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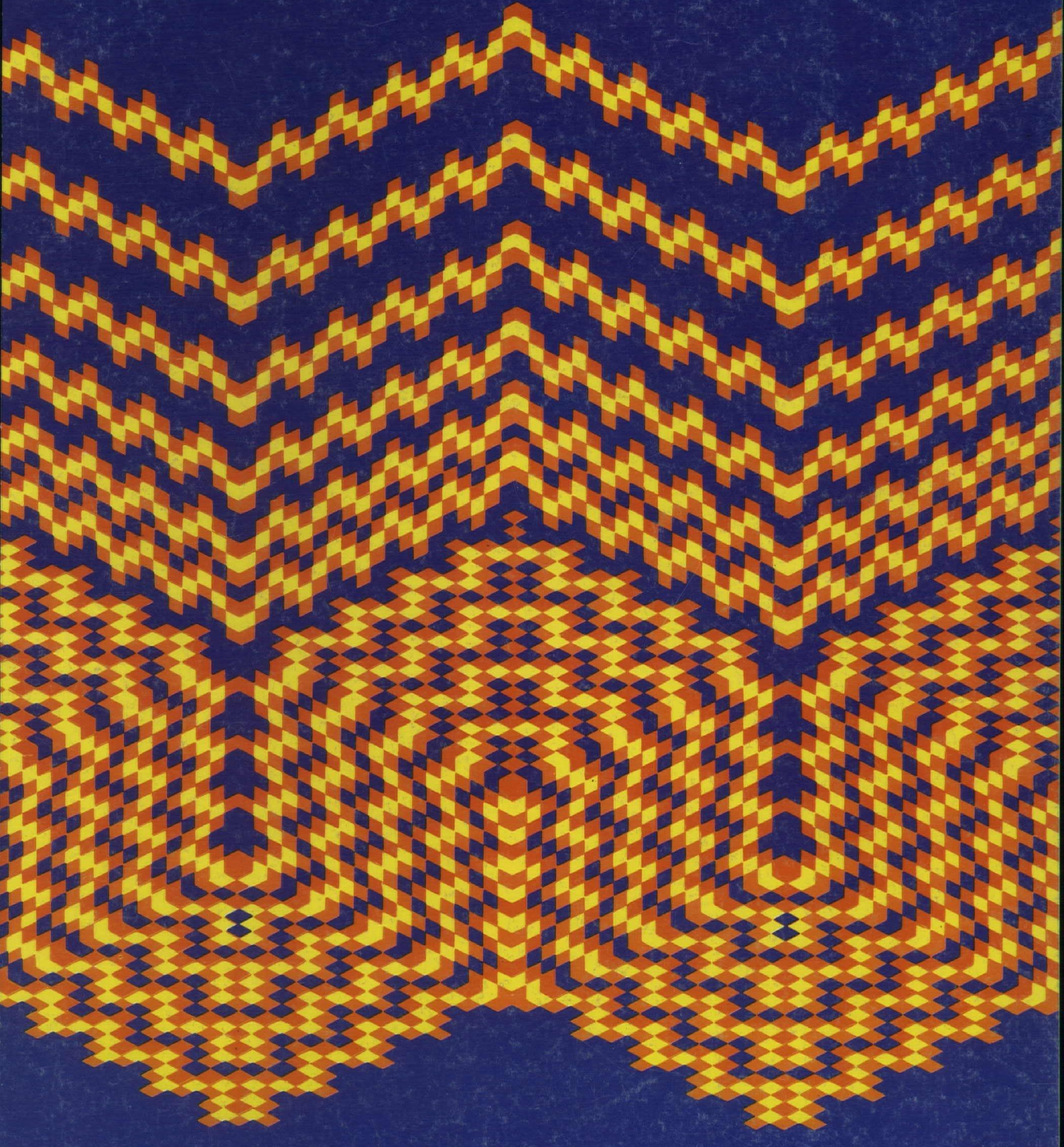
April 1982



