowed all the walls to be structurally independent of the roof. It was also a quick way to get the building enclosed before the weather turned cold, so that the devils could work unencumbered inside. Decisions about details and finishes were often made as building progressed, sometimes resolved with a hasty sketch on a scrap of 2x4.

The size of the hoagie house (Badanes likens it to a mini shopping mall) also allowed plenty of room for many talents. The house became an armature, and the devils, acting like medieval master masons, coordinated a small army of artisans and craftspersons that transformed architectural elements such as cabinets, stairs, and doors into works of art.

The organizing element of the house is the Roto-Lid, a computer-operated shading skylight invented by Adamson, which automatically moves with the time of day and the seasons. (Its operation is described in detail on the facing page). Like the Roto-Lid, the house is linear and has long north and south exposures. Inside, the Roto-Lid enlivens the house with generous sunlight, purging dark corners and making the interior of this big house appear even larger than it actually is. As counterpoint, nearly all of the artificial lighting is indirect, either neon or up-lights that wash curved surfaces and accentuate their geometry.

The Roto-Lid "can be left alone for years and the owners don't have to do a thing," says Adamson. It is only one of the house's technical marvels, however. A low-voltage artificial lighting system is programmable so that every fixture in the house can be turned off, on, or dimmed from a single point. The house has an automatic watering system for the interior's numerous planters, a central vacuuming system, stereo speakers everywhere, and motorized window shades. Operation of these gadgets and maintenance of the house is covered in a 150-page owner's manual written by the architects.

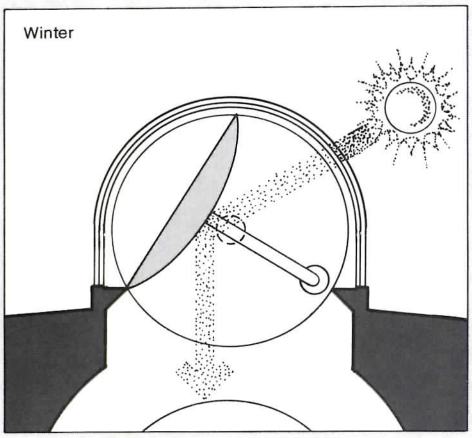
The daylighting theme of the Roto-Lid is introduced at the front door, on the north side. One arrives at the naturally formed white oak "tree door" (by Tom Galbraith) via a bridge from the gate house motor court. The two-story foyer is a well of sunlight within which stands, like a great spring of mahogany, a sinuous spiral staircase by Tom Luckey. This staircase, perhaps the house's most beautifully crafted element, marks the building's very core. From here the interior gallops off to the east and west, while Luckey's stair directs your eyes aloft to the second story, where another bridge branches out to the guest house.

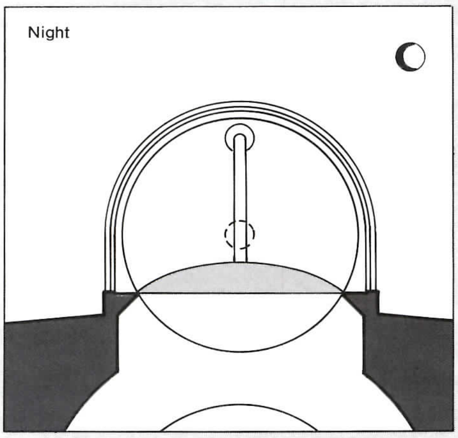
Around the corner from the front door to the west, just past a curved aquarium wall and spiral bar by Doug Hurr, are the laid-back entertainment spaces—two conversation pits lined with leather upholstery. One faces the hearth of a great bluestone fireplace by John Walter, above which floats a cedar-clad second-story bridge. The other pit, on the opposite side of the fireplace, focuses on a television console (also by Hurr) that is a monument to Wurlitzer.

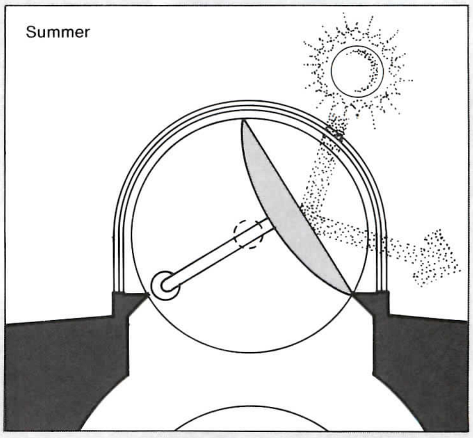
East of the foyer is a breakfast nook and a large kitchen with every convenience, distinguished by beautiful green Vermont marble counters. A dining room is opposite the kitchen to the north. Despite some interesting views up to the skylit second floor, the dining room seems cavernous and uninviting because of its high windows. Wisely, the devils placed no other important spaces on the first floor's north side, devoting it to service.

One of the house's most delightful spaces is the south-facing game room, which is just off the kitchen and where the family no doubt does most of its munching. The room has an encompassing view of the pool and guest house, and in its northeast corner a head-on collision of architecture and auto culture. The game room's fireplace, inspired by the auto-manic creations of artist Phil Garner, is the front end of a pink 1962 Chrysler Newport, complete with working headlights, taillights on the mantle, and a Jersey license plate. The devils bought the Chrysler from a used car dealer in Campbello, S.C., chopped off its front, and installed a fire box behind the grille, which flips down.

The second floor is devoted to bedrooms, a servant's quarters, and private spaces such as curved glass offices and round sitting rooms. The four girls' rooms are at the east end, paired in mirror images across a skylit corridor. Each has a gently vaulted ceiling, clerestories, and deep walk-in closets; and each pair



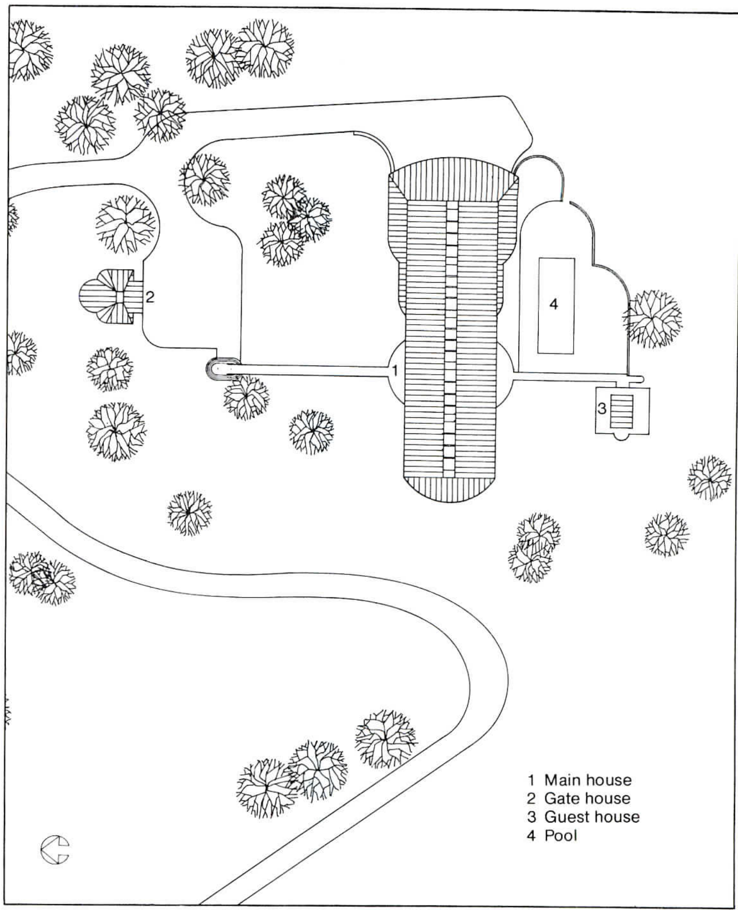

The hoagie's Roto-Lid—a skylight with rotating insulation—is the invention of Jersey Devil architect Jim Adamson. "With open skylights you get plenty of sunlight," explains Adamson, "but during the summer the space can overheat, and in winter you lose heat at night." The Roto-Lid is based on an equilateral triangle with a rotating panel of insulation that has three positions. Always on an east-west axis, during a winter day the panel faces north, admitting the sun's warmth. On a winter night the panel rotates to seal the triangular chamber from the interior, preventing heat loss. On a summer day the panel faces south, admitting northern light and minimizing heat gain.

Adamson built a Roto-Lid prototype with the help of a U.S. Energy Department Grant. The prototype was installed on the hoagie's gate house and tested,

Courtesy of Jersey Devil

prompting modifications for the seven Roto-Lids that crown the hoagie house. The panels' seals were tightened with Teflon-coated cloth, and the triangular chamber was changed to a vault of double-layered clear plexiglass in keeping with the hoagie's theme of circles and curves. The anodized aluminum panels, which have three-inch insulation, are counter-weighted and in perfect balance so that very little power is needed to rotate them. Each Roto-Lid turns on a 1/80th horsepower gear motor.

Adamson says that the hoagie house Roto-Lids are a lot "smarter" than the prototype: a computer controls their position (the prototype operated on a light sensor). As the summer sun slowly crosses the sky, the Roto-Lids move with it, controlled by a program that accounts for solar angles, the latitude, and the date. —Michael J. Crosbie




*Left above, view of hoagie house as it juts out over rock outcropping, hovering over its concrete base; left, tubular bridge to hoagie's front door meets visitors at gate house motor court, with concrete stairs that invert corbeled pedestal and are illuminated with a space frame tower; left below, long view of the hoagie's north elevation with scoop windows in bedrooms that catch morning sun. Right, detail of the hoagie's southwest corner, with balcony that overlooks the driveway.*

of rooms shares a bathroom. The hallway in the east wing is paved with glass block, allowing natural light to the first-floor corridor.

Way up at the west end, behind the fireplace wall, is the master suite—the most sumptuous of the house's spaces, with a party-sized bathroom and a series of closets and dressing rooms lined with mahogany and birch cabinets. You have to walk through the bathroom or the dressing rooms to get to the bedroom, which is actually quite small in contrast and is occupied by two steel I-columns sheathed in cedar. The bedroom doesn't have a skylight (a dressing room *does*), which would have made it a far more exciting space than the room where you pick out your earrings. There are built-in cabinets below the west windows, in front of which pops another television set. This isn't a room for reveling in sunsets, and it points up a quirk about this house: beautifully sited and environmentally designed, it has little dialogue with nature. Many of the spaces, such as the conversation pit, the media room, and the master bedroom suite, are inwardly focused. Although bridges lead to and from the house, there are few architectural gestures toward the site. Windows admit light, but don't necessarily frame views. Like a spaceship or a boat, the hoagie house is self-contained. This is entirely appropriate for clients who covet their privacy, and with all that luscious woodwork and handcraft there's plenty to focus on inside. But a melding of inside and outside seems a missed opportunity.

That deficiency aside, the hoagie house, with its gate house and guest house in supporting roles, is an edifying architectural anomaly in an age of deteriorating craftsmanship and environmental indifference—an affirmation of the architect and builder's magical mixture.

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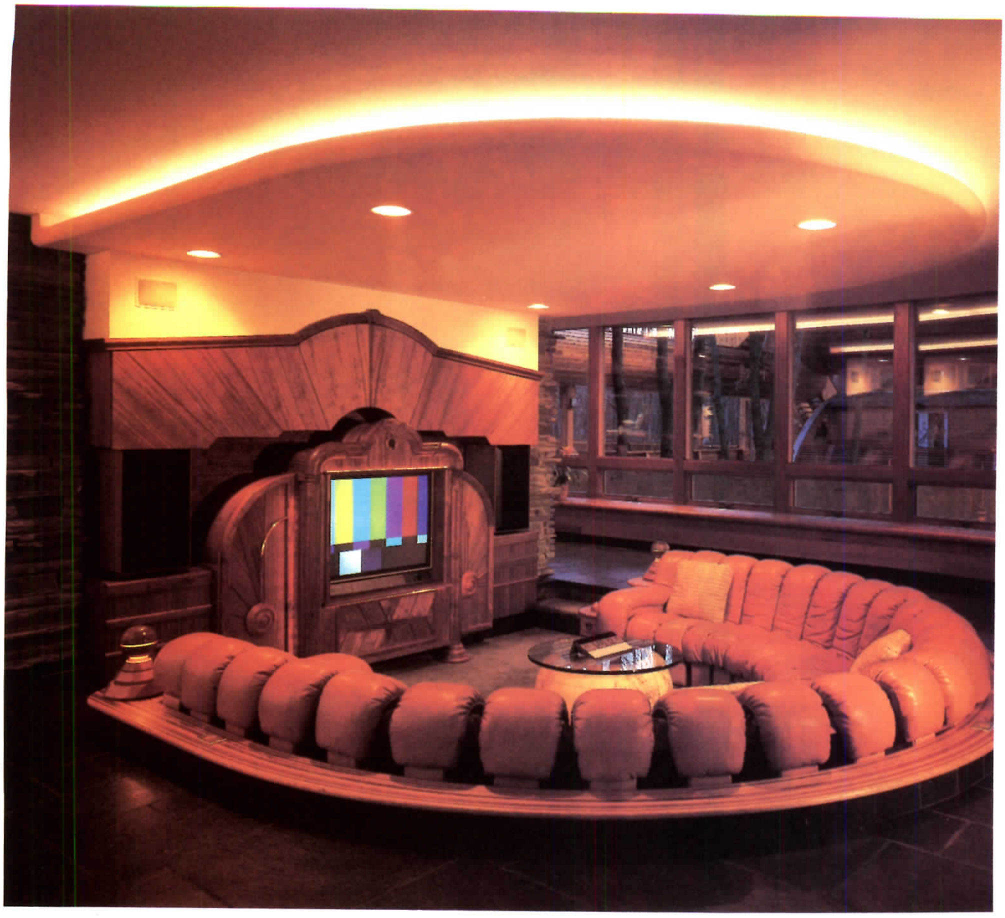

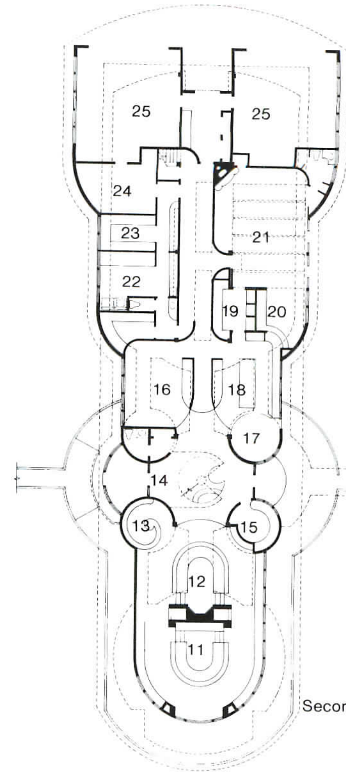



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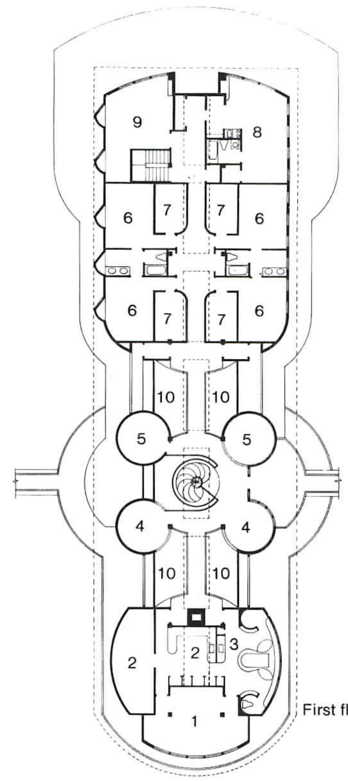



1 Master bedroom
2 Dressing room
3 Bath
4 Sitting room
5 Office
6 Bedroom
7 Closet
8 Maid's quarters
9 Exercise room
10 Open to below
11 Media room
12 Conversation pit
13 Bar
14 Foyer
15 Office
16 Dining
17 Breakfast nook
18 Kitchen
19 Pantry
20 Snack corner
21 Game room
22 Laundry
23 Gift wrapping room
24 Mechanical
25 Garage

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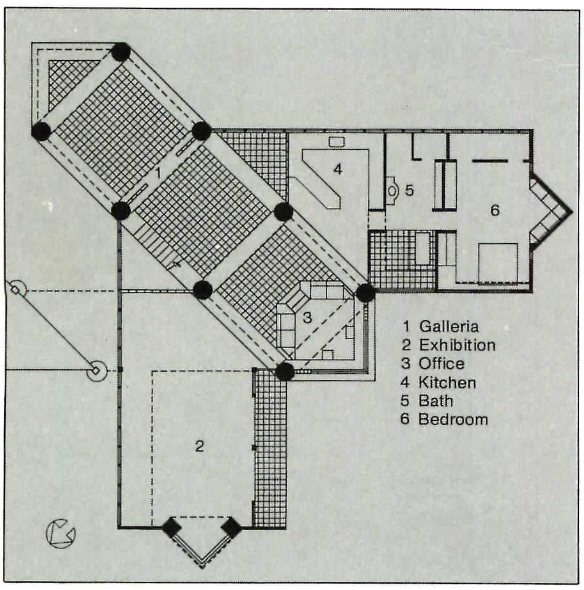
*Right, view of conversation-pit corner, with bar and spiral stair in background, all under a canopy of natural light. Left top, inwardly focused media room is found on opposite side of fireplace; left middle, detail of spiral stair; left bottom, car fireplace's internal combustion.* □

# Meeting of Two Cultures in A Model Home

*Designed by Californian Steven D. Ehrlich, AIA, for a Tokyo housing exhibition.*
*By Hiroshi Watanabe*




*Ma* is a term much used by interpreters of Japanese culture. It might be translated as "meaningful interval" and can refer to the pause between movement in a No play or the space between stones in a Zen garden. Behind it is the notion that inaction or emptiness is as significant as action or plenitude. However, though emptiness may be appreciated in traditional architecture, it is not a notable quality of the typical Japanese house of today. Consumers are forced by the exorbitant cost of land into living in tiny houses, which are, perhaps in compensation, not only crammed with household goods on the inside but often ornamented with a multitude of excrescences on the outside.

The Home Show, a collection of houses by various manufacturers, is open to the public and is located in Futako Tamagawa in Tokyo. The houses are a motley lot, built in widely differing styles derived for the most part from Western architectural sources. In their midst is a building exhibiting a bold use of forms that manages, without being obvious, to evoke the spirit of traditional Japanese architecture—and the spirit of *ma.* Maison 2001, as it is called, serves as a reception center, showroom, and gallery for the ABC Development Corp. Maison 2001 was designed by Steven D. Ehrlich, AIA, of Venice, Calif.

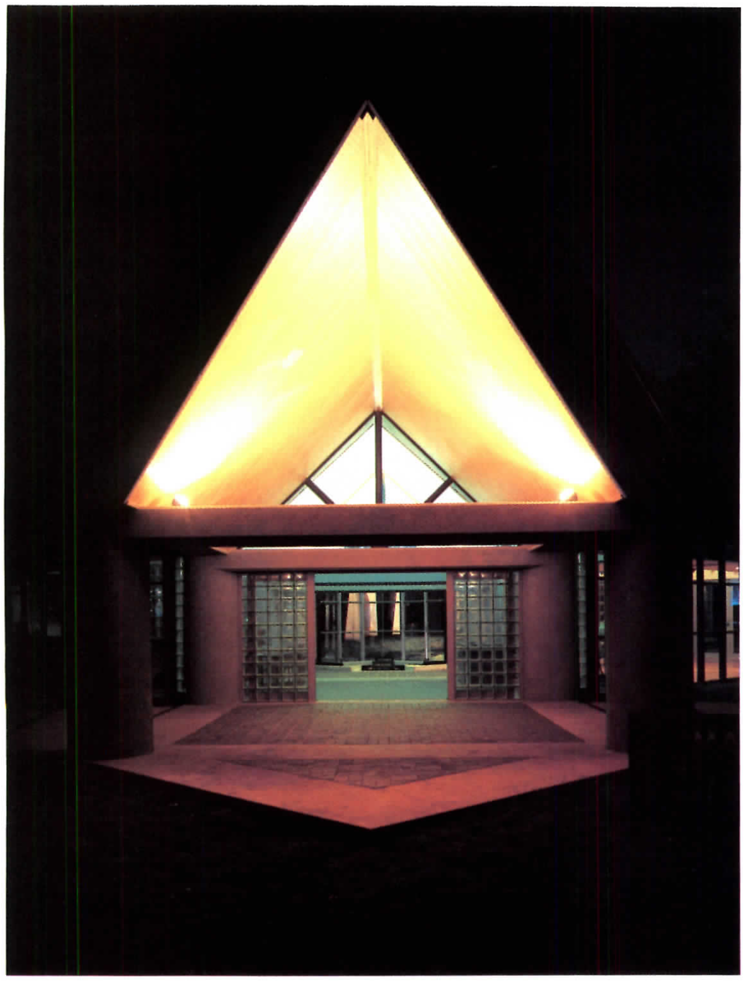
Tomomasa Hayashida, an executive of ABC, which manages the Home Show, wanted something more than the makeshift shelter normally used to receive visitors to such a show park in Japan—he wanted a building that made a "statement." He turned to Ehrlich, whom he had met at a home builders' convention in Dallas.

Ehrlich calls this "an unusual hybrid," "a global, binational project," and cites it as "proof that the world is becoming a global community." This seems a trifle premature, given the modest scale of the venture, but the building undeniably did its bit to foster international cooperation. However, Maison 2001 also appears to underline certain cultural differences. The majority of Japanese architects remain engineering-oriented, and Ehrlich's approach, which evidently stresses the development of purely architectonic ideas before any consideration of materials or structure, proved a novelty for the Japanese involved in the project.

Atsushi Yamada of Tokyo, the associate architect, recalls how subcontractors tried their best to persuade the architect to

*Mr. Wantanabe, a frequent contributor to this magazine, is an architect and writer working in Tokyo.*

*Above, the back of the Y-shaped building, with exhibition wing in foreground; right, bold geometrical form defines the entrance.*



*Above, looking through the central galleria to the termination of the 'sacred pathway,' right. Opposite page, exhibition wing.*

construct the building their way (the conventional way), but to no avail. "Perhaps as a result the building is not entirely rational," says Yamada. For example, "the roof truss is complicated, with members coming together at odd angles." Yet Yamada thinks that working with the American architect was a broadening experience for the Japanese concerned, in that it opened their eyes to an approach that was not strictly empirical.

The building, with its Y-shaped plan, sits on a corner site. Reflective panels, set in a three-foot grid of Cor-Ten steel, mirror nearby cherry trees and manufacturers' houses and are intended to be an interpretation of shoji screens. The roof is also of Cor-Ten steel, and the way the entrance canopy juts out vaguely suggests a feature of the Japanese folkhouse.

Running down the middle of the building is a galleria, a series of spaces defined by precast concrete panels and lintels, which were inspired by *torii,* the gates of Shinto shrines. From this two wings branch off, one used as an exhibition area and the other as a showroom. Movement through the galleria is clearly meant to take on a processional quality, as indicated by Ehrlich's statement concerning a "sacred pathway," but the fact that one enters the first space from the side and that there are only three spaces in the series weakens this effect. The scheme is more in the nature of a centralized plan, focused on the second space, which is lit by a high window. Ultimately, instead of a sense of movement, the plan and the proportions of the building instill a sense of repose. This works to the structure's advantage, however, for its feeling of stillness provides a sharp contrast to the continual movement of the builders' houses, with their twisting, narrow corridors and highly compartmentalized spaces.

Maison 2001, despite its name, is not a patently futuristic work. Indeed, it is only a series of spaces with barely a functional rationale. Ehrlich even banished the real, as opposed to the showroom, toilets to a separate building. (It would have been a further improvement had he banished the showroom, which was the responsibility of an interior designer and is a disappointment.) By stripping the building down to its essentials—that is, by providing a strong roof form supported by monumental columns and by dematerializing the walls—the architect reminds potential buyers who traipse through the Home Show how the Japanese for ages have created places. Rest and emptiness, the building hints, are as important as frenetic movement and plenitude. Less is *ma.* □

# 'Tiny, Amiable' Gate House

*For a Woodstock, N.Y., estate, Kliment and Halsband. By Andrea Oppenheimer Dean*

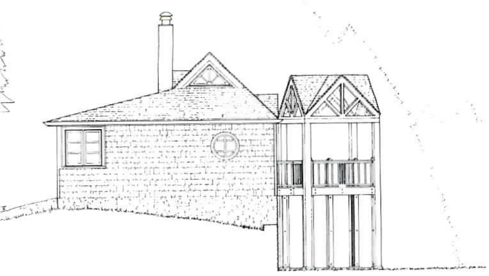
Woodstock, N.Y. The name recalls the 1969 three-day rock festival, though that was disowned by Woodstock's conservative city fathers and actually took place 60 miles away on a farm near Bethel. The real Woodstock is a little town in the Catskills, full of crafts and antiques shops, with an arts tradition dating from the 19th century, when artists, loosely united as the romantic Hudson River School, came to paint and subsequently attracted tourists. Woodstock is also the site of Robert Kliment's and Frances Halsband's weekend and summer home and what they call their "country doctor" architectural practice. Its most recent product is a tiny, amiable gate house, a combination garage and apartment for a Woodstock estate.

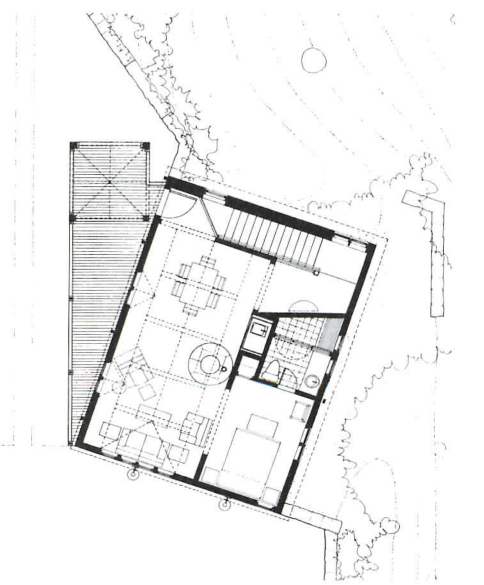
At least three qualities come together to transform what might have been just a friendly little folly into interesting architecture. The first is its siting as a transition between the valley it overlooks and the wooded mountain into which it backs. In fact, its first-floor cladding of bluestone from local quarries is an extension of the retaining wall separating the hill from the clearing at its base. Kliment aptly calls the dwelling a "wall house."