Energy-conscious design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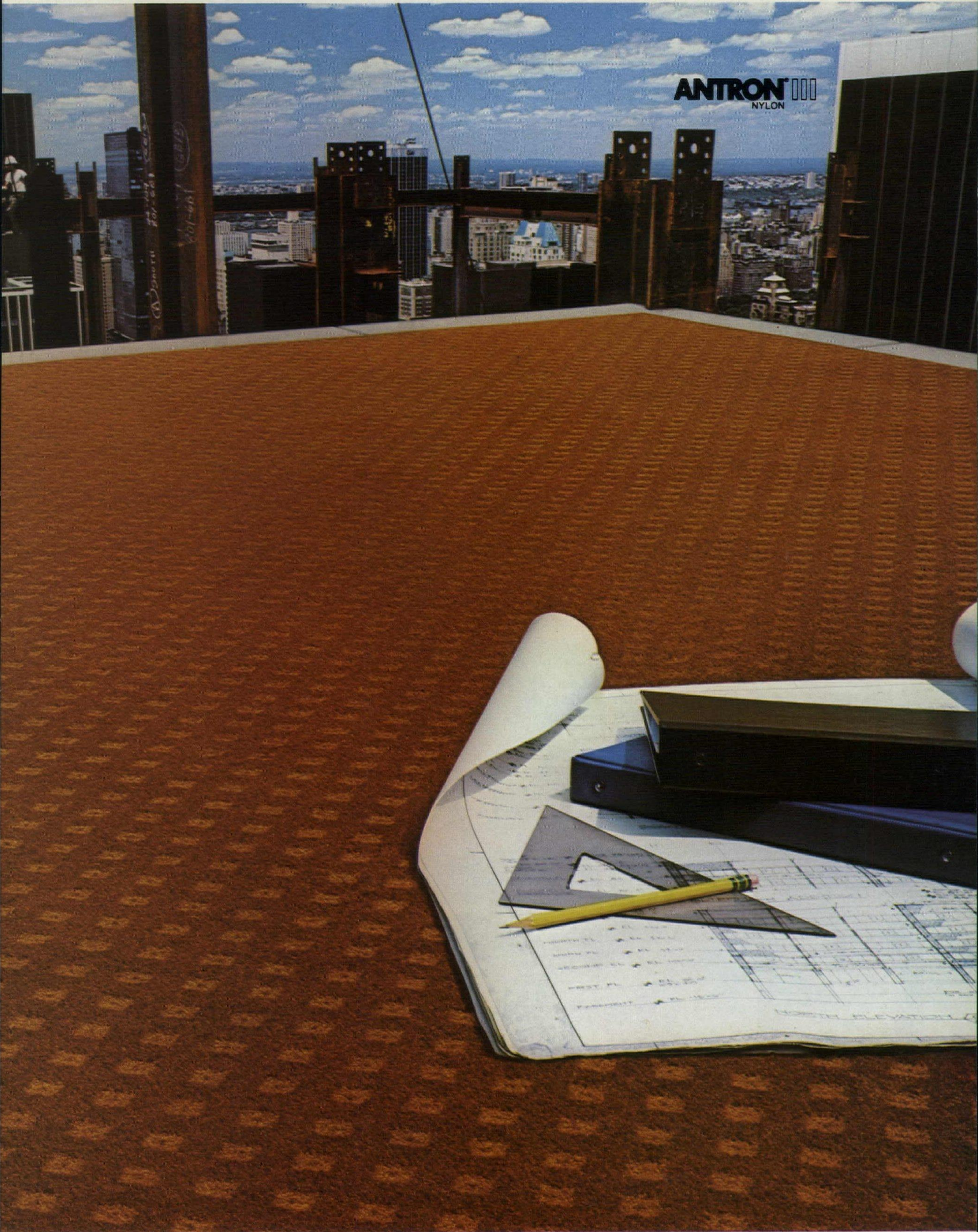
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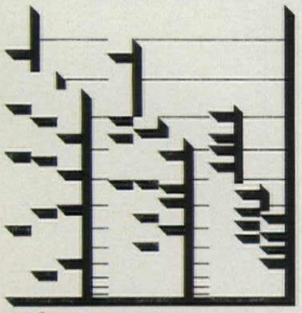
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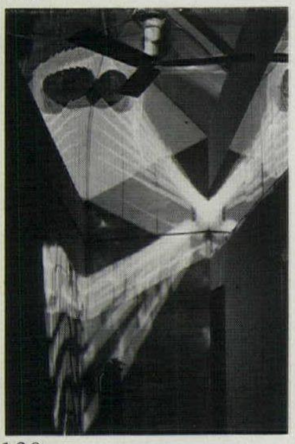
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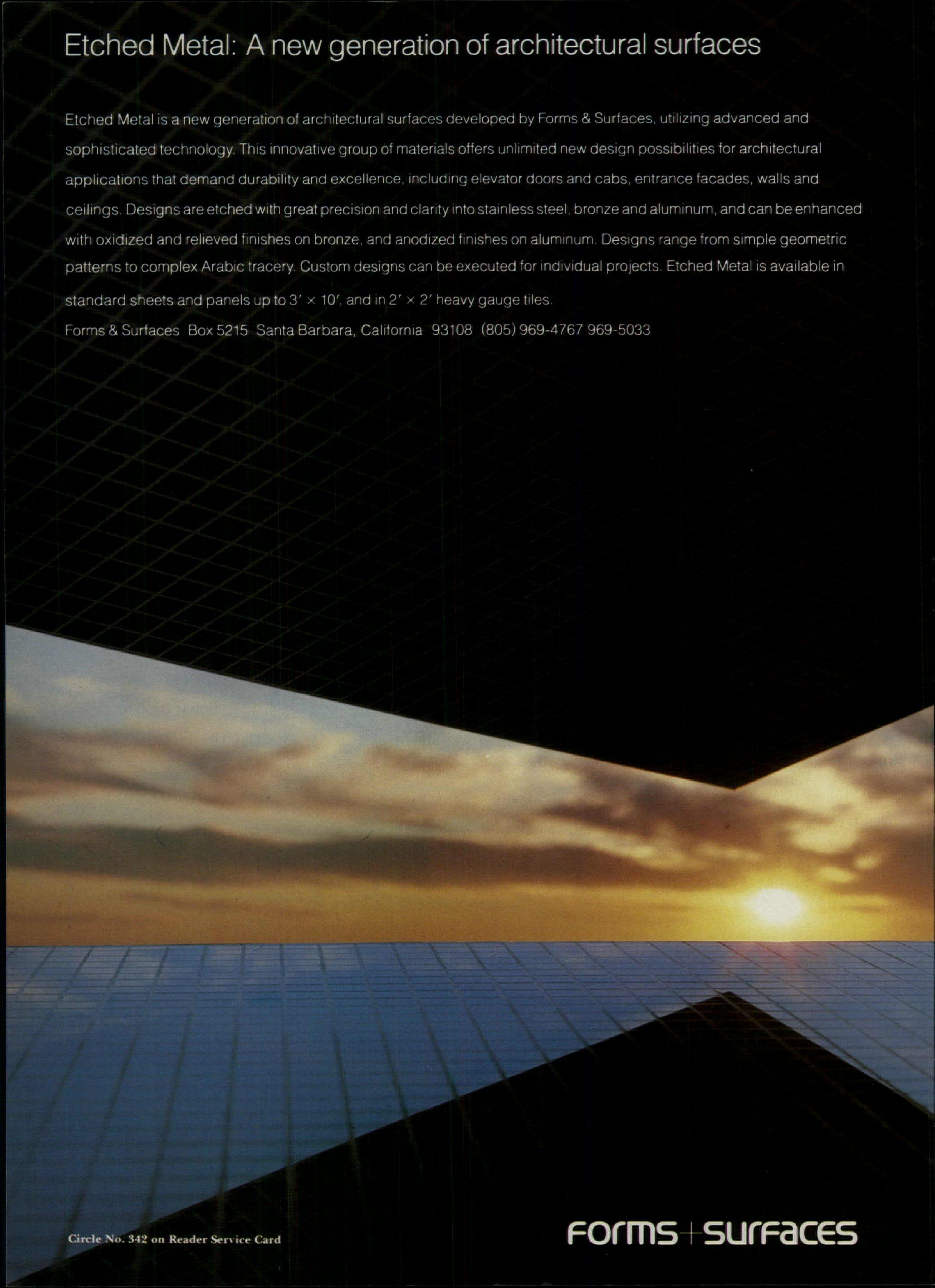
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Editorial