Then there is the matter of the peculiar axis. To transmute the building into a gate house, the architects pulled the east-facing porch away from the rectangle of the house at a 19-degree angle to parallel the alignment of the nearby main house and topped the porch's wide, south-facing corner with a tower. It is the main focus of the little house and a new pivot point for the property.

Finally, the architects achieved a crafted, but not saccharine, demeanor through controlled rusticity—cedar shake cladding with simple and rudimentary but appropriate trim and detailing. To give the illusion of the east facade as a sort of face peering at the clearing, says Kliment, the gables—which overarch the two east-facing windows like eyebrows—were fitted into the plane of the wall, rather than pushed over the eaves.

The interior is just two rooms—a living and dining space focused on the porch and a purposefully pint-sized penumbral bedroom facing the back wall, which also contains kitchen and laundry spaces. The living area's most striking feature is its peaked ceiling. Above exposed trusses, it is papered in a green and tan floral pattern to suggest a leafy cover. It is a fittingly romantic touch for a romantic little gate house. □





*Left, angled porch made way for corner tower, which creates gatehouse effect and, as seen at right, top, aligns building with axis of main house. Interior (right, center and bottom) is a single space (plus unseen bedroom) topped by papered ceiling resembling foliage.*

# Housing for the Poor: Losing More Than We Build

*So far no real substitute has been found for a positive federal role.*
*By Nora Richter Greer*


Illustration by Brian McCall

As 1990 approaches, so does a housing crisis of a magnitude not seen in the United States since Franklin D. Roosevelt called a third of the nation "ill housed" as he launched his New Deal. If current trends persist, by the turn of the century nearly the same percentage of the population could be living in substandard dwellings, be paying excessive rents, or be homeless altogether.

The causes of the crisis are interrelated and complex, centering around the virtual dismantling of federal low-income housing programs. The solution will necessitate a new, long-term financial commitment by the federal government, housing experts say. But just as assuredly, what is being called "the vigorous new creative thrust" of cities and states toward housing their poor will significantly transform national housing policy.

What has housing experts concerned is the impending confluence of trends in federal housing: the virtual halt of low-income housing construction; the aging and decay of subsidized housing projects, accelerated by dwindling rehabilitation funds; and the expiration of 20-year contracts with private sponsors of low-income housing. HUD's budget has dropped from $35.7 billion in fiscal year 1980 to $14.2 billion in fiscal year 1987. Although an exact tabulation is difficult to make, it is quite clear that many more low-income units are lost each year than replaced. Roberta Youmans, of the National Housing Law Project, predicts that in about five years a "massive influx of money will be necessary" to remedy the situation.

With the drop in production of new units and the rise in the number of poor, there are long waiting lists for public housing. Among the worst cases, according to the Council of Large Public Housing Agencies, are Baltimore, with 13,000 families waiting for openings in 17,000 existing, occupied units, and Chicago, with 44,000 families waiting for openings in 49,000 units. In fiscal year 1987, 74,000 new units were built, down from 192,000 in 1980 and from 393,000 units in 1977. The units being built now were authorized during the Carter years; under the Reagan Administration, new construction contracts have virtually stopped.

Just as damaging has been the meager provision for rehabilitating public housing units, half of which are over 20 years old. Since 1975 the government has spent $7.9 billion for repair and modernization; for fiscal year 1988, the Administration has requested $437 million. At the same time, ABT Associates, a private research group in Cambridge, Mass., has reported to Congress that $21.5 billion is needed to repair and modernize the nation's 1.3 million units of public housing. Each year, as many as 70,000 units of public housing are abandoned or demolished because repairs are too expensive. For example, in 1986 the Philadelphia Housing Authority closed two 15-year-old towers because the $18 million cost to repair them was prohibitive.

The biggest crunch, though, is expected in the coming decade, when contracts the federal government made with private owners of subsidized low-income housing start to expire. Then the owners will have no obligation to either the federal government or their tenants and will be able to convert their units into higher-rent condominiums, sell their buildings, or even tear them down. The General Accounting Office predicts a reduction of as much as 900,000 units by 1995. Others are less pessimistic.

William Apgar, associate director of the MIT/Harvard Joint Center for Housing Studies, warns, "We could be entering a period in which additions to the subsidized inventory are needed just to keep the number stable." The National Association of Home Builders estimates it would cost more than $130 billion to replace the current supply of subsidized housing.

The Reagan Administration's sole housing initiative is the five-year vouchers program. The vouchers, the Administration says, give tenants more freedom of choice as to where they might live. Under the program, recipients must find private-market housing and pay the difference between 30 percent of their income and the "fair market rate," a standard amount set by HUD as the maximum a low-income household should pay for rent. Under the current certificate program for subsidized housing, tenants pay only 30 percent of their income.

The Administration's proposal for fiscal year 1988 calls for 100,000 vouchers. "The program doesn't expand the supply of housing at all," says Douglas B. Diamond Jr., NAHB's assistant vice president for housing policy. "In fact, it expands the competition for the existing supply of housing."

The Administration's emphasis on the "privatization" of public housing portends another potential drain on supply. In 1984, HUD launched a demonstration program encouraging tenant ownership of such housing. Since then, 3,589 units have been sold in 55 formerly subsidized projects. Reactions are mixed. Doug Cavanaugh, legislative counsel for the Council of Large Public Housing Agencies, calls the program "a ruse for unloading the public housing stock on tenants who can't afford to keep it." Apgar calls it a "cruel trick."

As the federal role diminishes, a cutback in multifamily dwellings in the private market also is taking place, as the market moves further and further into the middle- and high-income levels. Between 1970 and 1975, single-family housing starts accounted for 55 to 65 percent of the total; between 1975 and 1980, 70 to 75 percent.

Private development of low-income rental housing is virtually nonexistent. In addition, nearly 100,000 privately owned low-income units are lost every year through abandonment, foreclosure, arson for profit, and condominium conversions, says the National Low Income Housing Coalition.

It is still unclear how changes in investment tax credits brought by the Tax Reform Act of 1986 will affect the partnerships of private investors with nonprofit organizations or state or local housing agencies geared to developing low-income housing, especially where a large private investment is involved. The tax credits remain significant—9 percent annually of the cost of low-income units, minus the cost of land, over a 10-year period. "But they are loaded down with restrictions that will discourage investors, particularly the clause calling for the credits to be taken only on passive income," Diamond says.

It is hard to avoid making the correlation between the decline in the supply of low-income housing and the rise in homelessness. Estimates of the number of homeless now range between 250,000 and 4 million. By the year 2003, unless some drastic steps are taken, 18.7 million could be homeless, burdened with excessive rents, or forced to live in slums, the Neighborhood Reinvestment Corporation predicts.

To avoid such an outcome, public, private, and nonprofit groups at the state and local levels are forging ahead with new approaches to providing low-income housing. So widespread are these efforts that "local influence on federal involvement may be as strong as the federal influence on local housing and community development activity of an earlier period—from 1934 to 1980," says Mary Nenno, association director for policy development at the National Association of Housing and Redevelopment Officials. Developer James Rouse puts it this way: "There is a whole uprising out there." New types of partnerships have been formed, new development methods tried, and new financing schemes devised, many of which seem to be more responsive to community housing conditions than the federal programs.

Take Chattanooga, Tenn., for example. Last September the city announced a $200 million plan aimed at providing a decent home to every city resident within the next decade. That will involve the construction of 500 units and the renovation of 13,000. A newly formed group, Chattanooga Neighborhood Enterprise Inc., will lend money and technical assistance to neighborhood groups, churches, and individuals for the renovations. So far, $3 million has been raised from local and national sources to cover the first three years' operations. The effort was spearheaded by local nonprofit and community groups and developed by the Baltimore-based Enterprise Foundation.

Although larger than most, this program is typical of work the Enterprise Foundation has been doing since it was founded in 1981. Its financial base consists of profits generated by the Rouse Company's festival marketplaces, modeled after Quincy Market/Faneuil Hall in Boston and Harborplace in Baltimore, but built in smaller cities such as Norfolk, Va., Toledo, Ohio, and Battle Creek, Mich. The Enterprise Foundation also receives grants from other foundations and businesses. It expects to have raised $25 million by the end of 1987 and will have provided funding and technical assistance to 67 nonprofit community groups.

"We work strictly with poverty-level families where the economics are very tough," says Peter Werwath, director of the foundation's rehab workshop. "The majority of those people live in substandard housing, and the odds against replacing all those units with modern, decent housing are enormous. It isn't a volume program. We're usually trying to demonstrate some new kind of production or financing technique." Emphasis is also placed on strong community services—health care, job training, and education, among others.

A similar organization is the Local Initiatives Support Corporation, which began in 1979 as a joint effort of the Ford Foundation and six major private insurance, industrial, and banking firms. LISC started with a budget of $9.35 million; by the end of 1985 its assets topped $100 million. Its objective is to assist local nonprofit organizations in securing private and public resources for the design, financing, and management of housing and community developments of significant scale. These developments are to be long-term, profitable economic ventures. Special attention is given to assisting low-income households while maintaining middle-income residency in a particular neighborhood.

Housing partnerships have been formed across the nation that assemble funding (and sometimes expertise) from private and public sources and direct it toward a specific low-income housing development. More recently, these partnerships have been formed to develop and manage multiple projects. For instance, the Boston Housing Partnership, formed in 1983, contracts with 10 community development corporations, which in turn are responsible for specific low-income housing initatives. The Massachusetts Housing Partnership, formed in 1985, set as its goals the reclamation of all salvageable abandoned housing units in the state, redevelopment of abandoned lots, strengthened efforts to maintain households in existing housing stock, expanded housing production, and innovative demonstration projects.

An example of a nonprofit, cooperative venture at the local level is the Nehemiah Plan, established in New York City in 1980. This coalition of 52 religious congregations—the East Brooklyn Churches—raised seed money, secured $15 million in interest-free loans from the state for mortgages, received land donations and short-term suspensions of property taxes from the city government, and built 1,600 single-family houses for families with incomes ranging from $20,000 to $40,000. In the San Francisco Bay area, BRIDGE, a nonprofit regional development corporation, produced 1,466 housing units in six counties for families earning $12,000 to $25,000 per year.

Meanwhile, special revenue-raising programs tied to the development dynamics of a specific market have sprung up. In San Francisco, for example, downtown commercial developers must either produce one low-income unit for every 1,125 square feet of office space or contribute a set fee to the Citywide Affordable Housing Program Fund. The requirement is based on the assumption that each additional million square feet of office space produces the need for 386 low-cost apartments to house the low-paid workers employed in the new buildings. From 1981 to 1986, 3,793 units were funded by this program. Similar programs have been adopted in Boston, Jersey City, N.J., and Santa Monica, Calif.

A fund-raising technique first used in the early 1950s has resurfaced in 35 states—tax increment financing. Under state laws, localities can generate new revenues for future housing and community improvements by taking advantage of an increase in property values resulting from redevelopment. Property taxes are frozen at the start of the redevelopment; at the end, when rates have increased, developers must pay the difference between the frozen level and the full taxes. The funds are used to help pay off the public revenue bond issued to finance the housing.

Other housing trust funds are created by the interest earned on real estate transactions, such as escrow deposits, real estate title transfer fees, mortgage property tax and property insurance prepayments, and commercial and residential tenant security deposits. Nationwide, income from tenant security deposit, sale, and mortgage escrow interest could total $1.7 billion annually, according to the National Association of Housing and Redevelopment Officials—enough to build 39,000 units or rehabilitate 170,000. Some trust funds take an unusual twist. California uses taxes levied against offshore oil revenues. Atlantic City collects taxes on hotel rooms, entertainment, and other luxuries; gambling casinos are required to invest in low-income housing.

Supplementing the housing trusts, states have generated new rental and homeownership assistance programs, rent supplements, neighborhood improvement programs, and aid to special-needs housing. California, for example, will use the funds from its offshore oil taxes over the next three years to provide seed money for construction of low-income rental housing, grants to organizations providing shelter for the homeless, and loans for housing for the elderly and disabled.

Localities, too, have increased their efforts. It is not unusual to find a local government acquiring or renovating low-income housing, although the programs are usually quite limited in scope. The Houston Housing Authority recently bought foreclosed homes to rent to low-income households. In Alexandria, Va., the housing authority recently purchased 152 units to "ensure there would be some low-cost housing." Under a neighborhood preservation ordinance, the City of Hartford, Conn., requires that anyone wishing to demolish or convert residential units must replace those units with an equal amount of square footage or contribute to a low-income housing fund. In the program's first 18 months, 65 units had been replaced.

Most of these state and local programs will ultimately meet only a small percentage of the need unless there is a significant influx of federal dollars. As of 1982, states and cities were subsidizing about 600,000 households. Currently, about 4.2 million households participate in federal programs.

But in terms of establishing the institutions that may someday be used to fill the needs, the state and local programs are significant, says housing expert Cushing Dolbeare. "The expertise state and local governments and nonprofit organizations have recently acquired in developing and operating housing projects provides a base on which federal programs may soon be rebuilt." Nenno predicts an even larger role: "If carried to fruition, these trends should have a long-term effect of changing the status of low-income housing as an isolated and after-the-fact activity to one of an assured place in the total marketplace." In the future, the availability of low-income housing may increasingly be seen as a key component in a locality's economic revitalization.

Housing experts, though, say it is still essential to have a strong federal role supporting the state and local efforts. Only the federal government, they say, can provide national standards and policies needed to direct private funds into housing. What those standards will be, concerning the construction or rehabilitation of any public housing, is intrinsically tied to costs.

"We imagine we have enough money so everybody can live in good-quality housing," Apgar says. "We set high standards for what we expect our public programs to achieve, and we produce very high-cost housing that becomes more and more like standard subdivision housing. But then we don't follow through and make enough resources available so everybody can get access to the housing."

Kenneth Beirne, HUD's general deputy assistant secretary for policy development, suggests, "The market can build shelter that by worldwide standards would be fantastic for low-income people. By American standards it would be utterly intolerable." In reality, the solution may be somewhere in between.

Kathryn Wylde, of the Housing Partnership Development Corporation in New York City, points to bathroom and kitchen size requirements. "By the time you are done," she says, "you've lost the economics."

Partial rehab is an option. "In most cities, 15 to 20 percent of the housing doesn't even meet housing codes," Werwath says. "If you drive a nail and pull a building permit, you are committed to spending $40,000 a unit. Partial rehabs can run from $15,000 to $35,000." Werwath says the Enterprise Foundation stresses least-cost, high-value techniques for such tasks as roofing, drywall fastening, caulking, and painting.

Another departure from conventional housing is the reintroduction of the single-room-occupancy hotel. That type of housing—where residents have private bedrooms but share bath, kitchen, and other living spaces—has proved appropriate and affordable for once-homeless persons who do not yet have the means for separate apartments. The building type is highly flexible and can be altered for a specific population, such as the chronically mentally ill, the elderly, or single men or women. Many argue that the single-room-occupancy hotel is a better social environment for these populations than separate apartments. Supportive services, located on or near the residential site, can add a crucial dimension.

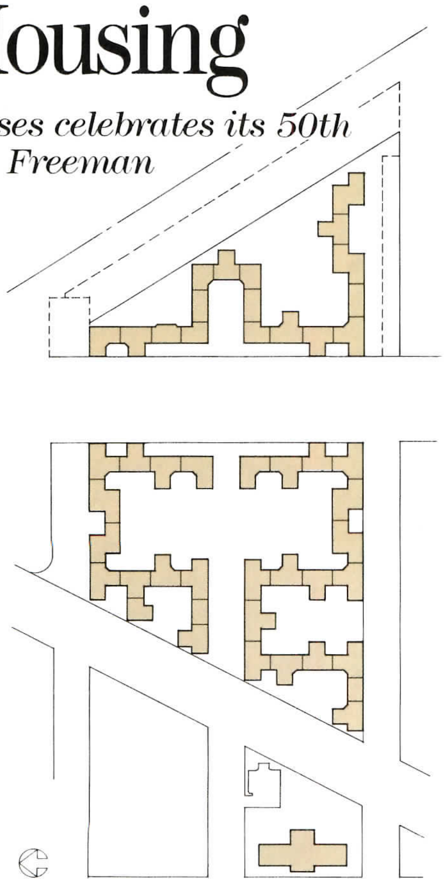
By the year 2003, says the Neighborhood Reinvestment Corporation, 7.8 million more units of low-income housing will be needed. "There is a sense that it's time to start putting housing policy back together," Apgar says. "You've got former enemies now working together—builders, bankers, advocacy groups. It's like starting fresh all over again." Spearheading the effort in Congress are Senators Alan Cranston (D-Calif.) and Alfonse D'Amato (D-N.Y.), who in 1988 or 1989 will introduce the first major post-Reagan-era national housing policy. And a number of both Republican and Democratic presidential candidates are talking about what the federal government can and should do to mitigate the impending crisis.

Already, essential elements of future housing policy are clear. Flexibility and diversity are needed to better match scarce resources, "so that where it is cost-effective to rehab, communities will do that, and where it is cost-effective to do new construction, communities will do it that way," Apgar says. Most projects will be community based and small in scale. "Volume production and highly standardized federal programs don't work," Wylde says. Kermit Baker, senior economist for Cahners Publishing Co. in Boston, says, "The federal government has much more ability to raise funds than anyone else. It's difficult for rural Mississippi, for instance, to raise the money for housing. The places that can afford to do that are probably not where the problems are going to be. Without federal aid, you're going to have very, very serious distortions. Whether the feds should administer the programs or not—that's a separate issue."

What is most clear is that "we have to re-establish a longer-term commitment to gradually expanding the number of subsidized, affordable units," in Apgar's words. □

# New York's First, And Perhaps Best, Public Housing

*Harlem River Houses celebrates its 50th birthday. By Allen Freeman*



This summer is the 50th anniversary of New York City's first federally subsidized housing project, Harlem River Houses, built during the Great Depression near the New York Giants' Polo Grounds in upper Harlem. With 574 walk-up apartments in three serpentine red brick buildings four stories high, Harlem Houses earned lavish praise from Lewis Mumford, Hon. AIA, who, strongly influenced by Ebenezer Howard's Garden City concepts, wrote: "Here . . . is the equipment for decent living that every modern neighborhood needs: sunlight, air, safety, play space, meeting space, and living space. The families of Harlem River Houses have higher standards of housing, measured in tangible benefits, than most of those on Park Avenue. By contrast, every other section of the city is makeshift, congested, disorderly, dismally inadequate."

Today, the Giants' Polo Grounds have given way to cheerless, stark slabs of high-rise housing. Nearby, along littered Frederick Douglass Boulevard (Eighth Avenue) in the west 140s and 150s, century-old tenement houses stand like giant tombstones—boarded, grimy, threatening.

But in the courtyard of Harlem River Houses off Adam Clayton Powell Jr. Boulevard (Seventh Avenue) at 152nd Street, elderly residents converse softly in the shade of 50-year-old plane trees. A block away, small children are closely supervised in a well-kept playground. And along the project's northern periphery, stuffed animals and bric-a-brac are neatly arranged in ground-level windows protected by burglar bars.

Harlem River Houses is a reminder that humanely scaled public housing, even with abundant green space away from the street (Jane Jacobs notwithstanding), can thrive next to urban decay. "It remains a community," observes John Louis Wilson, FAIA, one of the pioneer project's architects. "When I walk through the courtyard, people ask if they can help me."

Wilson lives a mile away. Now 85 and retired, he was in 1928 the first black graduate of Columbia University's architecture school, and in 1984 he won AIA's Whitney M. Young Jr. citation. He was the only black and is now the only living member of the seven-architect team assembled in 1936 by the New York City Housing Authority to design the project. The chief designer

*Facing page, Harlem River Houses from the west, with McCombs Place in foreground and Yankee Stadium on horizon. Above, child care between tennis courts. Right, WPA courtyard sculpture.*

was Archibald Manning Brown, Harvard- and Ecole-trained architect of city and country houses for the wealthy.

Riots in 1935 had focused attention on Harlem's housing needs, and the Federal Emergency Administration of Public Works agreed to spend $4.7 million for a model project, with the city providing the land. Of the original 574 apartments, 60 had two rooms with kitchenette, 259 had three rooms, 232 had four rooms, and 23 had five rooms. Each apartment had electric refrigeration and lighting, steam heat, cross ventilation, a tile bathroom, and what was considered ample closet space. Wilson believes one of the units' strengths is a circulation pattern with foyers that eliminate the need for going through the living room to reach the bedrooms. "Somebody might have to sleep in the living room," he says. He wanted showers in the bathrooms, but they were considered luxuries. Later, the housing authority installed showers over the tubs.

Well-designed units are one reason several dozen residents have lived there 50 years, like Pearl Carpenter, who moved up from 120th Street in 1937. "My husband and I were so happy with our apartment we were like honeymooners. I still love it," she says. And Josephine Baker, a "newcomer" who arrived in 1956, says, "I wouldn't move from here unless I had to." Indeed, there are stories—perhaps apocryphal—of people refusing jobs that would pay more than the maximum income allowance for residents in the project.

Most important to Harlem Houses' endurance are low density, domestic scale, and intelligent site planning. As countless subsequent projects have proven, no amount of open space can make a community of clustered high rises. Such projects seem to incubate crime, while the courtyard at Harlem River Houses has remained relatively safe, patrolled by tenants and a lone housing authority police officer five days a week. The resulting community pride, in turn, reinforces the benefits of good planning and management. □

# Now GE simplifies the whole difficult business of ordering built-in appliances.

# Mexico City as Seismic Laboratory

*A multinational team draws lessons from the 1985 tragedy.*
*By Donald E. Geis and Christopher Arnold, AIA*

On Sept. 19, 1985, an earthquake registering 8.1 on the Richter scale struck the central and southwest regions of Mexico. Felt as far away as Houston, the quake severely damaged Mexico City, some 250 miles from the epicenter. More than 20,000 were killed, and damage costs totaled between $4 billion and $5 billion. The total economic losses will greatly exceed this. Approximately 5,700 office buildings, schools, hospitals, and residential buildings throughout the central city were heavily damaged or destroyed.

The quake offers the U.S. and Mexican building communities a revealing, if deadly, "natural experiment." Mexico City structures used the same modern design and construction techniques for earthquake resistance that are used in the U.S. How did they fare? The answer to this question is vital not only in California but in 38 other states (with 70 million inhabitants) that are susceptible to moderate to high earthquake forces.

In an effort to learn in depth from the experience in Mexico City, AIA and the *Colegio de Arquitectos de Mexico/ Sociedad de Arquitectos Mexicanos* (CAM/SAM) are investigating the Mexican quake with support from a National Science Foundation grant to the Joint Council on Architectural Research. This council is sponsored by AIA and the Association of Collegiate Schools of Architecture. The investigation to date is notable less for uncovering new information than for changing informed speculation into fact and reinforcing again the importance of what we already know:

- A large earthquake is devastating in terms of loss of life and property damage for a modern city.
- The interaction of a building's form, structure, and construction quality determine its seismic performance. The earthquake unerringly seeks out any weaknesses.
- Well-designed and -constructed modern buildings perform well. To achieve this standard demands a high level of cooperation and understanding among all members of the design team.
- The traditional criteria for a well-planned city coincide with those for a seismically safe city.

Mexico City sits nearly a mile and a half above sea level, ringed by mountains. When Cortés conquered the Aztec city in 1519, this basin was partly a lake, which the Spaniards drained and filled in.

In the centuries since, Mexico City has grown into a modern metropolis of 18 million people. Much of the modern city is built on the high ground surrounding the old lake bed, but the city's central district remains atop the lake bed's layers of sediment, which have a high water content. Extensive ground subsidence has been a feature of downtown Mexico City for decades, causing buildings to tilt dramatically, even without earthquake activity. This geologic setting tends to amplify the seismic waves created by distant earthquakes, so that central Mexico City is particularly vulnerable to seismic attack.

Well aware of the nature of the ground and of Mexico City's extensive earthquake history, authorities first enacted a seismic building code in 1942. Following an earthquake of Richter magnitude 7.5 in 1957, regulations were made more demanding, resulting in a seismic code comparable to any in the U.S. at that time. New regulations, including provisions regarding dynamic analysis, were issued in 1966 and 1977. However, the intensity of the 1985 earthquake exceeded by a wide margin the intensity that had been anticipated in the code. Under these circumstances the question is not why so much damage occurred but rather how so many buildings survived.

While a seismic code provides a technical baseline, how the code is enforced and interpreted is another issue. The authority responsible for drafting codes and issuing construction and occupancy permits in Mexico City is the Federal District Department. Responsibility for complying with code provisions is usually placed with the registered engineer or architect who is given the construction license, and thus department engineers rarely check computations and drawings except in special circumstances. Mexican sources comment that a great deal of freedom has been given in the design and supervision of construction of privately owned buildings. This has led to a tendency for building codes to be regarded by Mexican engineers more as guidelines than as rigid regulations.

In the Pacific Ocean, about 250 miles from Mexico City, a section of the earth's crust, the Cocos Plate, moves roughly three inches a year as it thrusts itself under the Mexican land mass. In September 1985, this plate suddenly broke away from

*Mr. Geis is a principal investigator for the National Science Foundation's "Architectural and Urban Design Lessons from the 1985 Mexico City Earthquake" project. Mr. Arnold is the project adviser and a member of its U.S. research team.*

*Damage to two older office buildings (left) was repaired in 18 months. The structures were reduced in height and restored (right).*

Photographs by Chris Arnold

the adjacent crust, lurching between three and six feet. The resulting initial earthquake, of Richter magnitude 8.1, was one of the most powerful in history. In the days following, dozens of smaller ruptures occurred as the plate continued to release energy. The largest, of Richter magnitude 7.5, came 18 hours after the first quake.