Energy design on our own

As the profession's skill at energy-conscious design becomes more dependable, the government support that has nurtured it is being withdrawn. Can the private sector maintain progress?

As we planned this issue, a major theme developed, and a minor one emerged as well. The principal message, summed up by senior editor Richard Rush in the title "Energy Design with Confidence," is that we can now draw upon a substantial body of accepted knowledge and real experience relating to energy-conscious design at all scales of building. The minor theme—covered succinctly in an article by Thomas Vonier (pp. 106–109)—is that we will have to sustain this newly gained confidence through a period of federal withdrawal from the field; the building design professions and their clients are going to have to get along with virtually no government grants and—more critically—hardly any government-sponsored research or dissemination of information on energy-conscious design.

This federal retreat from involvement with energy-conscious design is, as you all know quite well, part of a broad and deliberate reduction of federal involvement in numerous areas of concern to architectural professionals: barrier-free access for the handicapped; occupational safety and health; conservation of natural sites and architectural landmarks; control of air and water pollution; support of public transportation; adequate housing, education, and employment opportunities for the disadvantaged; support of educational and cultural institutions generally; equal rights for women.

The justification for abandoning previous federal commitments in all of these areas is that excessive regulation has hobbled the American economy, and done so at inordinate public expense. There is surely a basis for believing this: architects will readily verify that federal regulation and federal largesse can both involve nightmares of paperwork and bureaucratic delay. The taxes to support a bloated bureaucracy have become an economic burden, and the jerry-built structure of tax law has distorted much private economic policy.

To some of us, however, federal regulations and the costs of federal progress seem to have taken too much of the blame for economic reversals that can be traced to a variety of concurrent causes: a drastic increase in the actual cost of energy; an almost-as-drastic shift in the cost and availability of land; keener than ever industrial competition from abroad; sharp drops in consumer spending projections related to lowered birth rate and deceleration of our standards of living. And the burden of bureaucratic inefficiency has turned up in the private sector, as well.

In any event, many of the areas of public concern now being deserted by the federal government cannot and will not be shouldered by private enterprise—or by organizations of industries or professions, however well-intentioned. How can we expect such serious public concerns as barrier-free access, minority opportunities, or energy conservation to be taken care of by unfettered market forces? In the area of energy use in buildings—the primary concern of this issue—there are considerations of the nation's long-term economic welfare and, as Vonier mentions, its very *security*—that simply will never be accounted for in the marketplace.

Private interests will, of course, keep trying. Companies such as OCF and industry groups such as the Brick Institute will continue to encourage and reward energy-conscious building design. Professional firms will develop their energy expertise to gain a competitive edge, and the AIA will sustain the efforts of its Energy Committee; other professional groups will continue to address the problem, and it is hoped that AIA will collaborate effectively with them. Professional organizations, which can identify key research and information needs, may be able to find private resources to cover some of them.

The expertise generated during DOE's initial burst of activity survives; the beneficiaries of its grants will bring increased knowledge to the design task; refugees from the DOE staff will take their knowledge into private practice, industry, and education. But there will be no comparable corps of experts at DOE accessible to the press, the professions, and our legislators.

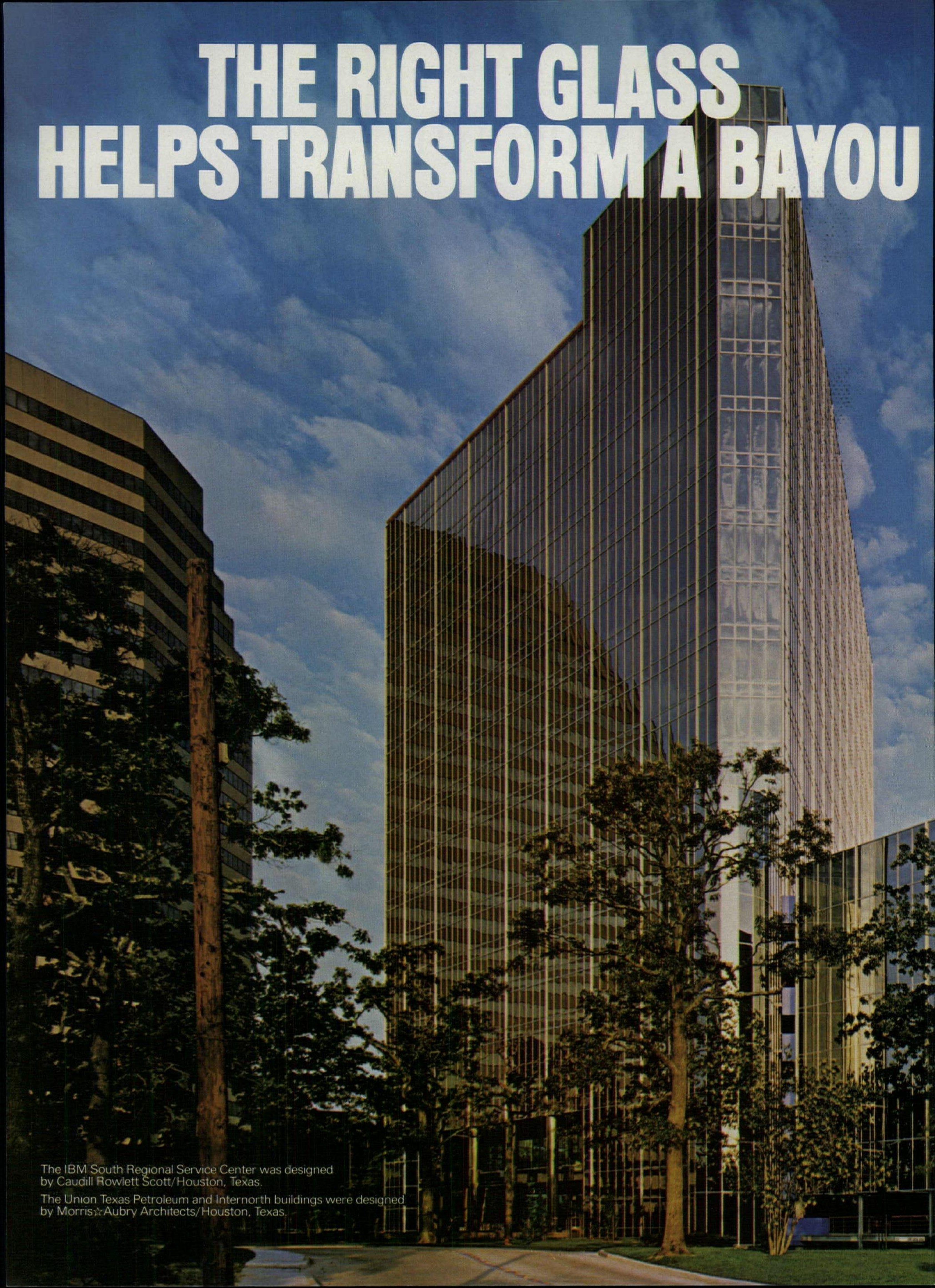
In the immediate future, much potentially valuable research on the subject will be left undone for lack of funding. The vital public role of evaluating and disseminating impartial information will be throttled. States and localities—which figure so largely in the "New Federalism"—may make some contributions, even under the economic constraints they appear to face, but it is obvious that the objectives and circumstances of energy-conscious design are unrelated to local boundaries.