On the outskirts of Mexico City, instruments recorded maximum accelerations of .04g. (One "g" is the acceleration of a free-falling body due to gravity.) In the soft ground of the center city, accelerations rose to .16g. These accelerations are not particularly large; a maximum acceleration of 1.25g was recorded in the 1971 San Fernando, Calif., earthquake. But the Mexico City motion continued strongly for over a minute (compared with 10 seconds in San Fernando) and the seismic waves vibrated slowly at about a 2-second period. This period corresponded to the natural frequency of buildings of six to 20 stories, causing the forces in many of these buildings to be amplified to the extent that, toward their roofs, they sustained accelerations of as much as 1.0g. It was this amplification, combined with the long duration of the shaking, that caused the damage.

Could such destruction occur in the U.S.? The evidence is not conclusive, but ground conditions in the San Francisco Bay area, the Los Angeles basin, and certain areas of the central states give cause for concern that, under certain kinds and distances of earthquake source activity, some of the Mexico City phenomena might indeed occur in the U.S.

Because of the nature of ground conditions in Mexico City, the earthquake damage was confined to an area of approximately 25 square miles, with severe damage concentrated in a zone of approximately 9.5 square miles. Little damage was done in the rest of the 385-square-mile metropolitan area. Of some 5,700 buildings listed as damaged, 950 were destroyed, 2,300 were severely damaged, and 2,450 suffered medium to minor damage. Sixty-five percent of the buildings were residences, 12 percent were schools, 6 percent were offices (public and private) and 0.7 percent were hospitals.

These percentages can be misleading as to the effects of damage on the city. The damage to hospitals (five destroyed and 22 severely damaged) represents a loss of about 30 percent of the available hospital beds. Damaged government and other public buildings forced the relocation of about 150,000 public servants. Total housing losses of some 76,000 units added to an already present housing deficit of 30 percent. Approximately 6,000 deaths were officially recorded, though the actual figure (including unrecorded casualties) may be three to four times as much. Forty thousand people were injured.

Further analysis of building damage shows that 26 percent of the buildings severely damaged or destroyed were constructed before 1957, 56 percent between 1957 and 1976, and 18 percent *after 1976*. While only 1 percent of one- or two-story buildings were damaged, buildings of six to 12 stories suffered an average damage rate of 11 percent.

The most vulnerable building type was the medium-height, reinforced concrete structure with no structural (shear) walls, employing a flat slab or waffle slab floor structure. Buildings of this type failed at the columns or failed because of insufficient strength of column-to-floor joints. But a more significant cause of failure lay in characteristics of building shape, planning, nonstructural components, or loading that created torsion or stress concentrations that the structural members or connections could not withstand.

## *Architecture, structure, and construction*

The earthquake "sees" and tests the whole building; it does not distinguish among the contributions of the architect, engineer, and builder. In studying building failure in Mexico City, it is useful to categorize four patterns: collapse of top floors, middle floors, bottom floors, or the whole building.

Engineering investigators from Mexico City University found that 38 percent of the seriously damaged buildings suffered an upper-story failure. This can be attributed to whipping action as the earthquake motion is amplified in the upper stories of a building. In some cases, architectural or structural irregularities contributed to the failure: a change of column size or the introduction of irregular framing or unusually flexible columns. Modern U.S. seismic codes require a more even distribution of a larger percentage of the seismic forces to the upper stories of a tall building to help prevent this problem.

The Mexican engineers found that 40 percent of the seriously damaged buildings suffered middle-story failure. Most frequently this was caused by pounding from an adjoining building vibrating out of phase so that the buildings struck one another. While pounding has long been recognized as a problem, the extent of pounding failures in Mexico City demonstrated that it is a major problem. Current codes impose limits on drift, or the extent of lateral deflections. In theory this should protect against pounding, but in practice the code drift limits do not represent possible actual motion. To separate buildings to the extent necessary to protect against pounding, the space between buildings needs to be very great—on the order of five feet for a 12-story building—and this presents real estate and urban planning problems.

At the same time, it is clear that many buildings in Mexico City were protected from collapse because they were erected hard up against the adjoining buildings on both sides, so that whole blocks acted as a unit and strengthened the individual buildings. As evidence of this, the Mexican studies show that 42 percent of heavily damaged buildings were corner buildings, lacking the protection of adjoining buildings. This finding necessitates serious thinking about allowable drift, pounding, and the design of closely spaced buildings.

Weak first stories accounted for 8 percent of building failures. The percentage is probably much greater because many of the total collapses were precipitated by this characteristic. But in buildings with weak first floors and stiff upper floors—created generally by open planning in the first floor to accommodate stores or lobbies—often the upper floors retained enough integrity to survive. The Mexico City experience reaffirmed the risks of this configuration, particularly for heavy frame structures lacking in resisting walls.

It is harder to diagnose the failures of buildings that totally collapsed. In many cases, no single cause predominated. Irregularities in plan or loading may have combined with a weak first floor, with inadequate connections, or with construction deficiencies to result in collapse. When an occupied building collapses, heavy loss of life is inevitable, and the niceties of analyzing building damage cease to be of concern.

The failure of many damaged buildings could be traced, at least in part, to asymmetry in plan, whether of overall form or in the location of stiff elements such as stairs or walls. One example of this explicitly shows the relation between architectural form and the form of the city—in its *street pattern*. Buildings that were triangular or wedge-shaped in plan suffered badly. Typically these were on tight urban sites created by streets intersecting at an acute angle. This form is common in U.S. cities, where our rectangular grids are intersected by diagonal streets. The wedge-shaped building often has a solid party wall and two open sides—a prescription for torsion, the most difficult building motion to counteract.

While analysis of the huge stock of Mexico City's damaged buildings is instructive, the successes must not be forgotten. One of these is the *Torre Latino Americana*, a 48-story building designed in 1948. The personal experience of its engineer, Adolfo Zeevaert, still active in his 80th year, gives a graphic impression of the earthquake in this building: "I was sitting at my desk selecting photos, when I began to experience a minor movement. About five seconds later my chair suffered a large displacement of approximately two feet (my chair is on casters on a plastic sheet). All the pictures on the wall moved. I stood up and walked with difficulty to the corner of the room, looking south. Only eight seconds had passed from the first movement of the rocking action.

"About one minute elapsed until, suddenly, I felt a change of movement from rocking to a kind of torsion movement and then the movement started to reduce. During this time I was looking to the east side of the city and saw the collapse of several buildings. I saw 20 buildings collapse in one minute. Finally, three minutes after the first movement, the tower stopped. The earthquake was over! I started to worry about possible damage to the tower; the movement was very strong."

In fact, this building suffered five broken windows, minor damage to contents, and minor cracking in partitions. The elevators had to be checked but were back in service in two hours. This building is famous in seismic design circles for the careful integration of its structural and architectural design, and its performance in earthquakes justifies this regard.

The new national lottery building, of triangular plan form, has a very tall first story—a conscious act of urban design that opens up the public space at an important corner—and an offset elevator core. The building also uses a complete floor-to-ceiling glass curtain wall of great delicacy. This building, a block and a half from some of the worst damage in the city, was undamaged. This example shows that knowledgeable engineering and architectural collaboration can make completely safe an otherwise questionable set of architectural concepts.

There are so many examples of both good and bad performance in Mexico City that only a systematic study of a large building inventory, in which configuration characteristics are accurately identified and correlated to degrees of damage, will make adequate use of all the information.

## The earthquake resistant city

The complex series of design, development, and management decisions made by design professionals, public officials, developers, and others has become more fragmented over the years because of specialization. The result is a lack of coordination by the players making decisions.

The problems experienced in Mexico City as a result of its explosive and largely uncontrolled growth were evident in familiar environmental deficiencies. The traffic congestion, lack of open space, pollution, and stocks of poorly built high-density houses are characteristic of the present environment of many of the world's huge cities. It is worth pointing out that these same deficiencies result in a city that responds poorly to a

Chris Arnold

Don Geis

*Many corner buildings, such as the one shown in top photo, lacked protection of adjoining buildings and suffered heavy damage. Above, typically tilted buildings after the quake.*

great earthquake and the ensuing destruction.

Inadequate design and construction and high density lead to casualties and multitudes left homeless. Congested streets and lack of open space result in impeded access during an emergency and a scarcity of sites for emergency shelter, temporary housing, and debris disposal.

Ironically, recent history has shown that earthquakes ultimately are beneficial in remedying a city's faults. In a ruthless way, the earthquake damage results in an instant redevelopment that normally is achievable only over decades of legislation and bureaucratic process.

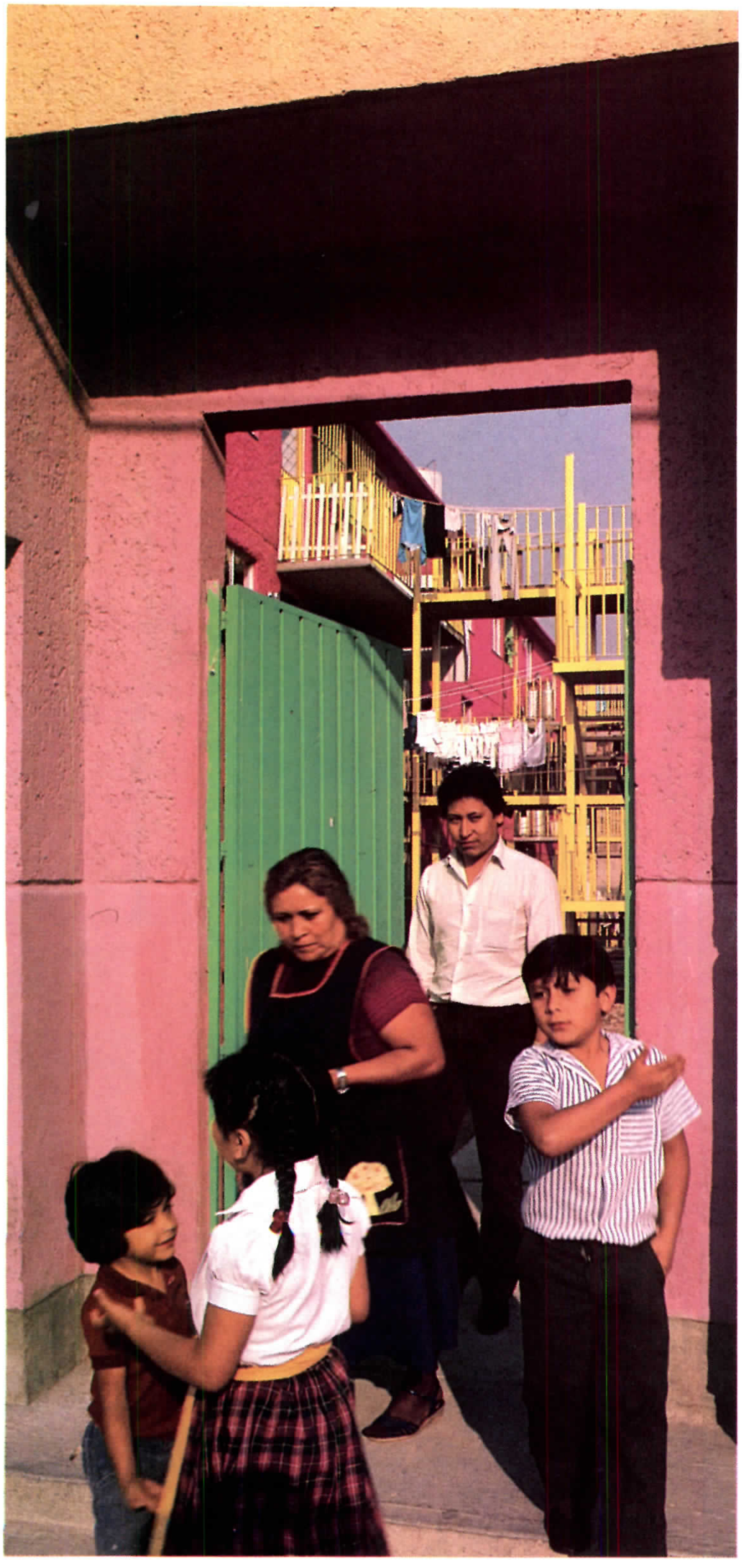
The continuing story of Mexico City, as it rebuilds and reconstructs, will show the extent to which it takes advantage of the destruction. Already the congested downtown has gained small parks where buildings, or even blocks, were demolished. Proposals to limit building height to four stories in the historic core are under consideration. We still have much to to learn in studying the progress of these measures.

So, Mexico City remains as a living laboratory of a disaster—initiated by nature but redeemed by human construction. The problems, the lessons, and the solutions are so complex, affecting all aspects of the physical, social, economic, and political environment, that we have no experience and no clear rules upon which to base our activities. The possibility of a disaster on the scale of Mexico City's certainly exists for an American city: it would be different in its details but the same in its gross impact.

Where do architects stand? Worried about their role, beset by issues of liability, and unsure of the scope and force of their decisions, perhaps the last thing they want to think about is an earthquake. But Mexico City has made it clear that architects, with their colleagues in the design and construction industry, share responsibility for disaster. To the extent that architects wish to lead the building team, they must understand the forces of disaster and work toward reducing them. □

# Neighborhoods Rise from the Rubble

*Mexico City's remarkable housing reconstruction program.*
*By Anne Ferrebee and Eduardo Terrazas*



After Mexico City was struck by a major earthquake in September 1985, the government, faced with the trauma of some 20,000 lost lives and $5 billion in lost property, immediately put into motion a series of plans that would result, 18 months later, in one of the largest housing reconstruction programs since the end of World War II. The program, called *Renovacion Habitacional Popular,* is outstanding in four respects: (1) its social plan, which reinforces rather than disrupts social networks; (2) the speed of its new housing construction; (3) the generous design and solid construction of its prototypes; and (4) the efficiency of its financing through a huge World Bank loan combined with aid from local Mexican financial institutions.

Less than a month after the earthquake, Mexico's President Miguel de la Madrid Hurtado used emergency powers to expropriate many privately owned housing sites in the destroyed areas. Owners were compensated for their lost property; and resident families, which for generations had been renters, would now have the opportunity to purchase their new housing units from the government and to become homeowners for the first time. Thus having set the tone for social as well as building reconstruction, the government conducted extensive physical and social surveys and set a budget.

As a result of the surveys, city planners limited the area of reconstruction undertaken in this program to the three boroughs of *Cuahtemoc, Venustiano Carranza,* and *Gustavo Madero,* which housed approximately 250,000 of the 18 million inhabitants of the Mexico City metropolitan area. These people lived in 44,437 units to be repaired or replaced.

Many of the expropriated properties had been, prior to the earthquake, in a condition of great decay. Because of rent control laws passed in the 1940s, which kept rents as low as $3 per month, landlords had been reluctant to make repairs on housing units. Social surveyors observed that the average size of the damaged units was 200 square feet, that 63 percent lacked toilets, and that 20 percent shared kitchen facilities. However, the surveyors found to their surprise that the age of the average head of a household was 44 years, mature compared with a national average of 27 years, that families were smaller than anticipated, averaging only four members, and that the average income for the head of a household was twice the minimum wage of $90 per month. It was the relatively small size of the families plus their relatively high income that, in the end, made the home-purchase approach successful.

Though the families were poor by North American standards, they had a history of steady work and of extended family networks in the same neighborhood for generations, which made family life far more secure and rewarding than might at first be apparent. In addition, free schools and free medical services substantially enhanced the quality of life in Mexico City's downtown barrios.

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Based on these findings, the planners devised a social strategy that emphasized reconstruction of dwellings on the same plots and for the same tenants who had lived in the original buildings. In this way, family and social networks could be maintained without disruption. In effect, Mexico City adopted a policy diametrically opposed to the new-town policy carried out in England after World War II with disruptive social consequences. The Mexico City reconstruction demonstrates that reinforcement of social ties is as important as provision of new housing stock and that new housing will accomplish little without effective family structure.

Mexico City's social strategy was implemented in May 1986 by more than 100 organizations, including earthquake victims; government and private agencies, such as the Red Cross; technical groups including architects; universities; and financial organizations, the most important of which was the World Bank.

*Temporary shelters were first made of cardboard. Later, shelters made of tin (above) replaced the cardboard.*

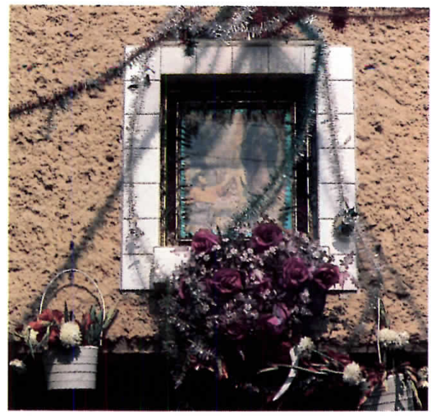
The financial strategy originally provided for about $400 million in loans from the World Bank. The strategy also established the reconstruction budget within Mexico's national budget, thus requiring cuts in other parts of the national budget. The combination of international with national funds proved effective: in the end, only 20 percent of the total reconstruction budget of $600 million came from international loans. The budget was administered by computer and subject to frequent audits.

The reconstruction program had several crucial elements: (1) all new housing units would measure 400 square feet, almost double the size of the pre-earthquake units; (2) each unit would have two bedrooms, a bath, a kitchen, and a space for washing; (3) former renters now buying their housing units as condominiums would pay only the basic construction cost of $3,000; and (4) loans to purchase the units would be made available to the former tenants, with monthly payments amounting to about 30 percent of the minimum wage, or $20 to $25 per month, with most loans anticipated to be paid off in about six years. Edward Echeverria, a senior planner at the World Bank, explains that, because inflation in Mexico runs at the rate of 100 percent a year, it was considered crucial to tie the home loan repayment rate to the minimum wage.

A technical strategy, implemented in tandem with the social strategy, made possible within 12 months the demolition and reconstruction of 34,500 dwelling units, repair of 2,500 units, and upgrading of another 3,000 units. At the heart of the technical strategy was a decision that each 400-square-foot unit should follow one of seven prototypes, each of which would be built on a concrete foundation slab with prefabricated, steel-reinforced concrete walls. To make them as safe as possible, the height of the new buildings was limited to three stories. While each unit was supplied with electricity and water, the warm climate made it unnecessary to supply heating. Further labor and time savings were realized by putting stairways on the exterior of buildings. Together, these factors made it possible to build each unit for $3,000.

During reconstruction, a provisional housing program provided several options for housing the displaced population. Approximately 10,000 units in Mexico City's public housing program were turned over immediately to families whose housing had been destroyed. In addition, provisional housing was set up in parks and on the streets for families from about 4,000 units of totally collapsed housing. The mild climate contributed to the ease of living in the temporary shelters. The situation could have been worse, as one housing consultant commented: "What would have happened if the quake had erupted in Toronto?"

The tin-built temporary shelters, fully serviced with social workers and doctors, were protected from auto traffic by chain-link fence and from crime by a 24-hour security patrol. Each family was given the option of living in the temporary tin shelters or, with a rent supplement from the government, locating its own temporary rental unit with relatives or friends. In the end, some 19,000 families found subsidized rental units. About 22,000 families elected to live in the temporary tin shelters. In addition, many privately owned damaged buildings were rehabilitated by their owners, often with effective cooperation between tenants and landlords.




*Pride in ownership is reflected in the personal details that enhance the individual housing units (left and above).*

Whether living in street shelters or temporarily renting rooms from relatives and neighbors, families watched the construction of their new homes day by day. Steel reinforcement was left exposed to reassure families of the safety of the new units, built under tight new construction codes.

Because much of Mexico City rests on the sandy bed of what centuries ago was a lake, soil mechanics proved to be a particular challenge. To compensate for the unusual degree of compression in the sand that is typical of Mexico City's terrain, special soils were brought into many of the construction sites. *Tepetate,* a heavy yellow soil, was brought in from the edge of Mexico City's lake bed. *Tezontle,* a light but rigid red volcanic soil, was brought in to balance the *tepetate* and natural sand in many of the sites.

When they moved into their new units, many families had private baths for the first time. Said one new homeowner, "My new home is beautiful. Before we had just one room with an awning. Now we have two bedrooms, living and dining rooms, kitchen, and bath. It makes me happy because later on my children can live in it." Another owner said, "I'm so happy because, after living and sleeping in the street, we have a home now. It's fair enough what they ask us to pay."

The reconstruction design strategy also addressed the issue of urban image, of how to tie the raw new reinforced-concrete dwellings back into the urban fabric of a city whose 2,000-year-old Aztec ruins form a backdrop for Spanish baroque cathedrals and Mediterranean-style housing. The answer was color. The new housing units were washed in a bright palette of red, orange, lavender, ocher, and green. And, equally important, proud homeowners have hung bird cages outside their front doors and have planted the courtyards.

Because the earthquake did its most severe damage in the center of the city, where the greatest number of historically significant buildings were located, historic preservation became one of the greatest challenges of the reconstruction program. Complete historic preservation was neither economically viable nor practical within the time frame of the program. Each damaged historic building was evaluated individually, and, at a minimum, the facade was restored while modern materials were used to ensure stability. To the dismay of hard-line historic preservationists, some of the historic buildings have been repainted with the bright green, orange, and lavender colors used for the new housing units.

The successful completion of the reconstruction program in 18 months (only three months off the goal) was due in part to the small size and efficient structure of the reconstruction team. The team coordinated the work of 1,350 firms and construction funds of $1 million a day to complete 130 dwelling units a day, among other projects. A happy by-product of the earthquake disaster was the generation of some 120,000 new jobs.

On February 7, 1987, *Renovacion Habitacional Popular* received the coveted Robert Matthews prize from the International Union of Architects for the best low-cost housing program submitted to the jury in 1986. When the second anniversary of the earthquake is marked next September, North American professionals, in their search for low-income housing solutions and shelter for the homeless, might look to Mexico City for workable strategies. *(Overleaf, a reconstruction showplace.)* □

# *Rebirth of a '60s Monument*

In the late 1950s, Mexican architecture acquired worldwide recognition due to efforts to solve the growing housing crisis in Mexico City by constructing huge high-rise housing projects in the city and around its perimeter. Although this approach to solving urban housing problems is now generally discredited, primarily because of the social and economic disruption it causes, the Mexican achievements were and still are remarkable.

Largest and most ambitious of these projects (and the largest housing complex in Latin America) was the *Tlatelolco* housing community, constructed close to the center of the city and completed in 1963. Designed by Mario Pani, *Tlatelolco* had 102 apartment buildings, 22 schools, five hospitals and clinics, two theaters, three community centers, and three nurseries, plus convenience stores in the first floors of some of the apartment buildings. Officially, the complex housed 70,000 persons in 11,900 units, but the actual number housed was probably much larger.

The *Tlatelolco* housing community was severely damaged in the earthquake of September 1985. The total collapse of two-thirds of one block received wide publicity because of the disastrous loss of life—approximately 2,000 persons—and because relatives of operatic tenor Placido Domingo were involved. Although this building was the only one of nine of its kind to collapse, the overall damage created a major problem of homelessness of survivors and forced the Mexican government to face a major decision. Should it abandon the complex or rebuild it at what clearly would be enormous expense?

The safest and most economical solution to the problem posed by the damage would have been to abandon the buildings and either rebuild on the site with different types of buildings or move the residents elsewhere. However, in view of the prominence of the site and the fact that since the earthquake the complex had become a forceful political community and had acquired considerable political leverage, the government decided to demolish six buildings that were irreparable and to repair and strengthen all the others.

As a result, *Tlatelolco* is now a showplace of reconstruction. Sixty buildings are undergoing repairs to finishes and mechanical equipment with the occupants still in place. Thirty-two buildings are undergoing major structural repairs, including, in some cases, removal of the upper floors from tall buildings to reduce their response to ground motion. For the buildings undergoing major repair, the occupants must be relocated and rehoused for an estimated 15 months. Estimates of cost approach a current expenditure of $1 million a day.

In the first months after the earthquake, authorities were heavily criticized by the *Tlatelolco* residents for their slowness and lack of response. Now the reconstruction project is being criticized for its expense and its role as a showplace, but the effort being expended is certainly impressive to the observer. It is also impressive to see this great 1960s experiment in social housing experiencing a rebirth and rejuvenation, and to see the energetic 75-year-old Marco Pani heavily involved.

Understandably, after the earthquake, no engineer wished to take chances. The structural renovations are massive, including, in the case of a number of huge, 13-story apartment buildings, the construction of a complete exterior reinforced-concrete frame using massive beams every third floor, projecting shear walls, a huge outward extension of the foundation, and new ties right through the entire building. —Christopher Arnold

# Chinese City Starts Over After Quake

*Totally leveled, Tangshan is replanned as well as rebuilt.*
*By Christopher Arnold, AIA, and Henry Lagorio, AIA*

In the summer of 1976, the city of Tangshan in the People's Republic of China was destroyed by a devastating earthquake, and hundreds of thousands of lives were lost. By 1986, when the city remembered the 10th anniversary of the earthquake, it had been reborn as an entirely new metropolis that had redressed many of the problems of the old city while preserving some of its stronger qualities.

Tangshan is a major industrial city in Hopeh Province on the railway line that connects Beijing, Tianjin, and the coast. The city was founded in the 1870s, when the Kailuan coal mines were started. These mines accounted for 10 percent of the country's fuel and, with other industries including a steel mill, railway locomotive factory, cement and ceramic plants, and aluminum and refractory brick production, gave Tangshan an important role in China's recent economic development.

In 1949 Tangshan's population was 470,000; by 1976 it had grown to 1.6 million, and during this period its production increased 220 fold. The development of the city had not been controlled, and new districts were added to the perimeters of the original urban center at random without adjustment to street patterns. The transportation system was particularly complex, and it was most difficult to circulate through and around the city.

Typical of cities in mainland China, Tangshan was built mainly of unreinforced bearing-wall masonry constructed with brick produced locally. Of the dwellings, 80 percent were single story; the remainder were predominantly two to four stories high, with some as high as eight stories. With few exceptions, these buildings were not designed to be earthquake resistant.

A year before the Tangshan earthquake, a large earthquake struck the city of Haicheng, 250 miles east of Tangshan. This earthquake had been preceded by unusual phenomena, including small shocks and changes in geomagnetism and water levels in local wells. In response, the city had been put on alert, with people evacuated from their homes and sent out into the streets, emergency duties assigned, and disaster relief facilities organized. Although substantial building damage occurred, thousands of lives probably were saved by these precautions.

Similar studies had been going on in the Tangshan and Beijing areas, especially since 1970. In 1974 earthquake warnings were issued and some evacuation took place, but no earthquake occurred. Seismologists noted continuing changes in the area. Long-range predictions were issued in early 1976, and the populace was warned by radio to prepare for an earthquake. However, the evidence was not conclusive enough to result in any short-range predictions before the quake. It therefore struck without warning on July 28, 1976. Its Richter scale magnitude was 7.8, and its epicenter was directly over the southern part of the city.

More than 95 percent of the buildings in Tangshan either collapsed or were so severely damaged that they had to be abandoned. Only one major building survived in good enough shape to be useful during the recovery period. Some of the few buildings that remained partially intact but beyond repair after the earthquake have been left standing in their critically damaged condition and are intended to be seen as historical monuments to the event and to serve as memorials to the dead.

Within the city limits of Tangshan, more than 140,000 people perished and more than 81,000 were hospitalized with severe injuries, while more than 250,000 died in the entire region of the earthquake. This ratio of deaths to injuries contrasts dramatically with that of, say, the San Fernando, Calif., earthquake of 1971, in which 58 people died and 2,400 were injured. The difference can be attributed to the predominance in Tangshan of unreinforced masonry structures, which for the most part suffered sudden and total collapse. Moreover, because the quake occurred at 3 A.M., many people were trapped in bed without even a few seconds warning to seek shelter.

Approximately 30,000 miners on the night shift were underground when the quake struck. Miraculously, all eventually made their way to safety, though some were underground for as long as two weeks. The huge rolling stock factory was destroyed and every building at the Institute of Mining and Metallurgy collapsed, killing more than 100 students and teachers in residence.

The earthquake cut off the power supply, but by the next day power was restored through rerouting of the network. Potable water service did not resume until 12 days after the quake. Communications were entirely cut off due to building collapses and damage to equipment and lines. Some emergency communication to Beijing was restored by late morning the day of the quake. Road traffic was blocked in both Tangshan and Tianjin as debris filled the narrow roads.

Both the natural gas and liquefied gas tanks were slightly damaged, and gas supply was resumed only in late August. At the Tangshan airport, buildings were severely damaged but runways were still usable. In terms of damage and casualties, the disaster at Tangshan was comparable to that of the atom bomb attacks on

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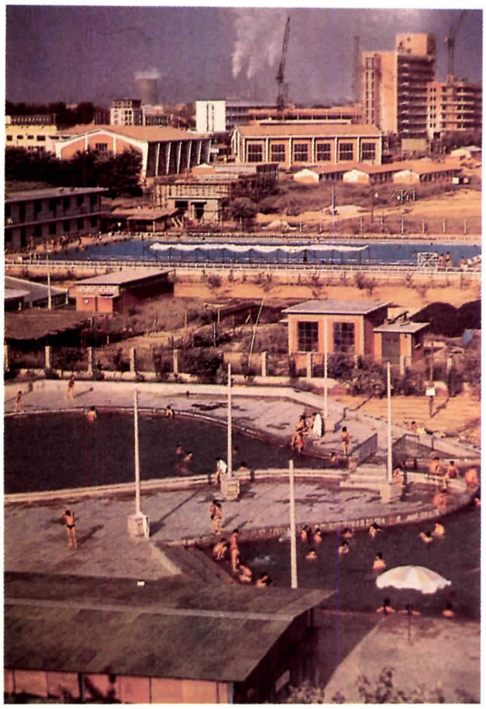
Hiroshima and Nagasaki in World War II.

Detailed news of the extensive damage to the city and its industrial base reached Beijing two days later only after a jeep managed to get through the debris-strewn streets, damaged bridges, and blocked arterial roads. In the midst of all this confusion, it must be recalled that, due to the disruption of all essential services, the several hundred thousand people who survived the earthquake, with 81,000 critically injured among them, were left without water, food, housing, and communication systems to assist them in putting things back together again. And more than 140,000 dead had to be buried.

Units of the People's Liberation Army and more than 30,000 construction workers were brought into the stricken areas as soon as possible to assist in the recovery. Army tents and other temporary, prefabricated, lightweight, small wood-panelled units were assembled in open spaces to serve as emergency housing for the survivors and workers. Four hundred thousand temporary dwelling units were provided within three months.



The Chinese approach to emergency housing was to rebuild housing on the same site as rapidly as possible, using indigenous materials and the rubble of destroyed buildings. Dwellings were built in which families could live adequately—if not in great comfort—without the need for another move until permanent housing was complete. This policy preserved local and neighborhood social structures and allowed the authorities time to plan the new city.

Thirty thousand medical workers were brought in with supplies, and no epidemics occurred. Parks and other open spaces proved valuable for evacuation and refuge. Parks in Beijing and Tianjin provided refuge for 300,000 people. Open space at the Tangshan airport was used as the main medical center.

Once the surviving inhabitants of Tangshan were secure in their temporary housing, the authorities began to re-establish the community's industrial and economic base—the mines, porcelain factories, heavy industrial fabrication, and the like—and then to plan and construct permanent resident neighborhoods. Surviving workers went to factories, repaired buildings and equipment, and restarted production. By the end of 1977 the coal mines restored production to nearly the 1976 level. By 1978, two years after the earthquake, the total industrial production approached 1976 figures.

In their approach to recovery and reconstruction, the Chinese pursued a course now being recommended by some leading Western planners: initially preserving and restoring the city's social and economic structure and, only when those are secured, following with physical planning and rebuilding.

Because the destruction resulting from the earthquake was essentially total, Tangshan could plan to correct the deficiencies of its former urban environment. Since the city of Tangshan itself did not have the required planning or design capabilities, more than 2,000 planning and design professionals and technicians were assembled from all parts of China to form a team to develop Tangshan's new urban plan. They considered three options:

- Complete rebuilding on the same site.
- Decentralizing services and decreasing density with satellite cities.
- Abandoning the old site and relocating the populace.

Because of the importance of the coal mines to the economy, it was essential that Tangshan be reconstructed in the same general area; hence, the option of abandonment was not feasible. Rebuilding on the same site would re-create the problems of density and poor circulation. Therefore, decentralizing and developing satellite cities became the favored approach.

The new plan for the city of Tangshan consists of three interdependent parts, located approximately 15 miles from each other: the oldest section of the former city, which sustained the heaviest earthquake damage; a satellite district identified as the main industrial area, developed around the existing coal mines to the east of the former city; and a completely new residential satellite district to the north of the former city, called Fengren.

The central section of the former city remains a relatively open area and the predominant commercial and cultural core. It contains department stores, a 16-story tourist hotel, shops, hospitals, and a large formal park that also contains recreational facilities. Areas have been developed between buildings as permanent open spaces. The resident population will be limited to 250,000.

Provision of adequate housing is one of the main goals of Tangshan's reconstruction. The new principal residential district, to the north, has been divided into 118 small living communities, which accommodate a population of 5,000 to 10,000 each. Schools, a nursery, theaters, and shopping have been provided in each residential quarter. The individual apartment

*Views of the rebuilt city are shown above, this page and opposite page. Below, rebuilt housing is constructed of many materials. Below, opposite page, a damaged building left as a memorial.*

units, which vary from one to three bedrooms, have a living area of 450 to 550 square feet plus a private balcony, private kitchen, toilet cabinet, gas fitting, and heating radiator.

Afforestation is arranged in the urban districts and subdistricts with an area of 64 square feet per capita. There are 16 parks—eight in the urban district and eight in the subdistrict. Along the riverbanks and roads, embellishment is well under way. The squares between houses also are decorated with flowers.

Several construction methods are used for the new residential buildings: interior poured concrete shear walls with brick exterior; interior poured concrete shear walls with exterior precast concrete panels; brick walls with reinforced concrete columns at the intersections of longitudinal and traverse walls; reinforced concrete frame with light infill walls. These types, where they existed previously, proved to be relatively earthquake resistant and suffered only light damage. The four- and five-story buildings are designed as walk-ups without elevators. Some higher blocks of six to eight stories were also built for visual variety.

One of the fundamental objectives in planning the new city was to develop an organized transportation system (the old one was tortuous and had few exits from the city) to allow easy egress in all directions and unconstrained access to all parts of reconstructed Tangshan. Accordingly, two main arteries, approximately 200 feet wide, have been developed as the principal means of circulation. Within each right-of-way, 50 feet have been developed for autos and buses, 5 feet devoted to a divider strip, 25 feet allocated to bicycles, and 20 feet devoted to pedestrians, each way. All major buildings in the reconstructed city are located along these two main arteries.

A special lane for bicycle riders only connects residential areas to industrial areas. The main railway line has been rerouted to avoid coal-bearing ground, a new station has been built, and the original rail line has become an industrial track.

The layout of the new city has been much influenced by geological exploration, surveys of water sources, identification of areas of potential seismic activity, and vulnerability analyses. Tall buildings and important service facilities have been built on shallow bedrock of high bearing capacity. In order to facilitate evacuation and avoid injuries due to structural collapse, ample space is left between buildings. Wide streets were planned to prevent traffic congestion and to help provide adequate access to disaster-stricken areas, and to remain free of blockage from wrecking operations by emergency fire and rescue teams. In order to reduce the occurrence of secondary hazards, chemical and engineering enterprises and hazardous-use warehouses have been located outside the urban area.

In addition, the Tangshan plan follows a policy in China that emphasizes development of new small cities in preference to the expansion of existing large urban areas. The form of the new city departs radically from that of the old and really represents the sort of rational planned city that Western planners have advocated as long as their trade has existed but have never executed in a form as complete as Tangshan.

What does Tangshan look like, and how does it work? In appearance the new city resembles the planned areas of American and European cities of the '50s. Rows of rectangular blocks of mid-rise apartment houses are generously spaced in a green landscape, interspersed with neighborhood centers and schools. The traffic pattern is planned; the roads are wide with avenues of trees; the obliteration of open space by parked cars is not provided for and probably not anticipated.

While Western planners now are fascinated by low-rise, low-density developments, the Chinese, with plenty of land and 2,000 years of experience in this urban form, are ready for a change. Already, the impersonal apartment blocks are undergoing a peculiar Chinese personalization: balconies are used extensively, and gardens and private storage buildings are appearing at the base of apartments. The older apartments already look more like apartments in old Hong Kong, Canton, or San Francisco's Chinatown than like those in a European new town.

The Chinese economy is such that architects still must concentrate on essentials and are not free to engage in the exploration of form that is popular in the West. However, architecture students avidly read the architecture magazines from the West, and they question Western visitors about postmodernism.

Uninhibited by Western systems of private land ownership and use, the Chinese have taken the opportunity to correct the deficiencies of land-use planning, high density, and traffic that beset old Tangshan. The Chinese have gone much further than planners elsewhere in Europe after World War II, or in the reconstruction of earthquake-damaged towns such as Skoplje, Yugoslavia. It is unlikely to work perfectly, but the new Tangshan should be a much more human and pleasant city than the old, except to those visitors with a romantic attachment to narrow streets, stone walls, and overpopulated rooms.□

# The Coming Changes In Earthquake Codes

*They will require sharp changes in designers' thinking.*
*By Delbert B. Ward*

Architects should prepare for significant changes in seismic design standards of the International Conference of Building Officials' Uniform Building Code (UBC), possibly as soon as the next (1988) edition. A complete rewrite of the UBC's renowned "Chapter 23" seismic provisions now faces scrutiny by ICBO members and others. It reflects more than a decade of accelerated earthquake research.

Although research typically is far ahead of the building codes, the proposed changes in the UBC are just one manifestation of how the new research findings are being applied. The so-called "Blue Book" on seismic design by the Structural Engineers Association of California (SEAOC), recently rewritten, is also now under review. The Building Seismic Safety Council (BSSC) recently published completely new seismic design standards entitled "NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings." These provisions were developed under the National Earthquake Hazards Reduction Program (NEHRP) and are being promulgated by the Federal Emergency Management Agency.

If adopted, the proposed revisions in the UBC will mandate some adjustments in thinking by design professionals. First, the methodology for establishing seismic forces under the revised provisions is quite different from the current UBC "seismic equation." Second, the proposed new provisions deal much more deliberately with the influence of building configuration on seismic performance, a topic that is especially important to the architect's role in building design.

These changes need not cause distress among designers if they are viewed simply as an acknowledgment of advancements in seismic design knowledge. Informed architects no doubt realize that seismic design practices heretofore have been as much an art as a science, lacking the degree of precision desirable for a regulatory process, and that a great deal of engineering judgment and experience have been necessary supplements to the seismic provisions of the code. While such judgment and experience will be as valuable under the proposed revised code, instances of ambiguity should be greatly reduced.

The last decade's advances in understanding the effects of earthquakes on buildings resulted at least partly from intensified research made possible through the national Earthquake Hazards Reduction Act of 1975. The advances also resulted from more systematic examination, by a growing body of interested private practitioners, of building performance during earthquakes. The enhanced and hastened research has led to a better understanding of earthquakes not only in the fields of seismology and geology but also in architecture and structural engineering. Significant advancements include these:

- Regions of earthquake risk are better defined than they were a decade ago.
- The effects of soils on ground motion are better understood.
- Concepts and details of structural design have been tested in laboratories and in actual earthquakes to some extent, and adjustments in practices have been modified based upon the findings.
- And, of particular importance to architects, the significant role of building configuration in seismic performance has been clarified.

First attempts to incorporate recent seismic knowledge into construction standards were manifested mostly in minor (but sometimes important) changes in selected sections of existing codes. Such changes have included revisions of seismic zones, addition of factors giving consideration to effects of soils on building response to ground motion, and revisions to confinement requirements for reinforced concrete columns. It is important to note, however, that the basic equivalent static methodology, set forth initially in the UBC and subsequently in similar form in other codes, was retained through the years. New knowledge was simply incorporated into the existing format.

Architects familiar with the seismic provisions of the current codes will find that the proposed revisions to the UBC (and even the "NEHRP Recommended Provisions") include basic changes in form—differences in equation formats, factors, and ranges of values for the factors—as well as changes in substance. Similar building characteristics and dynamic properties are used in both the old and new methodologies; for the most part, they are simply quantified differently. Most basic principles of the older methodology have not changed, except to be made more precise. One example of improved precision is in more definitive specification of the vertical elements of the principal lateral-load-carrying structural system. Analytical methods to be used, based on building importance and configuration, also have been prescribed more precisely in the revised provisions.

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Some of the changes are, in fact, simplifications of the existing UBC methodology. One such example is direct specification of a seismic zone factor in the revised procedures, wherein the factor used is an approximate value of the effective peak acceleration. This contrasts with the current UBC, in which the value of the seismic zone factor (Z) is obtained differently and is actually a different coefficient from that in the revised methodology, although both are called "Z."

While discussion of all the changes proposed for the UBC seismic code is beyond the scope of this article, the following changes should be of special interest to architects.

1. The basic seismic equation for determining the base shear has a new form and newly defined coefficients (see box).

2. In the new seismic equation, the numerical coefficient $R_w$ replaces the current K-value for characterizing the primary horizontal-load-carrying structural system. Both K and $R_w$, however, are based on the horizontal-load-carrying system of the structure, though they appear differently in the two seismic equations and their values are quantified differently. Consequently, architects will need to become more knowledgeable about the many possible lateral-load-carrying structural systems and the characteristics of these different systems so that design and details fulfill the requirements of the system for a particular building.

3. Building configuration, classified either as "regular" or "irregular" in the revised UBC methodology, becomes a significant factor in the design process, and specific provisions for design and analysis methods are prescribed for irregular structures. Architects will be compelled by the proposed regulatory provisions to consider more carefully the effects of building configuration upon seismic performance for their creations.

4. The revised provisions will require more rigorous analytical methods for buildings classified as "important" (for example, hospitals, police stations, and fire stations) and for irregular buildings. Furthermore, situations where this analysis will be required are more clearly defined. Although many buildings still will qualify for design by the equivalent static method, there will be more situations where dynamic or quasi-dynamic methods are required. Consequently, because most architects are not prepared to carry out analysis by these more rigorous methods, they are likely to become more reliant upon their structural engineers.

The immediate adjustments in format that would be brought about by the proposed UBC changes are apparent, but the long-term implications of enhanced seismic research on building regulation are more difficult to predict. Some of the patterns that are emerging include:

- Uniformity among codes and standards. One noteworthy aspect reflected in the revised UBC seismic provisions is that the seismic design procedures of the various codes and standards are moving in the direction of greater uniformity. Specifically, the UBC-proposed change for the Z factor brings that part of the methodology into the same form as it appears in ANSI A58.1 (1982). Moreover, the UBC $R_w$ factor (which replaces K in the seismic equation) is a further simplification of that portion of the methodology outlined in the "NEHRP Recommended Provisions." Although there is much still that could be done in this regard to achieve uniformity among seismic codes and recommendations, this is a significant first step.
- Regarding the possibility of the revised provisions eventually leading to a national seismic standard, most of us have heard talk in the past of a "single national building code" that has never materialized. Nonetheless, the prospect that a national standard for seismic design might evolve will gain even more momentum in the next few years as the UBC provisions, if adopted, are worked with and tested in the field.

In this regard, the Earthquake Engineering Research Institute (EERI) has moved in the direction of encouraging consideration of a national standard for seismic design. Robert V. Whitman (the EERI president in 1985-87) addressed this subject in an article appearing in the July 1986 issue of the EERI newsletter (Vol. 20, No. 7). Professor Whitman deplored the confusion caused by the plethora of seismic design rules and regulations among design professionals who work in more than one jurisdiction. He also said, "Perhaps it is too much to expect that the goal of a unified set of seismic design provisions can be achieved by 1988. At a minimum, however, the organizations involved should agree on a target date—perhaps 1991—for reaching the goal."

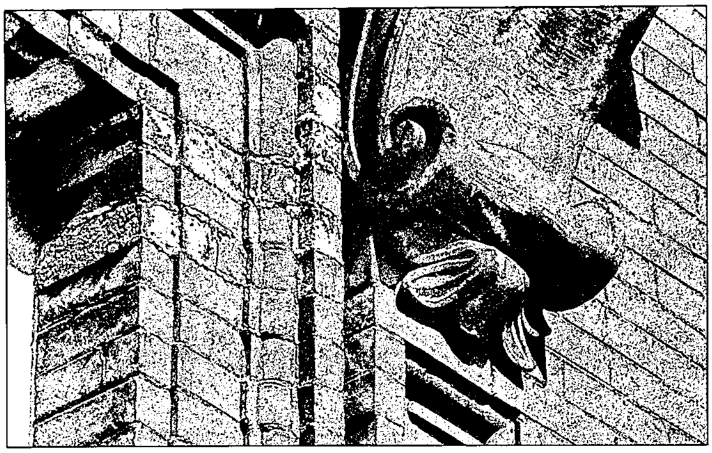
EERI subsequently carried this proposal further at its annual seminar last February, which was focused entirely upon review and comparative analysis of the various codes and standards. EERI is now working to suggest ways to achieve this goal. □

Existing $$V = ZIKCSW$$

V = the total lateral force or shear at the base
Z = a numerical coefficient dependent on the seismic zone
I = the occupancy importance factor
K = the horizontal force factor
C = a numerical coefficient based on the fundamental period of the building
S = a numerical coefficient for site-structure resonance
W = the total dead load of the building

Proposed $$V = \frac{ZIC}{R_w}W$$

V = the total lateral force or shear at the base
Z = a numerical coefficient dependent on seismic zone, quantified differently than the old zone factor
I = building importance factor (approximately the same as the old)
C = a numerical coefficient based on the formula: $C = \frac{1.5S}{t^{2/3}}$ (where S is the same as in the old equation, and t is the fundamental period of the structure)
$R_w$ = a numerical coefficient (from tables) that reflects properties of lateral load resisting systems (similar to K in the old equation, but with a new range of values)
W = the same as in the old equation



# Failures Short of Complete Collapse

*Their causes and prevention. By Elena Marcheso Moreno*

Building disasters make headlines around the world, but fortunately they are rare events. More commonplace than complete collapse are the system and component defects or shortcomings that plague both old and new construction.

Many times these building failures, small or large, cannot be attributed to any single design or construction specialty; the responsibility can be everyone's or no one's. The problem can be a design and construction oversight or an inappropriately applied material. It can result years after construction from environmental exposure or from an unanticipated building use. One thing is certain though: failures cost time, money, and often reputations. Avoiding them should be a high priority.

Even as construction begins, environmental exposure is initiating building deterioration. Though building lifespans are finite, buildings should remain intact for an acceptable period of time. How long that period should be is not easy to judge, but it is no longer in vogue to design 15- or 20-year obsolescence into buildings; neither are the overdesigned edifices of past centuries the solution. There must be some middle ground, and one key to achieving it is a better understanding of materials, their properties, and their interactions with other materials as well as with the environment.

A new product marketed without sufficient testing can cause a series of problems unlike those experienced in traditional construction. Even new applications of reliable products can produce unexpected interactions. For example, a new mortar additive, promoted for its ability to effectively glue bricks together, indicated the use of single-wythe masonry construction, an apparent means of reducing materials and labor costs. As with all masonry walls, building codes required steel reinforcement in the single-wythe construction. The system seemed perfect, but the innovative additive contained chlorine, which is extremely corrosive to steel. Add water to the picture and decay is rapidly accelerated. The results were extensive building facade failures and costly litigation.

Ignoring the relationship of one material system with another also can have detrimental effects. Consider the introduction of metal studs into masonry wall systems. The metal studs were intended to take over a market share from concrete block, providing a cheaper and faster means of construction. Manufacturers tested the studs for deflection and found their performance met code requirements.

However, codes do not necessarily reflect the actual performance of the complete wall system. In this instance, the more flexible wall system created by the metal studs caused the masonry veneers to crack and invited greater moisture penetration than ever predicted, corroding metal studs and fasteners. A more thoughtful analysis of component behaviors and systems interaction might have avoided the problem. These systems are still in use, but flexibility is controlled by heavier studs or additional bracing systems.

Combining dissimilar materials causes problems in new and old buildings alike. Lee Nelson, FAIA, chief of preservation assistance for the National Park Service, has seen this time and again in his study of reinforced concrete building structures during the 29 years he has been with the Park Service. Concrete tends to develop tiny hairline cracks that admit moisture that may rust the iron and steel reinforcements. Because rust has more volume than the original steel, internal pressures will build up and cause cracks in the concrete members. The problem is made many times worse in modern buildings where the rebar is typically placed close to the surface of the concrete element.

The rebar is placed less than three inches from the surface, says Nelson, to make it more efficient by increasing the member's strength. But the building can self-destruct as a result. He thinks such destruction will occur in direct proportion to the proximity of the rebar to the exposed concrete surface. The member may be stronger for a few years, but the closer the rebar is to the surface, the faster it is going to decay. This does not mean that concrete structures should be built without reinforcement—only that the design should consider the behavior of two very distinct materials and components.

Environmental factors affect the rate and extent of material deterioration. Among the most offensive are moisture, thermal

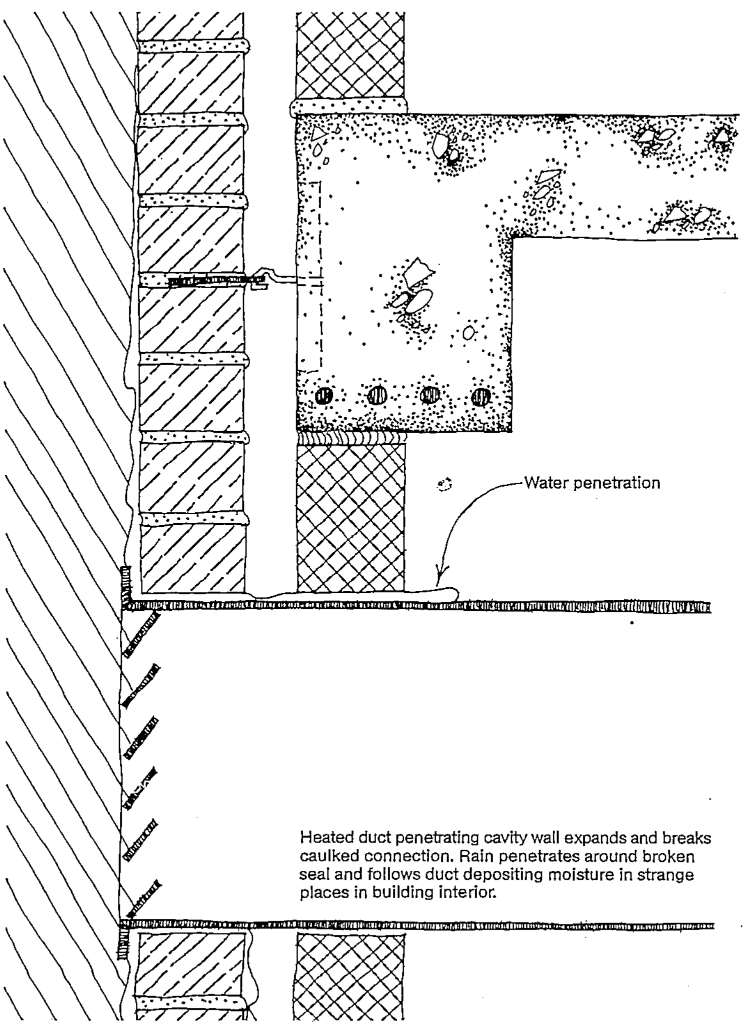
*Above, efflorescence signals moisture penetration into brickwork.*

loads, solar radiation, wind, man-made chemicals, and natural substances such as carbon monoxide and chlorine.

Plastics are particularly vulnerable to rapid deterioration under some environmental conditions. They are damaged not only by light but also by oxidation, hydrolysis in the presence of water, thermal aging, and biological attack. Plastics age most rapidly at high temperatures, but the degree of damage is most severe at the surface and diminishes with depth. The same holds for damage caused by light. Can this type of building material failure be ignored? Maybe. It depends on whether or not the product's function or esthetic value is diminished. Acrylic glazings intended for viewing do not make much sense if solar loads can be expected to reduce their optical qualities by 50 percent.

A key to predicting design life of new building components is predicting the speed at which environmental factors are likely to impair them. A product's test results should be requested if they are not offered by the manufacturer, and they should be carefully evaluated.

Both old and new materials often succumb to moisture. Failure-resistant design must consider any conceivable source of moisture, including water coming out of the ground due to a high water table or bad drainage; interference with drainage caused by regrading around the building or by landscape design; the natural movement of moisture in and around the building; interior moisture generated by a particular building use, as in a restaurant; and a high level of humidity, as in museums that demand a relative humidity of about 50 percent.




Heated duct penetrating cavity wall expands and breaks caulked connection. Rain penetrates around broken seal and follows duct depositing moisture in strange places in building interior.

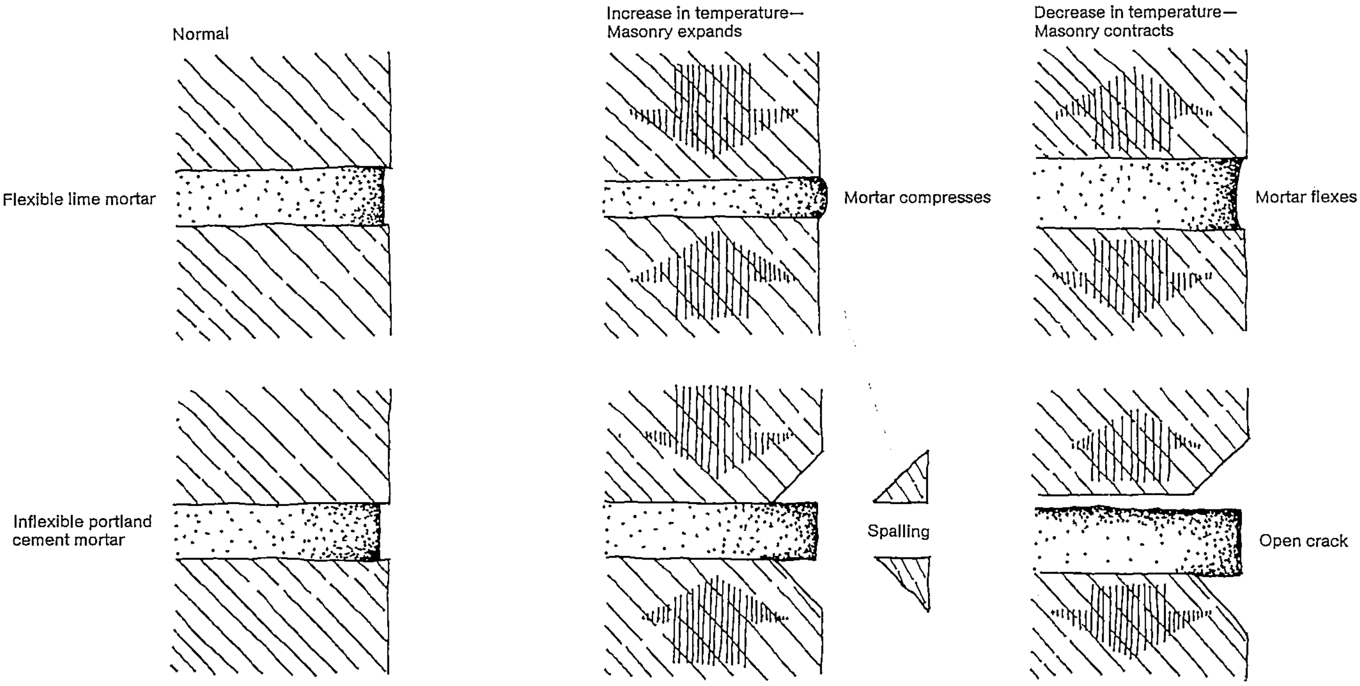
Inappropriate detailing or inferior workmanship, especially in renovation, can exacerbate decay of materials. Repairing deteriorated building components requires care, certainly from the craftsperson, but just as surely from the designer specifying the replacement. Substitute materials must be chemically and structurally compatible with the original. Care must be taken to ensure that new materials do not cause decay in existing materials, and the deterioration rate of the substitutes themselves must be evaluated. The task seems immense, but without a lot of up-front design effort that includes extensive materials analysis, a bad problem can get worse. The restoration of the Renwick Gallery of Art in Washington, D.C., provides a classic study of severely degraded masonry materials.

The Renwick Gallery is an early example of French Renaissance architecture in the United States. The shell of the building consists of load-bearing brick masonry with decorative sandstone elements that cover one-quarter of the total facade. The sandstone had suffered serious decay from salts that had leached from interior masonry of relatively soft-fired brick almost continuously since construction was completed. Quite a bit of the stone had broken away and fallen to the street when, in 1968, the Smithsonian Institution, owner of the Renwick, completed a series of repairs, reports a Smithsonian spokesman. By that time it was no longer possible to obtain sandstone from the quarry where the original material had been mined, and none was available that approximated the color. Therefore, the restorers used a synthetic nitrocellulose-based resin mixed with ground sandstone to fill in worn surfaces, molding it to replace missing or damaged sections, and ultimately painting the entire sandstone surface with it. This was a state-of-the-art restoration technique in the late 1960s.

By 1975, large pieces of the restoration were falling to the ground, and the hazard was so great that pedestrians on the sidewalk had to be protected by canopies. The restoration failed for two reasons. First, the sandstone and the resin had vastly different coefficients of expansion. In such disparate materials bonded directly together, daily and seasonal temperature changes created cyclical thermal loads (thermal fatigue) that eventually caused the bonds to fail. Second, the very quality for which the restoration material was specified—it is nonporous and impervious to water vapor—served to make the matter worse. Without further moisture penetration, leaching of salts from interior bricks would be stymied. But the resin also prevented the sandstone it covered from breathing, thus trapping interior moisture at the interface between the sandstone and the restoration compound. When eventually the resin coating was removed with a fine abrasive, the underlying sandstone was visibly wet despite the fact that there had been no rain for 20 days. The freeze-thaw cycle of trapped subsurface moisture accelerated failure.

The Smithsonian finally decided to replace nearly 90 percent of the sandstone (and all of the original restoration compound) with precast concrete that was chemically compatible with the original stone and could be made to simulate it visually. A special technique developed to attach the precast units is expected to minimize and possibly arrest further decay of the stone. It has been nearly two years since the repairs were completed, and so far there are no more problems.

Problems of detailing are not limited to restorations. Of particular concern to Nelson is the current resurgence of stone-




panel building facades. He believes that many stone panels specified today are just too thin. He fears that water will find its way through them to corrode and rust the metal pins that attach the panels to the building frame, causing panels to fall off and shatter.

Additionally, thermal damage may plague these stone facades. A common stone spandrel panel might be six feet long, two feet wide, and only an inch thick. Nelson compares such a unit to the tall, narrow chimneys on 18th-century buildings, which expand and contract daily because of cyclical heat from the sun. Over time, the chimneys developed permanent curves due to this thermal stress. Nelson is convinced that the thin stone panels will respond as the chimneys did.

"Architects need to find a better way to attach these stone panels, and for that matter architectural concrete, to allow for the curvature that will result," he says. "Or else the industry should return to thicker sections so that there is more mass to resist thermal stresses and more material to be anchored."

Problems with building materials and components can too often be traced to noncompliance with instructions. Many new materials look and appear to act like familiar products, but the installation techniques can be very different. Roofing membranes fall into this category, as do caulking compounds. For example, when the new generation of caulking is applied to precast concrete, bond breakers are needed to keep the caulk from bonding to the form. The concrete must be cleaned and neutralized or the strength of the caulk bonds will be greatly diminished.

A contractor might not believe, or for that matter even know, that a material being installed is really different from the one it is replacing. John Loss, AIA, professor and director of the Architectural and Engineering Performance Information Center at the University of Maryland, finds this trouble with roofing all the time. "Contractors see that single-ply roofing membranes look like rubber and their inclination is to use familiar methods to put them down," he says. "But these roofing materials are not rubber and they require the special installation techniques determined by the manufacturer."

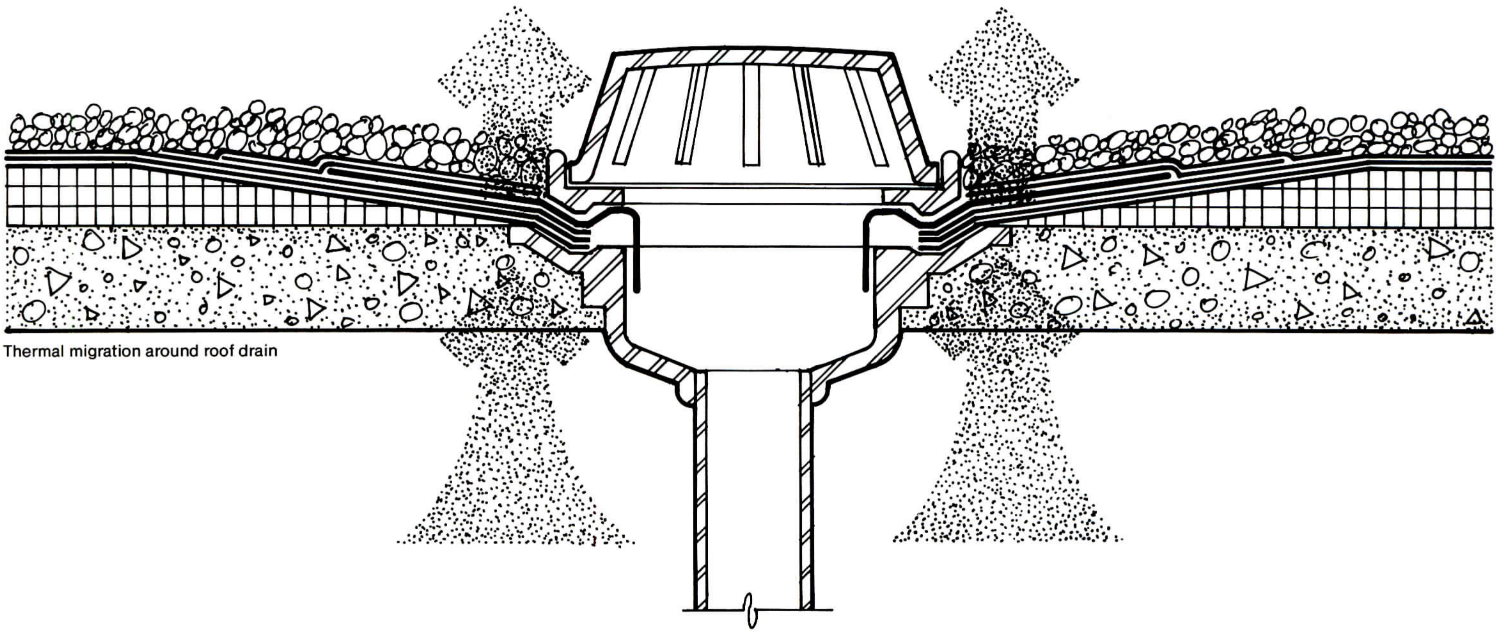
Adding to the confusion, designers, too, often do not understand the difference, and they supply details and notes from old products that are in conflict with the manufacturers' guidelines for installing the new products.

"I have investigated thousands of roofing failures," says Loss. "Usually there is big money involved, particularly when contents have been damaged. I can say without a doubt that the cause is virtually always improper installation. There are no problems when the manufacturer's recommendations are followed."

Building problems differ markedly today from those of the past in that lighter materials and smaller safety margins make new buildings less forgiving. Yet professional designers are not necessarily trained to anticipate the widening range of problems that could arise in a contemporary building. In school, architects and engineers are taught to judge building components and structures by their strength and stability, and research for many years has been dedicated to these qualities. However, structures fail today for entirely different reasons. Consider parking garages where steel structural elements are corroded by the migration of salt applied to the pavement in bad weather. From a design standpoint, the problem is a lack of serviceability, not a lack of strength.

Simplified theories and rules of thumb are comfortable tools for designing, and they often replace complex measurements and calculations. These practices served the design professions well until recently, but advances in the technology of components and materials have created entirely new conditions. Moreover, new component and building materials, combined with changes in construction and assembly methods that allow faster and cheaper building, also force architects to contend with a smaller margin of allowable error. The basic principles of design have not changed, but the formulas have, says Loss. Yet the industry still designs with formulas from a less demanding era.

There exists a technological gap between design theory and


Thermal migration around roof drain

actual manufacturing techniques and construcion procedures, according to structural engineer Lev Zetlin. The structural behavior of a completed building can be quite different from what was assumed in design analysis. "New materials and components usually live up to their promise," says Zetlin. "But the influence of innovation in one material or component cannot always be predicted with conventional design theories."

The standard procedure for designing tall buildings, for example, is based on the assumption that a minimum grade of structural steel will be used, which in turn will produce a structure able to support a specified number of pounds per square inch. With standard steel members under a conventional approach, noticeable building vibration and noise transmission do not occur and thus are not design issues. Advances in technology have produced steels of greater strengths, however, making it possible to reduce the amount of steel in building structures. The lightweight steel does live up to its promise: it provides greater economy and function, Zetlin says. The trouble lies not with the material but with its application. Unfortunately, designers have been using the same formulas for buildings with lightweight steel frames as those they depend on for heavier structures. Unlike their heavier counterparts, lightweight steel structures are subject to vibrations and deformation of columns and beams that can significantly affect their behavior. The result is building failure in the form of broken window frames and glass, cracked walls, and excessive sound transmission.

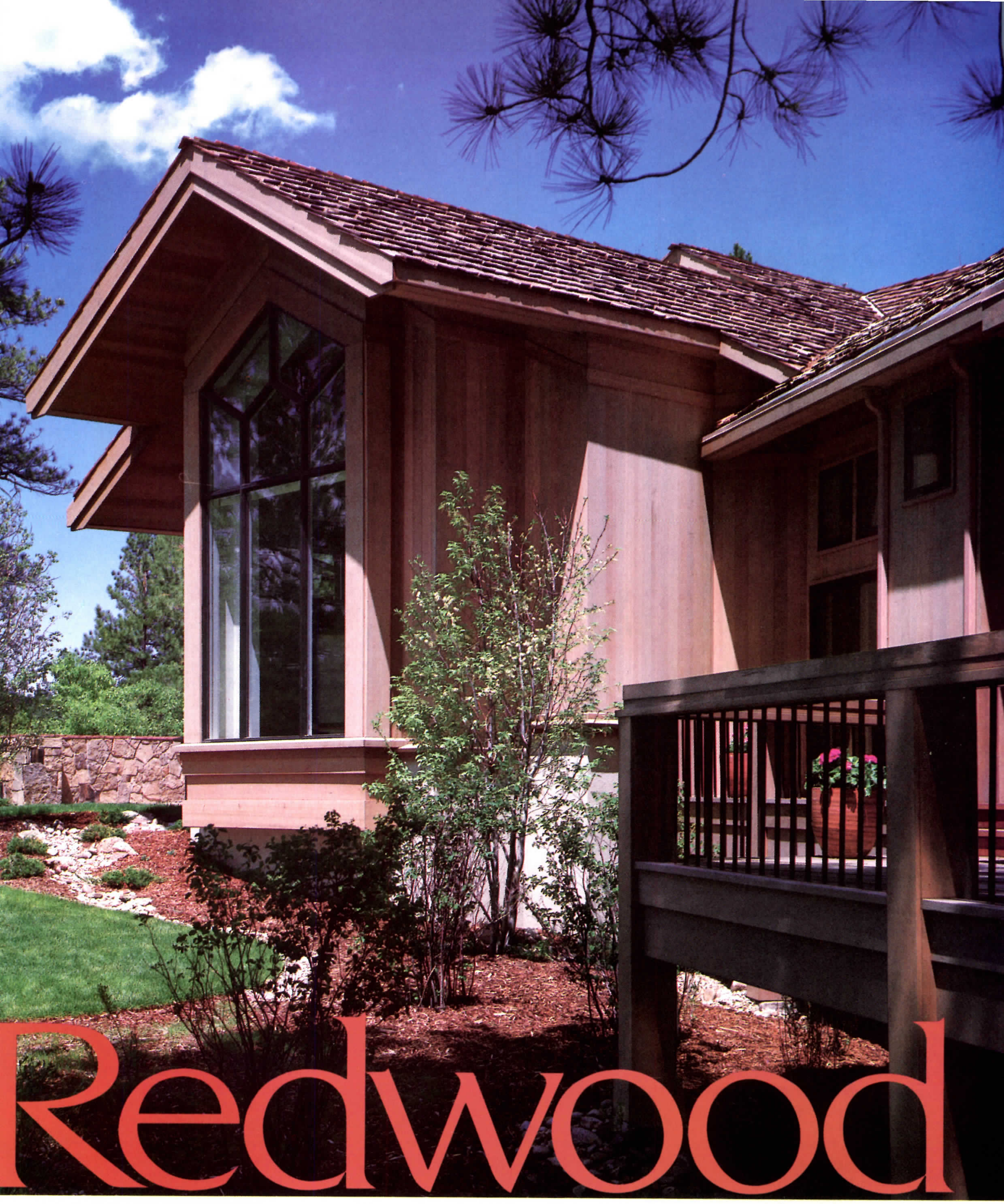
Fatigue and fracture have become major concerns. Cyclical loading is contrary to almost everything building designers have learned in the past. A static load of a given magnitude responds one way; the problem becomes quite different when the load has several million cycles. The characteristic loading and unloading of fatigue—caused by thermal load, wind, or occupants—normally is not accounted for in building design. Welding of building structures began about 20 years ago, and the static strength of welds was anticipated by translating design criteria. It was not recognized that welding caused a notch condition extremely sensitive to even minor loads, which produced cracks that could propagate thermally after numerous cycles.

A constant pressure to stretch components to closer tolerances is presented by tight schedules and budgets. With every advance in technology, more building limits are tested. Our technological capabilities are reflected in the capacity to generate closer tolerances, says Loss. Throughout construction history, the plus and minus factors have been getting more precise, more accurate. There is no problem building steel structures within one-sixteenth of an inch of design specifications, or precast concrete structures within one-eighth inch.

"I have a problem when you start slicing our safety factors, though," Loss says. "Designing with zero redundancy in critical structures is just bad practice. Unfortunately, economy drives these things. It is cheaper to do away with redundant supports, but we should not have it this way." No redundancy means no backup system, so even a little problem can result in disaster.

Zetlin agrees. As things become more commonplace, they get built more conservatively, he says. Redundant elements, by definition, are not necessary to support a structure under normal conditions. However, redundant elements are more likely to pick up a load should a critical member fail. Under these circumstances, a load redistributed to a redundant member might cause signs of distress, such as sagging or vibration. With adequate redundancy, the structure will not fall down and the problem may be corrected before disaster occurs.

It is common, Zetlin says, for engineers and architects to assume that the secondary stresses always present in structures will be small and that a safety factor can accommodate all unanticipated stresses. A design might correspond exactly to standard practice, but minor deviations during construction or, over the life of the structure, actual loads, traffic, and weather patterns that differ only modestly from the assumed sequence can easily transform the conventional into the unconventional. The causes of failures seldom are major mistakes. They generally are minor deviations that cause extraordinary stress. □


Redwood

# CADD on the Cheap Using PCs

*Surveys show it growing in favor.*
*By Elizabeth J. Macklin, AIA*

Only two years ago, some firms were buying minicomputer-driven systems for as much as a half million dollars while their equally forward-thinking but less capital-committed colleagues were settling for the limited capabilities of micro personal computers.

The market has since taken a radical swing toward a new generation of personal-computer CADD workstations. The increasingly available hybrid machines are able to run software that delivers the computer-aided design capabilities of older minis, but at costs of less than $50,000. The result, judging from AIA's 1987 survey of architecture firms and a less formal survey of major CADD vendors, is a move by buyers and manufacturers alike away from multiple-user, large CADD systems to powerful new 32-bit personal computers and accompanying software.

At the heart of this shift is the 32-bit processor, which since 1980 has moved from installation in large, expensive machines to use in desktop systems. The significance of this development can be better appreciated with a little historic perspective. During the '70s, most home personal computers were intended for educational and entertainment programs like Reader Rabbit and Donkey Kong. These were 64K personal computers: they could hold 64,000 bytes for immediate random access. (A byte equals eight individual binary digits, or bits. A bit is the fundamental form of all computer information.) The set of master switches that controls information flow—the microprocessor—could pass eight binary digits through at a time; thus it was known as the eight-bit microprocessor. Though it was useful in the home, this very early machine had no business applications to speak of.

The personal computer proved its worth as a business tool in the '80s. Popular word-processing and spread-sheet software now runs on personal computers that typically have 640K bytes of random access memory—10 times that of the early home models—and often runs twice as fast on 16-bit microprocessors. An equally dramatic increase in computing power came with 32-bit computers that can hold 1.2 million bytes and more. And just as the earlier leap in technology took personal computers from toys to business machines, this leap to 32-bit capability is pushing the personal computer into the more complex arenas of architectural and engineering design and analysis.

While advancements were being made in hardware, CADD software was not far behind. Ten years ago, high-cost CADD was the only CADD available to architects. At several hundred thousand dollars per system, the expense for hardware was only the beginning. To house these machines, firms built specially airconditioned and soundproofed rooms. To use available software, which was actually developed for engineering or manufacturing applications, employees devoted weeks to training.

Low-cost CADD came in the early 1980s, as drafting software was developed for personal computers. Many of these products were, again, drawing programs developed for engineering or manufacturing applications. Architects bought this software and adapted it for use in design and production. At $10,000 to $15,000 per workstation, personal computer systems were priced within everyone's reach. Crowds at booths at product shows and unparalleled sales by companies that supplied inexpensive software proved that architecture was a growing market for CADD. Software developers took notice and began creating products specifically for architects with personal computers.

By the time low-cost CADD entered the market in 1983, many large-system vendors had committed time and money to develop architectural product lines. So when their prospective customers began to look seriously at purchasing PCs for CADD, their first reaction was to fight back. Developers of products for PCs claimed to offer 80 percent of large-system capabilities for 20 percent of the price. Large-system vendors called personal computer systems toys that lacked the features required for serious design and drafting.

Now, with the new generation of 32-bit personal computers, the suitability of large minicomputer systems for architectural applications is under question. This is not to say they have no contribution to make in the marketplace, however. The powerful large systems, which usually support individuals working simultaneously from one processor on centrally stored information banks, retain their hold in the market because they are still fast, affordable machines for processing long sequences of engineering calculations and are able to maintain the very large data bases required for facilities management.

So, for firms looking to buy CADD capability now, the question remains, "How much should we spend and what is the smartest buy?" AIA's survey earlier this year of 2,000 firms nationwide seems to indicate the decision more and more architects are reaching. The percentage of architecture firms that will spend more than $25,000 on CADD in 1987 is significantly lower than the percentage of those who reported spending that much in 1986, showing a declining interest in the more costly systems. CADD vendors are well aware of this trend and are responding with the vigor and speed typical of the computer market.

Improvements in hardware have quickly broken down convenient distinctions among minis, workstations, and PCs. High-cost and low-cost CADD are now meeting in the middle. New ways of controlling information flow allow owners of moderately priced hardware the capability of running more than one CADD operation at a time. Plotting can be done concurrently with text editing or recording information to develop a drawing.

But it is with software, not hardware, that competition for sales to architects is keenest. While only a few vendors, such as Intergraph, still sell hardware under their own product line, vendors are competing to create programs that use the new low-cost capability of the generic 32-bit personal computers. And vendors of larger systems have changed their overall sales strategies so that many now promote products for the 32-bit PCs.

Individual products work in a variety of ways. Computervision emphasizes the architectural features of its PC software in contrast to its engineering-oriented minicomputer products. Skok Systems sells PC software that allows drawings to be transferred to their high-end workstations. Sigma Design offers their full range of applications software on both PCs and more powerful pro-

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*Ms. Macklin is an architect who uses computers to teach architectural design to elementary school students. She was staff director for AIA's computers in architecture committee in 1984-85.*

cessors. Intergraph sells a new low-priced station that can tie into a network with other architectural workstations and powerful VAX minicomputers, all running Intergraph's software.

Likewise, vendors who started out with products for the older generation of personal computers are now creating products with more advanced features. Developers of Versacad, Autocad, Pointline, Datacad, and Space Edit all claim 3D capabilities. A number of these and other vendors offer solids modeling, animation (allowing visual "walk through" of spaces), and the ability to work with photographic images captured on video.

Features for working with written descriptions of materials and spaces vary from product to product. Some have built-in programs for organizing nongraphic data and linking it to drawings. Others provide links to off-the-shelf data base management software such as Ashton Tate's dBase series.

Vendors that are serious about selling to architects now emphasize how their products are tailored specifically to architects' needs. Companies either start with architecture as the primary application for their drawing packages, as did Microtecture, or they offer special modules for architects, as do Autodesk, Intergraph, Micro CAD/CAM, Sigma, and T&W Systems.

Because architects are contributing to software development in a number of different ways, vendors will be creating a variety of new design tools. Most companies have groups of architectural users who meet regularly to comment on software performance and suggest improvements. Some companies, such as McDonnell Douglas and Intergraph, have architects who manage the development of their architectural product lines. Other companies, notably Autodesk, Micro CAD/CAM, and T&W Systems, encourage users to develop libraries of symbols and procedures that can be sold as supplements to their products.

Despite the variety of big-CADD and small-CADD vendors pursuing the same market, vendors have yet to offer the perfect product. So far, few programs for architects follow an easily grasped intuitive process. Furthermore, improvements in hardware technology come out so rapidly that software writers sometimes have a hard time keeping up.

For the new purchaser, system selection remains a process of knowing a firm's needs and making the appropriate compromises. The rule is: know what you can live with, as well as what you would rather live without. Software that is easy to use often has been limited to small data bases or has offered few opportunities for customizing for special applications. Fast, high-quality output is available only with expensive plotters and printers.

Approaches to training, once the greatest stumbling block in using a new system, are beginning to reflect a demand for "friendly" software. Traditionally, large-system vendors offered two weeks of training to purchasers of new systems. Subsequently, architects could expect to take as long as six months to become proficient. As time passed, more choices in what to spend and whom to consult became available. With low-cost CADD, authorized training centers and microcomputer dealers offered instruction at fees of $500 and more for three to five days of classes. Vendors now supply manuals with tutorials for beginners, and software is written with features to help remind architects of command choices.

Problems of translation between software programs and compatibility of hardware are examples of the issues architects must consider when they want to improve their systems, and assembling hardware with the new systems is as difficult as ever. Equipment configurations are still unintelligible to the uninitiated. Monitors (video displays that look like TV sets) must be compatible with graphics cards (circuit boards controlling the monitors), which must be compatible with the main computer processor. The problem is complicated by frequent changes in equipment specifications. And limitations in systems are not always obvious.

Firms selecting systems for the first time need to think ahead. Sidestepping technical limitations means asking a lot of questions. Vendors offer these suggestions:

- It is often a good idea to work with a consultant, but if you do, make sure that someone on your staff understands the logic behind each decision or action throughout system selection and installation. Learn enough to be able to fix the problems that may occur when your consultant is on vacation.
- Ask vendors and dealers how their products allow users to add new capabilities after purchase.
- Ask software vendors for the price and timing of major improvements. Even if they can only tell you when they offered past improvements, you get an idea of how often new versions are released.
- Buy standard hardware. Ask dealers who propose to sell you a computer they claim is compatible to define "compatible." All computers differ from each other in some way.
- Consider computers with "open architecture," a feature that allows more possibilities for system development through products by third parties.
- Know the name of the computer's operating system—the software that controls and schedules the way the computer runs other software—and confirm that vendors will support their CADD software under that system.
- Be aware of which graphics cards, printers, plotters, and other products will work with your computer or CADD software, so you can begin to identify options for improvement.

While easy-to-use products prompt fewer questions about system problems, technical assistance is always important. People who enjoy using CADD will stretch it to its limits. Architects need to know that technical support is available for just such situations. Dealers and consultants have long been a source of such support. CADD manufacturers also offer telephone technical services, usually at a charge. Autodesk, which produces the most commonly used CADD software, sponsors a forum for users on an electronic telephone conference service.

Most experts advise architects to create a plan to grow into CADD. Expect change, says architect and computer consultant Nick Weingarten, AIA. "Look at what you are trying to do and what it is worth to you. Then buy a tool that people can learn to use. As people become skillful, upgrade."

In assessing today's market, Douglas Stoker, a partner in Skidmore, Owings & Merrill's Chicago office, recommends, "Whatever you spend, look for software that runs on generic hardware that is easy to maintain. The most versatile software runs in full 3D and allows easily definable links between graphic and nongraphic data."

Firms facing a purchase this year will do well to consider it as a first step rather than a final one. In the next few years there will be significant changes in products and in architects' abilities to use them. □

*All projections and analyses of the survey of AIA member-owned firms in this article are our own, drawn from raw data made available to* Architecture. *The published results from AIA were not available to us by press time.*

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# Coatings That Protect Against The Corrosion of Steel

It is no secret that steel and steel alloys are susceptible to corrosion when exposed to oxygen, moisture, certain chemicals, and other metals. And that the most effective protection against steel corrosion is the application of a protective coating. The principle is simple enough, but actual specification of a steel-protective coating must take into account the exposures the steel must endure; the chemical interrelationship between the grade of steel used, primer, and top coat; the finished appearance the architect desires; and the proposed maintenance schedule.

Anticorrosion coatings for steel include metallic coatings, such as hot-dipped zinc; inorganic coatings, such as vitreous enamels; and organic paint and paint-like coatings. This discussion will concentrate on organic paint and similar coatings: those generally defined as coatings consisting of a mixture of insoluble particles of pigment suspended in a continuous vehicle that is either organic or aqueous.

The criteria for selection are:

• Alloy compatibility. When selecting a paint-like coating, be sure to consider the type of steel alloy to which the coating will be applied, because some coatings are better suited than others to certain steel alloys. Water reaching the metal surface dissolves a certain amount of the pigment in the coating, supplying the necessary concentration of inhibiting ions to reduce corrosion potential. For instance, zinc-rich paints cathodically protect the steel, in essentially the same way hot-dipped zinc coatings do. Likewise, when water reaches a steel surface coated with a red lead paint, the paint releases a sufficient amount of inhibiting ions to passivate and protect the steel.

• Job size. The selected coating must match the size of the job. For instance, a brushed-on coating probably takes too long to apply to a multistory steel frame structure.

• Solvent toxicity. It's wise to check the solvent emission level of some coatings, since they can be extremely hazardous; and of course make sure the coating complies with fire ratings.

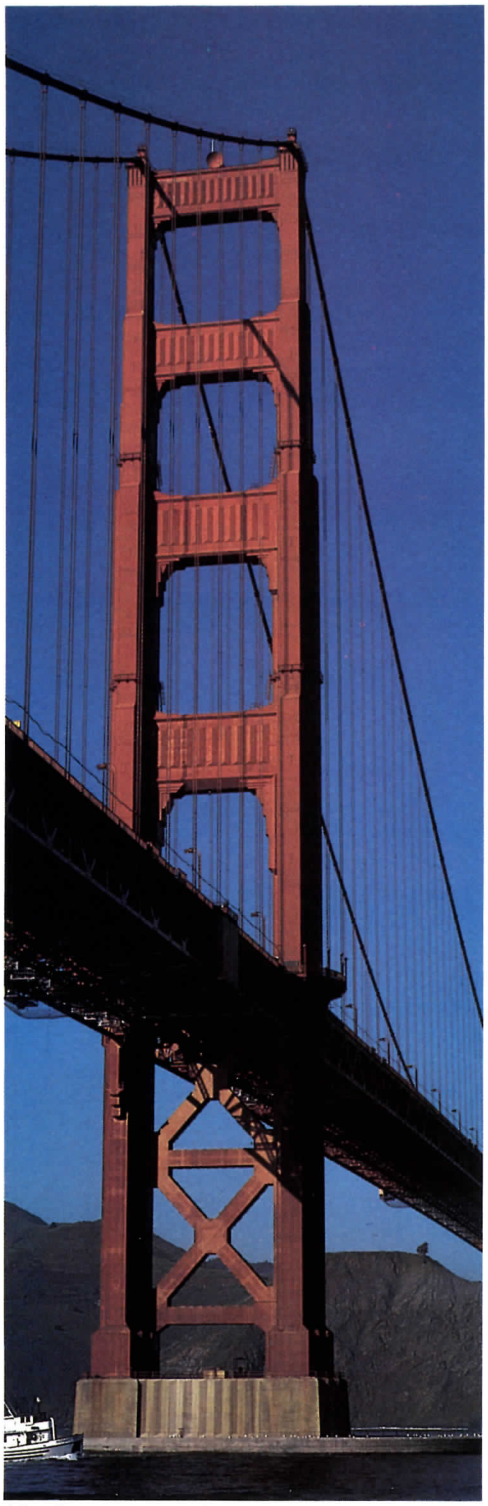
• Maintenance. Acrylics, vinyls, and other single-component coatings, generally termed thermoplastics, can be refurbished once the surface is cleaned and bare, or rusted areas are touched up with a primer. Multicomponent coatings, such as epoxies, need a clean, dry surface that has been abraded to produce a profile. This will require a higher level of skill and attention by the maintenance workers.

• Color. Cost and color may be the first and last considerations, depending on budget and where the coating is going to be applied. Epoxies are excellent for corrosion protection, but they tend to fade and chalk on exterior applications or in aggressive environments. Where gloss and color retention are necessary, catalyzed alyphatic urethane may be the best choice. However, under normal weathering conditions and with a limited budget, good alkyd or acrylic emulsion coatings will do nicely. A coating that requires special environmental conditions isn't recommended if the coating is to be site-applied.

• Surface preparation. For a coating to prevent corrosion, it must be applied on a properly prepared surface according to the manufacturer's instructions. Adhesion and bonding are the two means by which a coating attaches to the steel substrate. Adhesion is a molecular attraction of the interfacial forces of both the coating and the steel substrate. Bonding is the mechanical attachment between the coating and the substrate. Both adhesion and bonding must occur for a coating to be effective.

Methods and their resulting degrees of surface preparation vary greatly. Before any one method is specified the architect should consider first the environment to which the steel will be exposed. Coastal and dense urban environments are more corrosive than inland and rural environments. Secondly, the architect should consider the expected service life of the coating. Some coatings are less tolerant than others of surface contaminants and require extremely clean substrates with good surface profiles to achieve proper bonding. Zinc-rich coatings and vinyl coatings are particularly intolerant of contaminated substrates.

The surface preparation requirements often are dictated by the type of coating specified, as well as the type of steel, and can incorporate a number of methods and materials. Solvent cleaning, for instance,



Allen Freeman

*Right, south tower of San Francisco's Golden Gate, now 50 years old. Bridge has a coating of 'international orange.'*

is particularly important in removing surface grease or oil prior to abrasive cleaning, which by itself is ineffective in removing oil and grease. Specification of a coating must include text dealing with surface preparation. The text should clearly specify that all forms of surface contamination be eliminated, that the size and hardness of the abrasive be selected according to the type of steel, and that all abrasive residue be removed from the work area prior to coating. Also, consult with the coating manufacturer to set abrasive blast or solvent cleaning standards. Before the cleaning work begins, require the contractor to clean a sample test area for your approval to set the standard for the work. In addition, all weld splatter and slivers should be removed and the coating applied before flash rusting can occur, usually within 24 hours.

For applications that require abrasive cleaning, the Steel Structures Painting Council (SSPC) and the American Society for Testing and Materials (ASTM), along with several other organizations, have published a pictorial reference book that sets abrasive blast standards.

## *Primers*

Many coatings require a primer before application, and the primer must be compatible with both the steel substrate and the topcoat. If the primer doesn't adhere and bond properly to the steel, off it will come, taking the topcoat with it. Likewise, the topcoat won't last long if it doesn't bond with the primer. Most manufacturers state clearly which primers to use with which coatings. The primer is often the component that carries the rust-inhibitive pigment, while the topcoat provides a protective surface.

Zinc chromate is a low-cost, rust-inhibitive primer pigment, considered not as toxic as red lead but still unacceptable in food processing areas. A whole family of zinc chromate primers is manufactured for specific applications. Zinc-rich primers (not to be confused with zinc chromate primers) contain 80 percent to 95 percent zinc dust by weight of the dry coating. Their major drawback is that they are considered difficult to apply.

Where a white primer is called for, an oxide white primer is often the answer.

Where a steel surface needs protection from a highly corrosive environment, or where immersion in water is expected, epoxy primers are recommended. Some epoxies have a limited color range and many have a short pot life once mixed.

Alkyd primers are often called universal because they accept most topcoatings, but they do have limitations. They tend to lift when they come in contact with vinyls, epoxies, chlorinated rubber, or urethane coatings.

Several primers don't use rust-inhibitive pigments to protect the steel because they are themselves so water-impervious that the essential electrolyte can't reach the steel and rust can't occur. Vinyls are among these water-impervious primers; however, one must be cautious when specifying a vinyl primer. It will require excellent surface preparation to achieve adhesion, and the use of a pretreatment primer is recommended. Red oxide, another primer that excludes moisture from the steel but has no prohibitive properties to speak of, has been around for a number of years and is still used extensively.

Aluminum primers with aluminum as the sole pigment have no inherent rust-inhibitive properties. Zinc chromate or strontium chromate is added as a rust inhibitor. As with all the other primers, aluminum primers come in a number of formulations, and the architect should consult the manufacturer to match the proper primer with the job's special conditions.

## *Curing*

The mechanisms by which protective coatings cure are another important consideration. Each mechanism is greatly influenced by the type of resin present. The four common mechanisms that promote curing are solvent evaporation, oxidation and polymerization, cross linking, and hydrolysis.

Solvent evaporation mechanisms rely on the resin molecules' natural attraction for one another, resulting in an ever-tightening film. The final product is a solid, continuous coating. Coal tar pitch solutions and chlorinated rubbers and vinyls are examples of coatings cured by solvent evaporation.

Oxidation and polymerization mechanisms rely on molecules of the same type combining (polymerizing) in the presence of oxygen to form the required solid film. Epoxy esters, vegetable oil-type paints, and oil-modified alkyds are all classified as oxidation and polymerization coatings.

Cross link mechanisms, unlike oxidation and polymerization mechanisms, work when dissimilar molecules without oxygen combine to form the required coating. Polyester epoxies, catalyzed epoxies, coal tar epoxies, urethanes, and zinc-rich epoxies are all coatings that cure using a cross-link mechanism.

Hydrolysis mechanisms depend on the reaction between the resin and the moisture in the air (as opposed to the air itself) to cure the coating. An example is an alkyl silicate inorganic zinc-rich coating.

## *Already corroded walls*

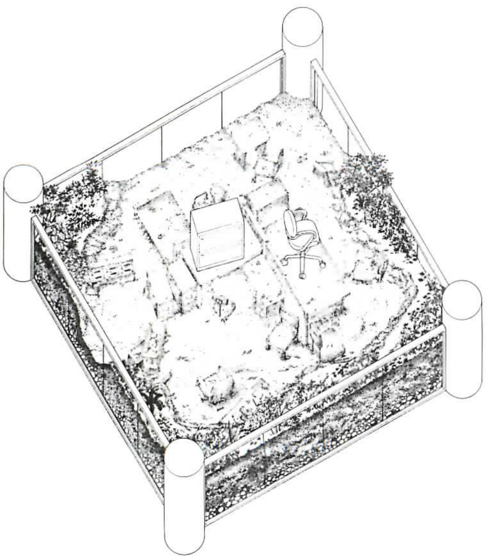
If there is an existing coating on the steel surface, make sure it is compatible with the new coating, and require that it be properly prepared before the new coating is applied. If the surface is already rusted and corroded, consider specifying one of the coatings developed specifically for application over rust. These coatings are meant for situations where proper surface cleaning isn't possible or for areas of limited space or intricate surfaces. The high-build polyamide epoxy coatings go on over the rust with little surface preparation (only removal of flaking rust in most cases) and provide a moisture and chemical barrier that retards or prevents further corrosion.

Other coatings actually react with the corrosion products, turning them into a passive insoluble organometallic compound as hard as the original steel. (Of course, the architect shouldn't confuse hardness with structural strength.) These chemical formulations consist of tannin derivatives and phosphoric acid combined with an appropriate wetting agent. When brushed, sprayed, or rolled on a rusted metal surface, they convert the unstable iron oxides into stable ferric tannate. However, not all these products are equally effective, according to Martin Weaver, of Heritage Canada Foundation. He states in the Association for Preservation Technology Bulletin (No. 1, 1987): "In order for the passivation or corrosion-product conversion process to be completed, oxygen must continue to reach the surface. Resin and solvent-based 'converters' tend to form a skin, excluding oxygen and preventing completion of the conversion."

Water-based products are more effective because they penetrate rust better than resin-based products. In addition, resin-based products can't be used on heavy, wet, or soluble rust. There is little available information on the long-term protection these coatings provide.

—Timothy B. McDonald

# *Interiors*



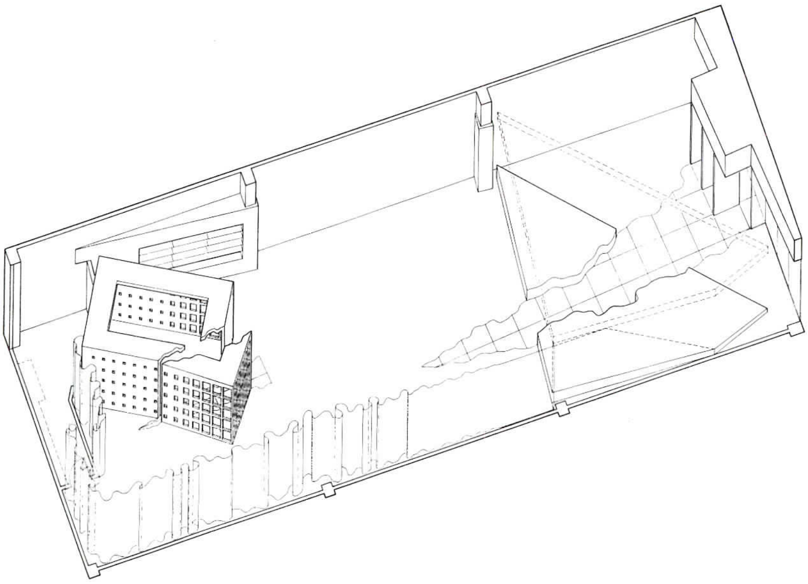
What can you do with a 13,732-square-foot showroom in four weeks for $30,000? That was the problem posed to SITE, the firm hired to do Allsteel Corporation's permanent showroom at the International Design Center (IDCNY) in Long Island City, N.Y.

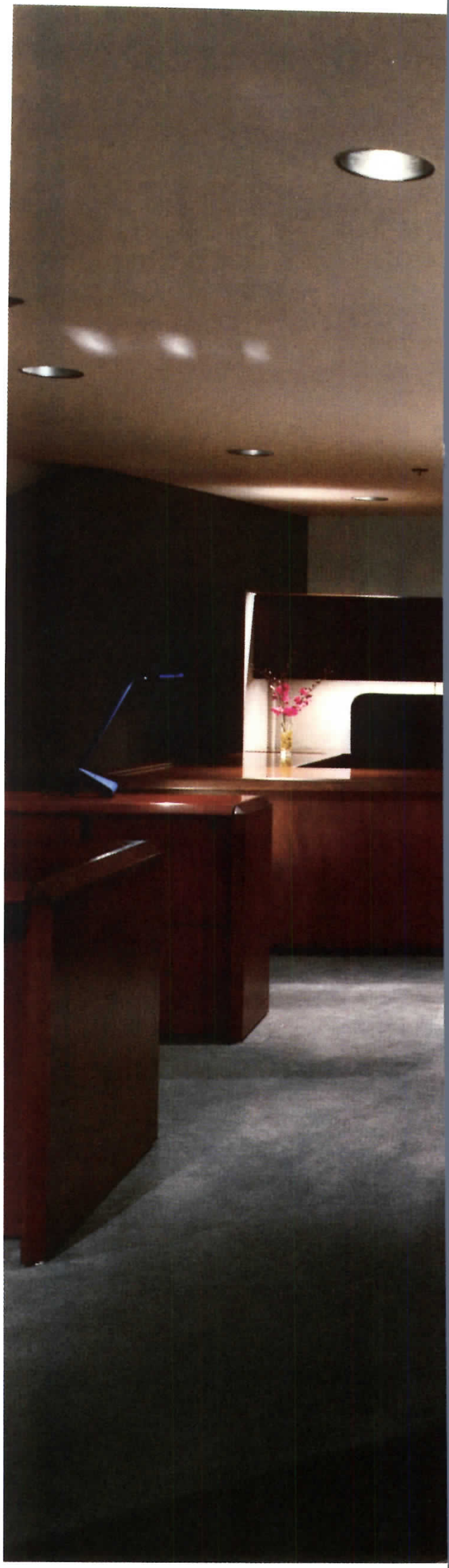
Employees had bought out the company, and the new management faced the prospect of an empty showroom at the industry's big fall event in New York City, "Designer's Saturday," just when they wanted to dramatize the company's move away from its staid, conservative image.

To emphasize Allsteel's history—75 years of marketing a complete line of office equipment—as well as its new products, SITE came up with the concept of an archeological display—the "big dig," in the words of project architect James Wines. All the products included were made by Allsteel; some of the older ones were bartered away with difficulty from their original owners in exchange for newer equipment. The older products were grouped together and covered with spray glue and many layers of sand and were set in the center of the vacant showroom. This assemblage served as base and background for the company's new products, left uncovered.

The display drew crowds, more than anticipated. It also provided amusement for the IDCNY employees, who brought their friends in for a viewing. Allsteel (whose creative people remember no small amount of trepidation when showing the SITE concept to management) decided to make the temporary display permanent and installed it behind glass in the lobby of its headquarters outside Chicago.

—Sharon Lee Ryder





If modernist architects had their way, no one would be surprised to see the world redesigned with straight edges, down-lighting, geometric hills, and gridded ground planes on which all the pieces might rest—a carefully ordered environment with not one irrational curve nor one object out of place. While a mere 3,728 square feet doesn't constitute the world, architect Stanley Felderman did adapt such a metaphorical landscape for the design of the Gunlocke furniture showroom in Dallas's World Trade Center, showing just what it is possible to do when architects confront the natural order of things.

Felderman chose the landscape imagery as a way of expressing the idea of evolution and change, both in the design of a series of showrooms for the Gunlocke Co. (of which this was the fourth and last) and in the company's shift from a conservative, dealer-oriented firm to one perceived by the specifier as very design-conscious.

With the purchase of the company in 1981 by some of its officers, the new, younger management team wanted the 80-year-old furniture company to make its mark by evolving products that would combine the quality implied by longevity with the appearance associated with being at the leading edge. Their original concept included both the introduction of new products and the design of showrooms to reinforce their image.

Working within the constraints of an existing building, a compressed schedule, and a tight budget, Felderman picked up elements he had used in previous show-

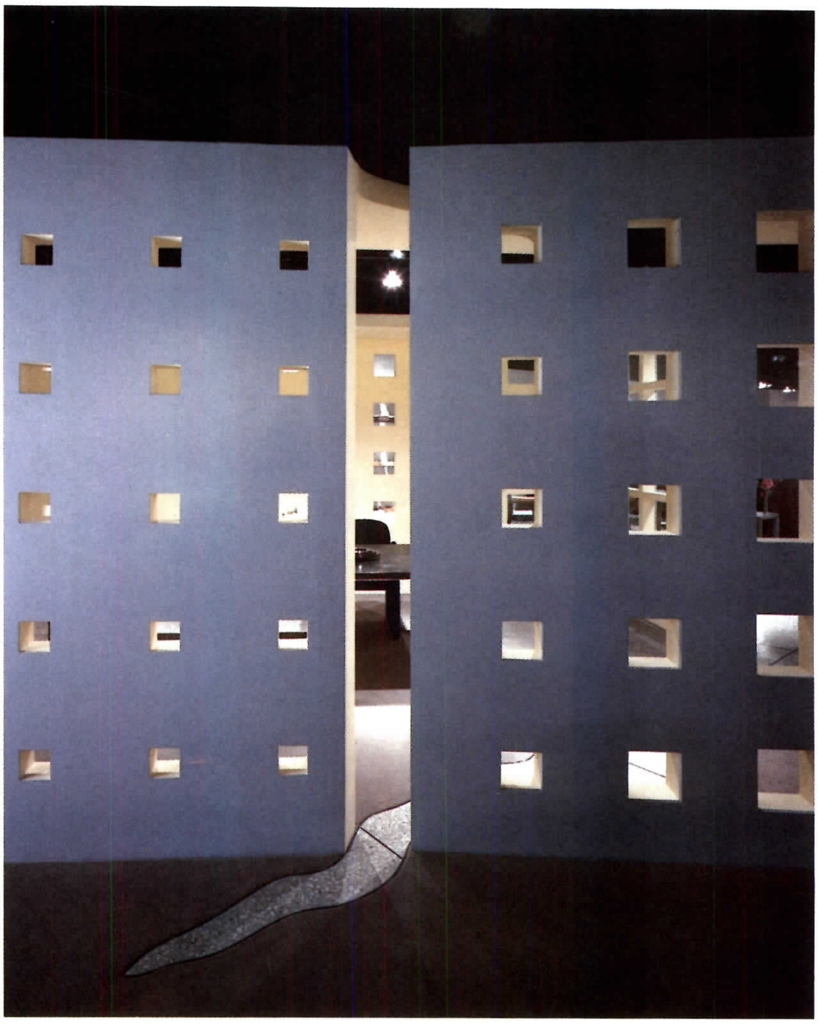
Photographs © Chas McGrath

*The change in floor material and height at the entrance breaks up an undefined space into smaller display areas for the company's product.*

room designs and developed these ideas further, to show visual progression from one to another. The white triangular plane floating below the black ceiling and the dark gray carpeted platforms are all aspects of an abstract landscape, representing clouds and hills. More literal is the fissure, an organically shaped form in granite with an inlaid grid of black plastic set into a warm lavender-gray carpet. The collision of shapes appears as if the ground has been peeled away, revealing what lies beneath. Located at the entrance to the showroom, this large fissure draws people into the space, guiding them past two small display areas.

A second fissure, reduced in scale, penetrates a cube at the rear of the showroom, wrenching apart the walls and creating an entrance into a semiprivate conference and audiovisual facility. The visual irony here, not easily discernible, is the distorted size of the open portion of the cube; the corner will, in fact, never fit back into place to close the cube. Other subtleties are present in the way the grid of openings in the walls changes the proportions of solid to void in the enclosure, rendering the cube nearly transparent at one end, almost a fortress at the other.

Although the landscape metaphors were the prime generator of forms in the showroom, the main focus of the

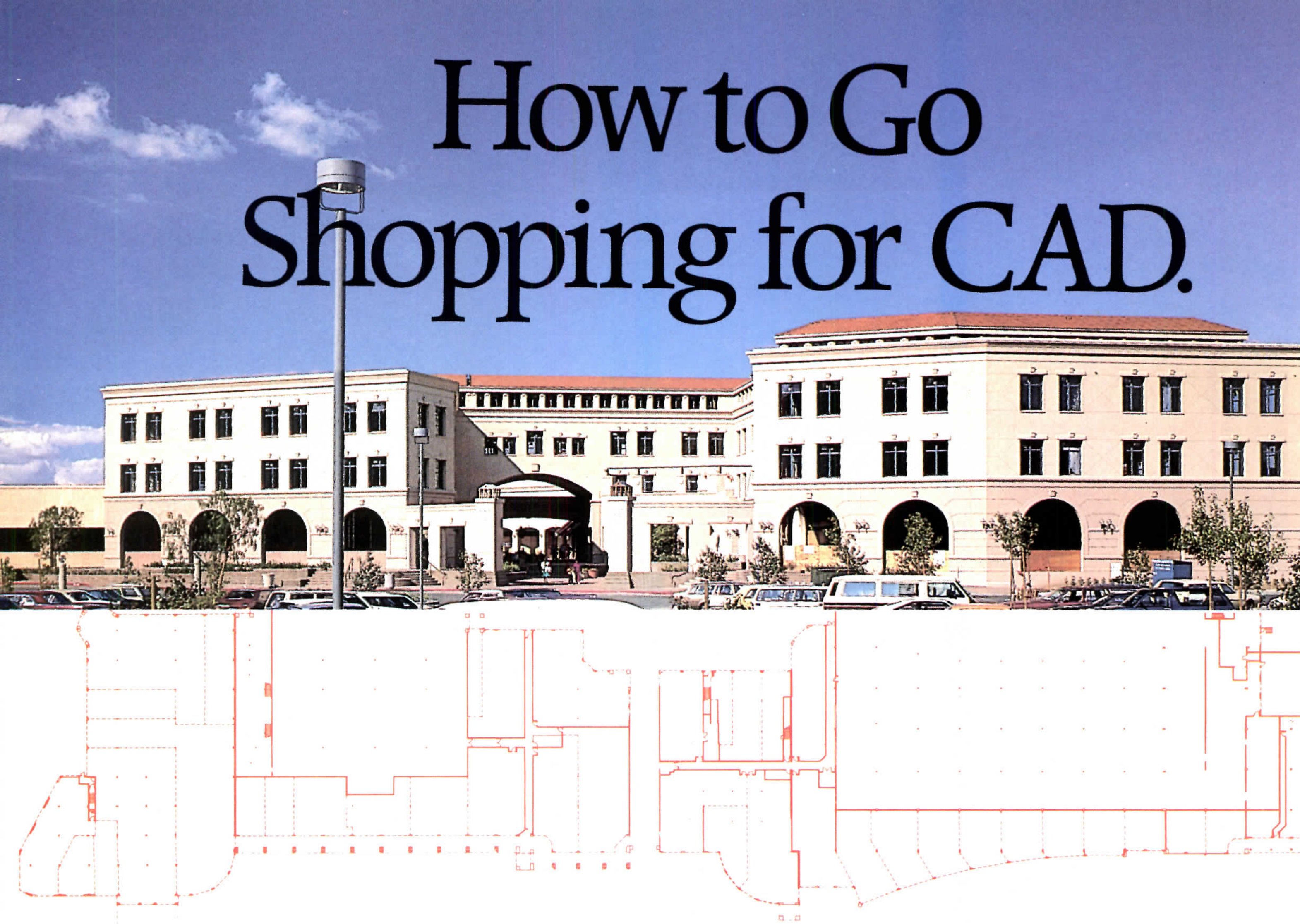


*At the far end of the showroom, the volume of the enclosed conference room is pierced by a granite fissure similar to the one at the entrance. Windows that grow larger lend a sense of transparency at the entrance to the conference room.*

space is this cube, which appears wholly man-made, its strong geometric forms pierced by the cleft. The natural versus man-made is just one dichotomy built into the design. The other is the balance between making a strong design statement, capable of influencing specifiers' perceptions of the company, and allowing the furniture its prominence as the major product. Outside the conference room, no specific uses were assigned to other areas, and no particular type of display system was developed. This left Gunlocke free to display its products in whatever manner seemed appropriate and to accommodate new product introductions without redesigning the showroom. The simple, raised platforms break up the space, providing focal points for older products to be seen in their new setting. Felderman also had the opportunity to select the wood, metal, and fabric finishes for all the products that were to go into the showroom, thereby gaining a greater degree of coordination between container and product than is usually possible.

Although the change in Gunlocke's image came gradually over the course of four showroom designs, Felderman remembers that at the outset what he considered restrained was a radical departure for Gunlocke, and it changed their thinking around. By the time the fourth showroom was completed, the company had realized a total transformation of image as well as a change in attitude about design. Felderman's satisfaction is in taking his client along and watching this process of change.—SHARON LEE RYDER

# How to Go Shopping for CAD.



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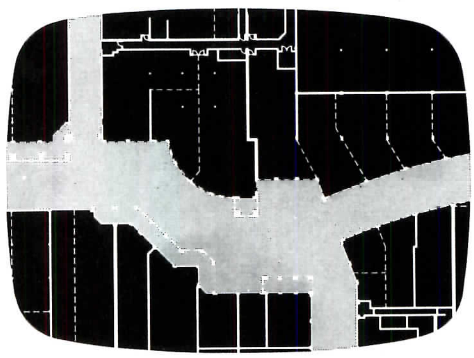

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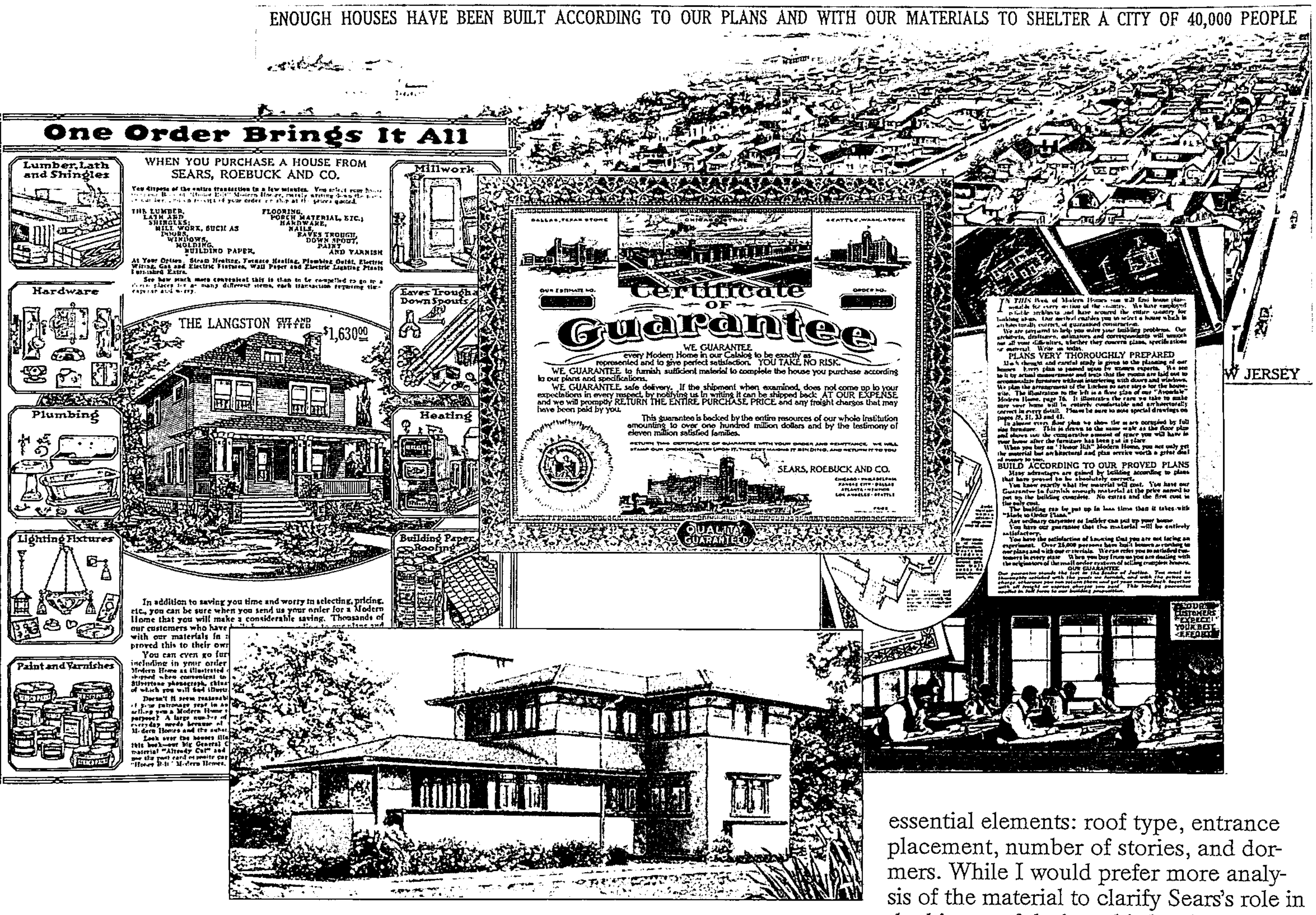
# BOOKS

## When Houses Could Be Ordered from the Sears Catalog




**Houses by Mail.** Katherine Cole Stevenson and H. Ward Jandl, eds. (Preservation Press, $24.95.)

This book has been in the making for some time, and it is a welcome addition to the growing literature on industrial vernacular architecture. This kind of vernacular represents the overwhelming majority of building in this country, and the system that produced structural and finish goods for Sears also produced churches, stores, warehouses, and light industry buildings for the rest of the country.

The book has two sections. The first begins with testimonials about the value of Sears houses and a brief essay on Sears's design, production, sales, and distribution systems. The second and larger portion reproduces specific pages from Sears catalogs, sorted into design types, and concludes with a brief bibliography and two indexes: styles (trade names) and catalog numbers for cross-referencing.

Sears sold precut houses from 1908 to 1940, producing about 15 houses in two grades—Honor Built (top quality) and Standard Built. The typical Sears house was a frame building with an easily recognized shape, with cladding materials and finishes that allowed the house to be absorbed into the general population of housing stock. In terms of design, Sears reflects safe, middle-class ideas about single-family housing within modest square footage.

The authors of *Houses by Mail* have attempted to sort housing types by a few essential elements: roof type, entrance placement, number of stories, and dormers. While I would prefer more analysis of the material to clarify Sears's role in the history of design, this book was conceived of as a primer. It is intended to motivate people to detect Sears buildings, and whether or not that activity produces a great inventory, it should enlarge the data base for this kind of vernacular. That could be significant, because this architecture, which is original to the U.S., is the least understood. If only some people identify Sears houses, and if the promotional activity for this book by the National Trust for Historic Preservation is successful, more people will learn something about the nature of their built environment, and that is a good thing.

—Herbert Gottfried

*Dr. Gottfried teaches architecture at the college of design at Iowa State University.*

*Books continued on page 112*

**The Secret Life of Buildings, An American Mythology for Modern Architecture.** Gavin Macrae-Gibson. (MIT Press, $25.)

*The Secret Life of Buildings* is at least two projects—the first an attempt to forge a critical method, "an American mythology," for interpreting modern architecture; the second an attempt to analyze seven buildings based on that method. The buildings are Frank Gehry's own house in Santa Monica, Calif., Peter Eisenman's House El Even Odd, Cesar Pelli's Four Leaf Towers in Houston, Michael Graves's Portland Building, Robert Stern's Bozzi Residence in East Hampton, N.Y., Allan Greenberg's Manchester Superior Court Building in Connecticut, and Venturi, Rauch & Scott Brown's Gordon Wu Hall at Princeton.

The title reflects a quasi-psychoanalytic undercurrent that runs through the text, surfacing at moments when the author claims to have penetrated "the deepest level of content in the buildings under consideration." Like the Freudian psychoanalyst, the author is interested in the "figure in the shadows," which is the figure of the self. At the end of the book, this figure stands in what the author calls "the secret city" with no place to hide, fully revealed as "ourselves," the subject of the author's storytelling.

Freud, unlike Gavin Macrae-Gibson, understood that "content" is an inexhaustible fabrication of the interpreters—patient and analyst. And Freud might also have said that the determination of a "deep layer of content" is especially tricky because the mechanism of repression tends to obscure the relation between layers of consciousness. In any case, Macrae-Gibson stops far short of the implications of the psychoanalytic model. He uses Freud (and others such as Ronald Barthes and Claude Lévi-Strauss) to validate a position that has little to do with the interpretive issues these thinkers brought to light.

The new method proposed by the author, called "lyric modernism," enacted through what Macrae-Gibson calls "poetic logic," supposedly debunks the utopian modernism that argued for a unified interpretive position—a *zeitgeist.* His goal is to expose the "secret life of buildings," which is "the embodiment in architectural form of mythological knowledge having the power to address the ambiguity and mystery of life." The project is interesting but it is hard to see how lyric modernism and poetic logic are any less utopian or impressionistic than *zeitgeist* thinking.

An example from Macrae-Gibson's text may illustrate this. At the beginning of his analysis of Gehry's house in California, Macrae-Gibson writes: "The Pacific Ocean is to Los Angeles what Europe is *to New York*. Perceived with the senses, it dissolves memories, just as Europe, perceived with the mind, creates them. The passing of time there does not confer upon history the same authority it has in other places, where it is treated with respect rather than with nostalgia. As a result, in Los Angeles the present instant has become a source of meanings that in other places would be supplied by history. This significance is registered through the senses, which bestow on perception the importance given elsewhere to memory. It is with the representation of this condition that Frank Gehry's own house in Santa Monica is concerned."

This kind of "logic" is baffling. Not only are there massive assumptions about history and some universalized concept of time, but Los Angeles turns out to be a stranger place than anyone imagined, a place where the "present" is somehow different from that in the rest of the country. There is, in addition, a whole series of specious distinctions. The opening analogy between the Pacific Ocean and Europe doesn't make any sense. Does everyone in New York perceive Europe with the "mind?" Is "New York" a euphemism for America? Does the author mean that Europe is not perceived with the senses? On what grounds are the senses separate from the mind?

In the epilogue to the main text, Macrae-Gibson gives a summary outline of his methodological intentions. He talks about three kinds of content: literal, representational, and mythological. Getting from the first to the third is the "deepening" gesture that he believes gives rise to the discovery of a building's "secret life." As the author says in his introduction, he starts with "objective reality" and culminates in the "unified expression of experience." In spite of Macrae-Gibson's trembling on the threshold of a radically new reading of architecture, he gets mired in the very swamp from which he is trying to escape—the swamp of science, modernist claims for unity, utopianism—by backpedaling into concepts such as "objective reality" and factual data. It is the old one-two-three world. First you have something "literal" (in the Gehry house, Macrae-Gibson sees this as the cross in plan), then you have the "representational" (the marine imagery of the house), then you have the "secret life" or mythological level (in the Gehry house this is supposedly "critique of centrality").

It seems that Macrae-Gibson undercuts his own best insights. The "critique of centrality" that he finds in the Gehry house, the "critique of monumentality" that he finds in the Portland building, and so on, are extremely important observations. They are not, however, one observation among many, as Macrae-Gibson seems to treat them.

If anything of importance has come out of recent critical theory, it is that critiques of centrality throw everything else—historical argumentation, impressionism, imagery, and metaphor—into jeopardy. These can no longer be pursued without a good deal of irony.

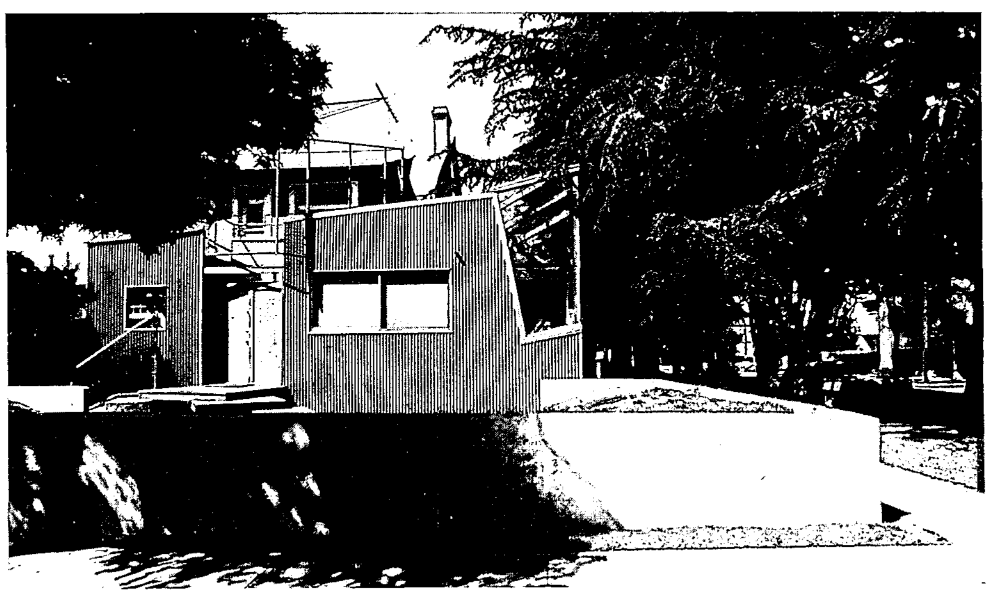
I have said very little about the other projects that Macrae-Gibson writes about, taking the Gehry house as a paradigm for his general inquiry. However, he does write extensively and often with more force about the other projects. And the conclusion of the book, with its reinsertion of the reader into the "city as a machine for thinking in," is a compelling concluding gesture. But the book as a whole is incomplete. It is as if the author went through a partial divestiture of conceptual baggage and stopped suddenly, inexplicably, in the middle of the process. And then turned back.

—Catherine Tobin Ingraham

*Dr. Ingraham is special projects director for Betrand Goldberg Associates in Chicago.*

**The New Atrium.** Michael J. Bednar, AIA. (McGraw-Hill, $37.50.)

This book delivers most of what it promises. "The intention," says Michael J. Bednar, AIA, "is to analyze a prevalent, architectural phenomenon, to reveal design principles, and to give technical aid to practicing architects and engineers." The



*Frank Gehry's own house in Santa Monica, Calif., winner of a 1980 AIA honor award.*

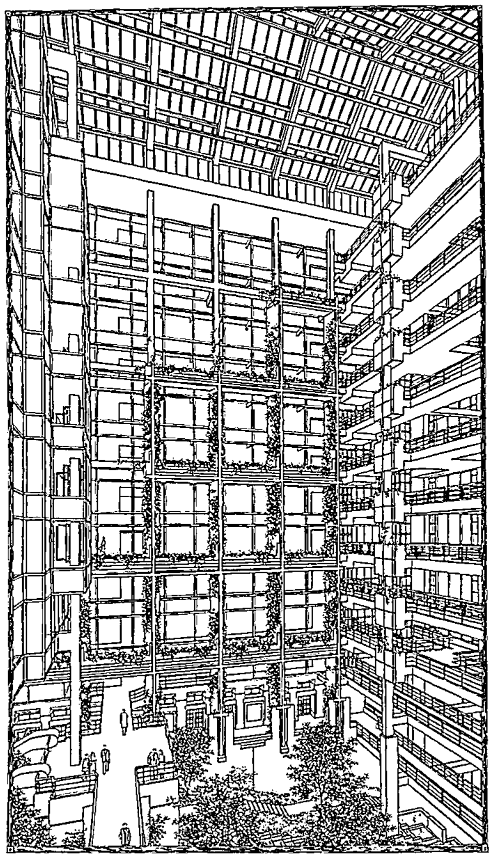
increasing prevalence of the latter-day atrium is undeniable. As Bednar points out, an atrium building has won a national AIA honor award in 18 out of the last 25 years.

But the atrium is an ancient design phenomenon. Thus the book begins appropriately by tracing the historical development of the atrium building type. Mesopotamian, Greek, and Roman houses lead eventually to Renaissance palazzos. Having defined an atrium as "a centroidal, interior, daylit space which organizes a building," Bednar further delimits its meaning in the 19th and 20th centuries, saying that the "new atrium" must be roofed. This clearly distinguishes it from ancient prototypes, with open courtyards, cortiles, or galleries. Accordingly, Sir Charles Barry's Reform Club in London, built in 1841 and modeled after the Palazzo Farnese, is cited as the first new atrium architectural precedent. It had a light-admitting, vaulted roof of metal and glass over its interior court.

Bednar divides the 19th and 20th centuries into three atrium "epochs"—the first, iron and glass in the early to mid-1800s; the second, turn-of-the-century; and the third, the last 20 years. Among "second epoch" examples cited are the Pension Building (1887) in Washington, D.C., Denver's Brown Palace (1892), and Frank Lloyd Wright's Larkin Building in Buffalo (1904).

Forty-seven "third epoch" projects are presented as design studies in part two. They are grouped by building type—office, institutional, and civic, housing and hotels, and retail and mixed use. Each set of building types, in turn, is organized by atrium type—closed, open, linear, multiple lateral, and partial. Many of the projects will be familiar to most readers: Hyatt Hotels pioneered by John Portman; New York City's Trump Tower, Citicorp Center, and Ford Foundation building; and the National Gallery of Art east building, Intelsat, and the Old Post Office in Washington, D.C. Chapters in part one refer periodically to projects described in part two, each of which includes its own analysis and commentary, along with photos, plans, and sections.

There is a chapter on urban design in part one that discusses atrium spaces within city fabrics as places of destination, orientation, passage and connection, commerce, and recreation. It points out how atria can be mediating spatial junctions between old and new, facilitators of historic preservation. A section on design analysis attempts to define atrium spatial and programmatic types and considers (always favorably) the economics of atrium buildings in comparison with conventional building types. Incontrovertible design guidelines, such as "make the design address the context" and "use furnishings to enhance the space," conclude this chapter. The last two chapters, on energy and detailed design, qualitatively



*Above, atrium rendering of the Hercules Plaza in Wilmington, Del., by Kohn Pedersen Fox Associates.*

cover daylighting (but not electrical lighting), heating and cooling, solar control, ventilation, fire safety, vertical transportation, glazing, finishes, and the use of art, water, and plants.

This book is easy to read. Bednar writes clearly, and the publisher has formatted the volume well by placing illustrations next to related text. Referring to the design studies in part two while reading part one is reasonably convenient. Black-and-white photos, drawings, and diagrams are informative, but they don't always show everything the reader might want to see. This is partly due to the nature of the subject—have you ever tried to photograph an atrium? But sometimes, essential documentation is missing. For example, in design study 26, John Portman's 1974 Hyatt Regency Hotel in San Francisco, Bednar talks emphatically about the project's relationship to the Embarcadero context and the city's street patterns, stating that "the form of the building is a direct response to these site conditions." Yet no site or vicinity plan is included.

Bednar may have had to rely too much on directly reproducing material supplied by project architects. Not all drawings include graphic scales. Some plans, filled with patterns of furniture, plants, floor textures, and structures, have been shrunk to the point where they are difficult to read and interpret. Nevertheless, most of the drawings adequately communicate project concepts.

The author commendably seeks to be comprehensive, pitching both to architects looking for theoretical discourse and to those concerned with building execution. To that end, he roams freely between pragmatic and esthetic issues, attempting to merge objective description with subjective judgments. The former, however, is more convincing than the latter. Indeed, the book suffers periodically because of brief critical comments gratuitously embedded in otherwise descriptive text.

Instead of advocating atria so affirmatively, perhaps Bednar could have offered more critical substance. Readers can't help but get the impression that every "third epoch" atrium building is an overwhelming, "successful" design. Surely, some are worthy of question from urbanistic, technical, functional, economic, psychological, or esthetic points of view. Is an atrium always an appropriate formal gesture, notwithstanding its well-understood attributes within a building?

The book's rigor and profundity vary widely. The discussion of atrium plants and garden design ranges from handbook-like detail to trivial or painfully obvious generalizations—"some plants will die, others will suffer a lack of growth." One senses that other topics—economics, urban design, historic preservation—also are treated a bit too superficially. And while mentioning the nearly two-thirds of a century dormancy in creating atrium buildings. Bednar never fully explores the hiatus. He notes with resignation that "the reasons for the atrium's demise at the beginning of the 20th century are uncertain." After that sentence, one wonders about it through the rest of the book.

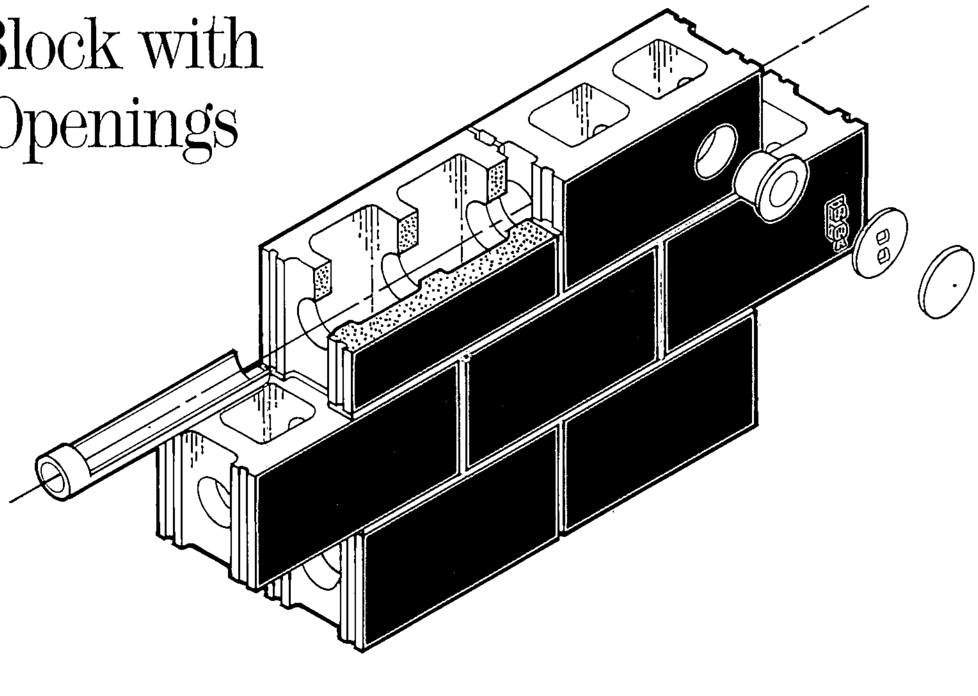
Despite its flaws, *The New Atrium* is lucid and thoughtfully compiled, written to be useful without being tedious, pedantic, or encyclopedic. Coupled with Richard Saxon's more technical book, *Atrium Buildings,* which Bednar frequently cites, it can add much to an architect's understanding of this ubiquitous building type and its evolution—Roger K. Lewis, FAIA

*Mr. Lewis writes about architecture in the* Washington Post. *A collection of his articles,* Shaping the City, *is available through the AIA Press.*

**Dictionary of Architectural and Building Technology.** Henry J. Cowan, and Peter R. Smith (Elsevier Applied Science Publishers, $29.50.)

This dictionary contains more than 5,000 entries compiled from more than 200 standard textbooks in architecture and structural engineering. Key areas covered in the dictionary include: building construction, architectural detailing, structural design, active and passive solar energy, electrical and mechanical services, building management practices, and architectural computing. The definitions, arranged in alphabetical order, are supplemented by illustrations, charts, and explanations of the symbols used throughout. □

## Coming: Concrete Block with Biaxial, Horizontal Openings



A new manufacturing process for concrete masonry units (CMU) developed by the National Concrete Masonry Association (NCMA) promises to revolutionize the CMU market.

A block with biaxial, horizontal openings should be generally available by the end of 1987. Biaxial (Bi-X) block creates a network of vertical and horizontal cavities within walls, resolving the problem of utility integration inherent in typical hollow-unit masonry. Modular grids of access created by the biaxial openings allow integration of electrical power, data communications wiring, plumbing, acoustical inserts, thermal ventilation, and more.

In the case of electrical integration, the block can be used like a utility course. A closed-cell rubber or flexible PVC wire trough with a lengthwise slit at the top accommodates the wiring.

Multiuse inserts fit into Bi-X block openings to hold partitions or wall-mounted objects. Multiuse inserts can also be used for electrical, plumbing, hardware, or general access cover plates. Steel rods placed within the wall provide additional support for wall-mounted elements, if necessary.

All Bi-X block courses can be accessed on every floor, so the integrally insulated block can be used to distribute air vertically and horizontally. For instance, by connecting a roof cavity to parapet-wall vents, the Bi-X block collects hot air and distributes it through the cores to the outside. Typical flashing and stone coping details protect against water penetration. Acoustical insert possibilities are numerous. Used as an acoustical wall, the block could have a fabric-faced acoustical insert or any number of surface treatments. Fire and smoke barriers are applied to the biaxial openings as with any fire barrier penetration.

A broad range of esthetic possibilities is available with the Bi-X block, since the exposed Bi-X access openings can be used for space differentiation, to articulate particular areas, or to support facing materials like wood, stone, or glass.

The block's openings facilitate construction by providing hand holds for the masons. Although Bi-X blocks are lighter than standard CMUs, their compressive strength is decreased little if at all, according to NCMA tests, because the holes are configured to act like the openings of arches.—Douglas Gordon
*The National Concrete Masonry Association*
*Circle 261 on information card*

Products *is written by Amy Gray Light*

## ROOFING

Releases on roofing products outnumber all others this magazine receives by a ratio of two to one. The following are some of the more innovative roofing products developed recently, starting with insulation.

**Roof Insulation Products**
A line of roof insulation products from ARCO consists of cellular polystyrene factory-bonded to fire-resistant inorganic chemical board. ARCOR FM-1 insulation is a Factory Mutual Class I board bonded on both sides for use with asphalt built-up roofing (BUR), modified bitumen, and single-ply membrane systems. ARCOR SP insulation is bonded on the bottom for direct application to metal decks and for use in loosely laid ballasted single-ply systems. This insulation board is also recommended for double-layer applications. ARCOR MB insulation is a top-side bonded board that can be applied over structural concrete, wood, or existing roof systems. Compatible with asphalt BUR systems, it can also be used with loose-laid, mechanically fastened, or modified bitumen single-ply systems. The products are available in flat stock form or factory tapered to provide roof drainage.

Carlisle's rigid, lightweight Sure-Seal EPS insulation boards made of expanded polystyrene are designed to be easy to cut and shape. A high compression strength enables them to withstand foot traffic and the weight of stone ballasts. Tapered systems are available.

A plastic "locking" plate by Cooley protects roofing membranes from damage and is said to eliminate the potential for fastener backout and membrane rupture. The plate locks the head of the fastener into place on the plate with an audible "pop," indicating the fastener is sufficiently driven. The plate and fastener will continue to remain above the insulation in a single unit should the insulation material deteriorate or lose thickness. The plate's three-inch surface helps prevent immediate damage and allows for detection and repair before a leak forms. Constructed of a polyethylene material, the plates meet or exceed Factory Mutual corrosion-resistance standards.

Although not strictly a roofing insulation but rather an ice and water barrier, the Weather Watch by GAF protects roofs against the potential hazards caused by
*continued on page 116*

**Products** *from page 115*
heavy snowstorms that melt and cause ice and water damage. The polymer-modified asphaltic barrier is installed during new roof construction or reroofing between the roof deck and shingles or other roof coverings. The material has a self-adhesive backing that bonds to the roof deck. It can also be installed on all trouble-spots.

The Icebreaker, marketed by Teltex, is a flexible waterproofing membrane made of white polymer sheeting and rubberized asphalt. When installed under shingles, shakes, tile, and metal roofing, the membrane prevents water back-up from ice dams and leak damage caused by wind-blown rain. The waterproofing underlayment doubles as an air infiltration barrier around doors and windows, as wall waterproofing for steel stud construction, and as a vapor barrier for roofs, walls, and floors. The Icebreaker has a self-adhesive backing that provides a positive seal around roofing nails and penetrations. The reflective white film helps maintain adhesion by reducing the membrane ambient temperature. It is said to be unaffected by cracking, rot, or dessication and to be bacteria- and fungus-proof.
*ARCO Chemical Company*
*Circle 241 on information card*
*Carlisle SynTec Systems*
*Circle 242 on information card*
*Cooley Roofing Systems Inc.*
*Circle 243 on information card*
*GAF Building Materials Corporation*
*Circle 244 on information card*
*Teltex Inc.*
*Circle 245 on information card*

**Rooftop Cooling Systems**
The main system requirements and features of the Sprinkool system are that the system mists the roof evenly and completely; the amount of water remains limited so that the evaporation rate is not exceeded; the rate of evaporation remains consistently dependent on the ambient temperature, roof surface temperature, and the relative outdoor humidity; and the maintenance of the system remains limited to spring start-up and winter drainage.

The Sprinkool system uses a programmable logic controller with roof temperature, moisture, wind velocity, water pressure, humidity, and ambient air temperature sensors. The controller monitors the periodic misting of the roof and also controls the building's ventilation system. The spray heads adjust to the size, type, layout, varying conditions, and slope of a roof, with 16 different delivery rates and patterns available to provide flexibility.

Refinements to the system in the form of polymer nonclogging spray heads and the implementation of intelligent controls are designed to permit roof cooling with extended maintenance-free periods.

Rainmaker roof cooling systems are designed to relieve 80 percent of the heat gain through sunlit roofs by evaporation of a fine film of water misted onto the roof surface. The Rainmaker uses an estimated 0.1 gallons of water per square foot a day. A controller programs variables such as cycle time and spray intervals. Each zone may be shut down individually without shutting down the entire system. Dual programs with overlap averaging allow maximum efficiency with a minimum amount of water. Sprinkler spray heads have self-cleaning nozzles and are protected by an internal 100 mesh filter screen. The system can be retrofitted to any roof or slope without penetrating the roof membrane. Both systems operate with city water pressure or clean process waste water.
*Sprinkool Systems Inc.*
*Circle 246 on information card*
*Rainmaker Cooling Inc.*
*Circle 247 on information card*

**Thatched Roofs and Shingle Systems**
C & H Roofing creates wood shingle thatched roofs using prefabricated framing components and prebent shingles. The firm offers a product catalog and roofing and framing manual.

To complement wood roofs, three-course cedar shingle siding panels from Cedar Valley Shingle Systems are available in regular or rough-sawn textures in either straight or staggered butt line. The siding is a panel sandwich of individual shingles, glass fiber building paper, and APA-rated exposure-1 sheathing plywood.
*C & H Roofing Inc.*
*Circle 251 on information card*
*Cedar Valley Shingle Systems*
*Circle 252 on information card*

**Membrane Anchors and Fastening Strips**
Carlisle Sure-Seal membrane anchors used in Carlisle's roofing system attach without penetrating the membrane surface. Consisting of a black base plate, a threaded white retainer, and a threaded black cap, the base plates are secured to the insulation and the roof deck with fasteners; then the membrane is laid over the base plates. The white retainer hinges under one side of each base plate knob and closes over the knob and membrane. A bead of lap sealant is applied to the base of the black cap, which is then pressed onto the white retainer and hand-tightened.

Sure-Seal RFS-3 rubber fastening strips are used for securing horizontal and vertical roof perimeters. The strips are mechanically fastened through the insulation and the roof deck; fastening heads are set flush with the fastening strip surface. The RFS-3 strips conform to building walls, regardless of whether they are perfectly straight, and are designed to be waterproof. They come in 500-foot packages comprising 50 10-foot lengths.

The Omega stainless steel fastener for mechanical attachment of the membrane and roof insulation by Cooley Roofing Systems combines the corrosion resistance of stainless steel with self-drilling features. The nonmagnetic fastener has a fused, carbon steel drill point capable of drilling steel decks as heavy as 18-gauge in either reroofing or new construction applications. Approved by Factory Mutual for use in both wood and steel deck applications, the Omega fastener can be used with various CRSI stress distribution plates.

Pure 18-8 type stainless steel fasteners from J.P. Stevens are a primary element in the company's Hi-Tuff Plus mechanically attached roofing systems. Designed to be corrosion resistant, the fasteners feature a specially welded carbon-tip drill point that will penetrate steel roof decks.
*Carlisle SynTech Systems*
*Circle 248 on information card*
*Cooley Roofing Systems Inc.*
*Circle 249 on information card*
*J.P. Stevens & Company*
*Circle 250 on information card*

**Roofing Guides**
The "Wind Uplift Resistance" brochure from J.P. Stevens & Co. details the wind-uplift resistance of the Hi-Tuff single-ply roofing system, a white, mechanically attached, single-ply system designed to resist tears, punctures, and high winds. The guide provides wind velocity diagrams, rating charts, photographs, and technical information. It also examines the wind-resistance characteristics of various kinds of single-ply systems, including ballasted, fully adhered, and mechanically attached systems.

A Sarnafil Inc. brochure explains how the firm's roof management plan is set up. The plan is designed to set up preventive measures and offers a systematic approach to reroofing, roof maintenance and repair through use of a roofing inventory, and a master schedule of overall roofing activity. When necessary, Sarnafil will provide a formal proposal covering reroofing recommendations and budget estimates.
*J.P. Stevens & Company*
*Circle 253 on information card*
*Sarnafil Inc.*
*Circle 254 on information card*

**Elastomeric Closure System**
Expand-O-Gard is an elastomeric closure system that is typically installed after joints have been formed. It is designed to weatherproof vertical abutment joints between adjacent buildings and expansion joints in building facades.

Expand-O-Gard is used for abutment joints that are very large or where there is differential sway between structures. It is used in facade joints where movement is excessive in relation to joint size, or where movement is multidirectional, as in curtain walls. Seismic joints, which may have all the above conditions, are also a suitable application.

*continued on page 118*

**Products** *from page 116*

The standard product offers four-, six-, eight-, and 10-inch-wide neoprene bellows, which are cured and calendered to 60-mil thicknesses. Flanges of .018 stainless steel bent to double thickness in 10-foot by four-inch lengths are attached to both sides of the neoprene bellows with adhesives and by a continuous metal edge crimp. The flanges are prepunched with ¼-inch-diameter holes 12 inches on center to facilitate fastening to a building structure or other substrate.
*Manville*
*Circle 255 on information card*

**Copper Roofing**
ASC Pacific, a manufacturer of steel building products, offers a roll-formed copper in standing seam or batten profiles. Available in 16-ounce half-pure copper in a smooth or textured surface, the panels can be used for vertical or inclined applications down to 3:12 slope and are flexible for hip, mansard, and soffit conditions. Several paint finishes are offered, including a metalescent fluorocarbon called New Penny Copper and an acrylic copper system, Thermo Aging Copper, which changes color as it ages. The aging coloration or "patina" process can be accelerated by applying an acid bath.
*ASC Pacific Inc.*
*Circle 256 on information card*

**Infrared Heat Scanners**
Two technically advanced hand-held infrared heat scanners are available from Prospect Technologies. The Roof-TK Fire-Scanner minimizes the fire hazard associated with torch-applied modified bitumen membranes by detecting temperature variations in roof deck areas caused by smoldering combustion in the roof deck, insulation, penetrations, perimeters, and other roofing detail areas. When the pocket-sized portable unit, which is used much like a flashlight, detects a "hot spot" with its beam it emits an audible alarm if the temperature rise is greater than 25 degrees Fahrenheit over a previously established deck reference temperature. The increase in infrared heat radiation is shown on a three-color LED display scale.

Bitumen temperatures for BUR and modified bitumen systems can be monitored at the point of application with the Roof-TK Bitumen Temp Scanner. The Temp Scanner's infrared thermometer provides instant job-site temperature readings at the kettle, mop bucket, and point of application on a digital display screen when the unit is held close to the area in question. The Bitumen Temp Scanner is said to be accurate to within two degrees Fahrenheit within a range of 10 degrees Fahrenheit to 550 degrees Fahrenheit. Both scanning units come equipped with a belt carrying pouch and operate on standard nine-volt alkaline batteries.
*Prospect Technologies Inc.*
*Circle 258 on information card*

**Single-Ply Roofing Membrane**
Versigard HP-75, a 75-mil-thick, single-ply synthetic rubber roofing membrane introduced in March, is designed to be fully adhered to a hard insulation laminate and compounded to provide greater resistance to aging. The membrane reputedly has an ideal level of expansion and contraction to compensate for the movement of buildings during thermal changes. The nonballasted, fully adhered system is designed to provide maximum wind uplift resistance, and minimum deck and structural loading. The HP-75 system also contains a compounded fire retardant for additional safety. The system is sold for new construction or where old roofing and insulation is being completely removed. The system includes a vinyl sheet vapor barrier to be installed over clean decking so that the insulation remains protected. The Versigard system is available in black or white, comes in 100-foot rolls, 12 feet wide, and is backed by a 20-year warranty.
*Goodyear*
*Circle 259 on information card*

**Roof Drains and Expansion Couplings**
Carlisle's Sure-Seal roof drains are made of PVC and lightweight plastic. The drains are designed to resist rust and corrosion and to be compatible with any piping system and adaptable to all types of roof construction. A raised dome provides protection against clogging.

Expansion couplings are designed to connect the roof drains with various types of piping systems. Each coupling comes with two clamping rings.
*Carlisle SynTec Systems*
*Circle 260 on information card*

**Asbestos-Free Cement Siding**
Rigid, fiber-reinforced cement slates for roofing are designed to be noncombustible and contain no asbestos. The blue-black roofing slates can also be used for fascias, mansards, and facades, and are available in either a smooth or textured finish. They are appropriate for new construction as well as for remodeling. A color brochure is available.
*Eternit Inc.*
*Circle 257 on information card*

## NEW AND NOTEWORTHY

**Lead-Rubber Bearings for Seismic Design**
One solution to the problem of designing in earthquake-prone areas is to use the base isolation concept, which permits a building or a bridge structure to be substantially decoupled from the ground so that earthquake-induced ground motion is significantly dissipated before being transmitted to the structure. Flexibility, wind resistance, and energy dissipation are built into a bearing unit, composed of a lead plug and alternate layers of rubber and steel and encased in a vulcanized rubber cover.

The lead plug, which fits into the center of the unit, provides wind resistance and seismic damping. It allows a building to displace approximately three to six inches at the unit during an earthquake and then to reposition after the stresses are removed. The rubber bearings reputedly can reduce the seismic forces acting on a structure by factors of five to 10. Because they remain elastic for wind loads, additional mechanisms for wind resistance are not necessary.

Lead-rubber bearings range in standard size from six to 36 inches square; other sizes and shapes are available. They are placed as column bases, or at the top of bridge piers, and can be designed into new and retrofit structures.

The company has developed preliminary design procedures for its system and will assess the most practical and economical solution for a particular project.
*Dynamic Isolation Systems Inc.*
*Circle 262 on information card*

**Pipe Deicer**
"No-Freeze" drain pipe deicer works without electricity to keep drainpipes from becoming ice-clogged. The "No-Freeze" deicer is constructed of a brass canister filled with ice-melting crystals and has adjustable legs that fit into the top of any drainpipe. The unit is harmless to shrubbery, flowers, and grass and comes with a money-back guarantee.
*Aeroil Products*
*Circle 263 on information card*

**Elastomeric Waterproof Sheeting**
Londeck PVC vinyl sheeting is a lightweight, sound-absorbing, waterproof covering for outdoor walking decks and balconies, as well as a complete single-sheet roof covering system. Designed for resistance to foot traffic, the effects of sun and water, and industrial chemicals, the sheeting can be installed on plywood, concrete, metal, or magnesite substrates.

The three-layer laminated PVC sheeting has a center layer designed for maximum elongation properties and a bottom layer molded to a backing cloth that provides stabilization and additional strength while increasing the surface area of the sheet and the bonding strength of the adhesive.

The vinyl sheeting is manufactured in 57- and 72-inch widths, in rolls 60 feet long, and sheeting comes in five stock colors.

*Lonseal*
*Circle 264 on information card*

**Wooden Art Cabinets**
Cabinets fabricated of quality birch or oak plywood and finished in a medium walnut stain have a Formica top in wood grain, white, or gray. The Formica top permits the cabinet also to be used as a worktable.

The cabinets are designed to store standard 30x40-inch artboards, flats, blueline paper, and similar materials. Dimensions of the standard cabinet are 40 inches high, 45 inches wide, and 33½ inches deep. An open storage area, 42½ inches wide by 9½ inches high, is provided at the bottom of the cabinet. Custom cabinet sizes are also available.

*Brian's Custom Woodworks*
*Circle 265 on information card*

**Windows With High-Performance Glazings**
Low-emissivity glazings in a variety of shapes and sizes such as squares, rectangles, right-angle triangles, and trapezoids are available with high performance, and high-performance insulating glass.

Flexiframe windows can be ordered in any size up to 72x96 inches. Wood subframes are clad with reinforced engineered plastic; the inside facing is of natural wood. Units are available in white or earth tones to match the manufacturer's Perma-Shield line for double-hung, casement, awning, and picture windows, roof windows, and patio doors.

*Andersen Windows*
*Circle 266 on information card*

## CREDITS

**Treaster/Gray House, Tesuque, N.M.** (page 34). *Architect: Antoine Predock Architect, Albuquerque.* Mechancial engineer: Don Felts. General contractor: Blue Raven Construction Works.

**Door County Vacation House, Door County, Wis.** (page 40). *Architect: Hammond Beeby & Babka, Chicago.* Principal-in-charge: John Syvertsen, AIA. Project architect: Jonathan Levi. Structural engineer: Gullaksen, Betty & White. Mechanical and electrical engineer: Chicago Design Consultants. General contractor: The Highland Group.

**Weitzman Residence, Annapolis, Md.** (page 44). *Architect: Bohlin Powell Larkin Cywinski, Wilkes Barre, Pa.* Structural engineer: Utility Engineers. Mechanical and electrical engineer: P.L. Frank. Landscape architect: John P. Gutting. General contractor: Berliner Construction. Interior designer: Anthony Childs and Bohlin Powell Larkin Cywinski.

**Fire Meadow at Cook's Branch, Montgomery County, Tex.** (page 48). *Architect: Clovis Heimsath Architects, Austin, Tex.* Structural engineer: Michael G. Huffman. Mechanical and electrical engineer: Shrader Engineering Co. Landscape architect: Clovis Heimsath Architects. General contractor: Crest Construction.

**Hoagie House, Washington, D.C.** (page 52). *Architect: Jersey Devil (J. Adamson, S. Badanes, J. Ringel, G. Torchio), Stockton, N.J.* Structural engineer: Advanced Engineers. Mechanical engineer: Brian Ford. Electrical engineer: Jim Adamson. Landscape architect: Gay Crowther, Ed Bisese. General contractor: Jersey Devil.

**Studio House, Woodstock, N.Y.** (page 64). *Architect: R.M. Kliment & Frances Halsband Architects, New York City.* Project team: R.M. Kliment, FAIA; Frances Halsband, FAIA; Mark Wright, AIA. Delineator: Allan Jim. Landscape architect; Luis Villa/Lois Sherr Associated. Structural engineer: Robert Silman Associates. Contractor: Adam Schwartz & Co. Landscape contractor: M. Ross Landscaping & Tree Service. ☐

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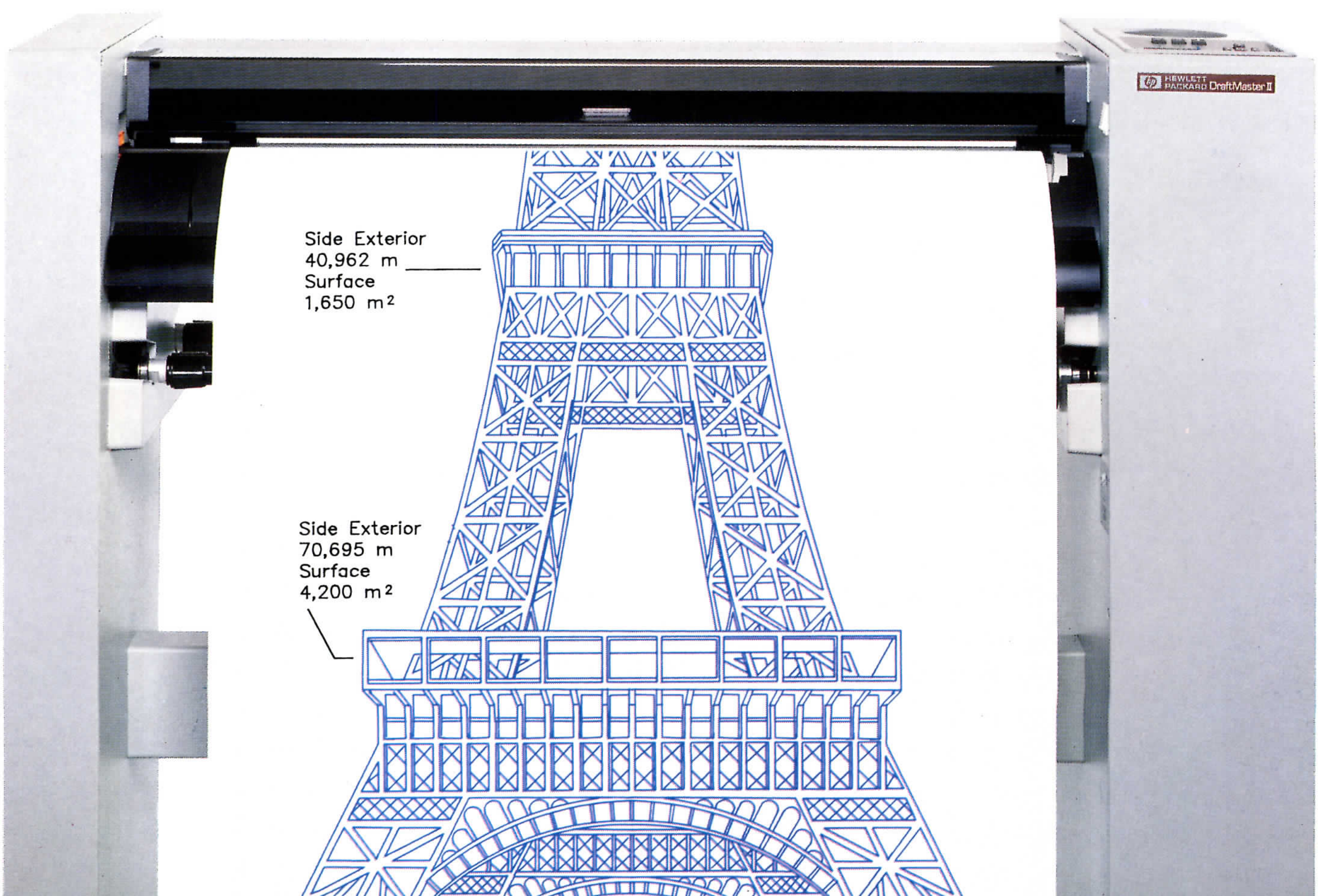
Circle 36 on information card

# How to create monumental plots in a matter of minutes.



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# Six major reasons to specify Sloan...

# the first time.

At first glance, it's difficult to imagine how these six different buildings are related. But if you take a closer look at their histories, you'll find they all share a common theme: the washrooms in all six buildings have been refitted with Sloan flushometers.

True, these buildings don't look old enough to need major plumbing repairs. But the fact is, the original flushometers that were installed just didn't hold up. Even after repeated servicing, they continued to malfunction. They didn't shut off properly. They leaked at the stops. In some cases, they even flooded the washrooms. In short, they weren't Sloan flushometers.

Unlike substitutes, Sloan flushometers offer proven, reliable service. With built-in quality at an affordable price. That's why today more buildings are equipped with Sloan flushometers than with any other brand.

Only Sloan's rugged, tamper-proof design can assure the quiet, dependable operation so critical in buildings like these. Plus, Sloan flushometers are built to last for years with only minimal, routine maintenance—an important consideration for specifiers who value time and money.

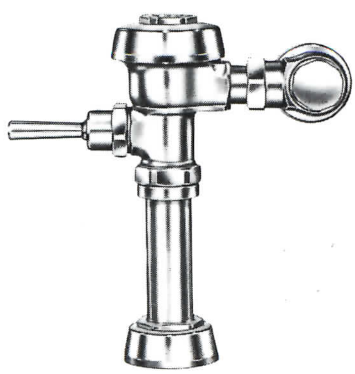
The next time you consider specifying a substitute, think about these six buildings. Then specify Sloan. The first time.

4

5

6

**1.** Psychiatric Center of Michigan Hospital, New Baltimore, MI **2.** YMCA of Raleigh, NC
**3.** Barnett Bank, Tampa, FL **4.** S.E. Louisiana University School of Nursing, Baton Rouge, LA
**5.** Southwest Financial Plaza, Phoenix, AZ **6.** North Central High School, Spokane, WA



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