Valuable knowledge generated by DOE to date will not all go into mothballs. In fact, this issue of P/A marks the first installment of effort to organize and disseminate DOE-generated information of particular value to architects: results of the major program of *re*designing representative buildings for best energy performance (pp. 110–115).

And P/A's commitment to this architectural subject of exceptional public concern will not diminish.

John Morris Dixon

THE RIGHT GLASS HELPS TRANSFORM A BAYOU



The IBM South Regional Service Center was designed by Caudill Rowlett Scott/Houston, Texas.

The Union Texas Petroleum and Internorth buildings were designed by Morris☆Aubry Architects/Houston, Texas.

Views

How to get published . . .
(Re Editorial, Jan. 1982) Kudos! Perhaps the best explanation I ever saw of what journal composition and editorial choice is about. Very helpful, and enlightening; high transfer capacity (applies elsewhere) too!
Dana Roberts
Office of Environmental Planning
Department of Public Service
Albany, NY

. . . and how to get read
It was informative to read the January editorial on how the projects are chosen to be published in P/A. However, I believe the process lacks a major ingredient, that of the readers' interests. I mention this because the reader can be as critical of P/A as P/A is of the projects the reader submits.

Each year the members of our office assemble around the conference table to decide which of the 30 office magazine subscriptions will be renewed for the coming year. In a process not too dissimilar to your "wicket" meetings, each magazine comes up against a critical review. "Is the magazine giving us information that is important and up to date?" "We saw that same project four years ago." "Is there any text in this magazine, all I see are advertisements?" "The format of this mag sure is boring." "Are the projects in this magazine really PROGRESSIVE or are they just another RECORD of architecture?"

The results of our wicket? Congratulations, P/A has made it through another year. But don't get head-strong, we're starting to sharpen our red pencils for next year.
Ken Mitchell
Alley Friends Architects
Philadelphia, Pa
[Like most magazines, P/A solicits evaluations from a random sampling of readers on every issue. We pay attention to opinions recorded, article by article, as well as other responses to more general questions about reader interests. —Editor]

Awards: The readers judge
The January issue that contains the 29th annual P/A Awards has our firm looking questionably at the credibility of *Progressive Architecture.* Our entire staff reviewed that issue, including the editorial, and in no way is it clear how-and-why the work shown in this awards issue was selected.

As we review that issue, it only convinces us more that the problems of architecture today are architects who create these esoteric monsters that leave the public in utter dismay with our professionals. Architecture must be humanistic and comprehensible by the populace, not just the members of an elite group that are able to derive pleasure from an academic approach to architecture that in general appears to say the more bizarre, the better it is.

As President of the Colorado North Chapter of the American Institute of Architects I feel that the issue of credibility should be brought up to all members of the Colorado Society of Architects, based on the simple issue that *Progressive Architecture* is supposedly a vehicle for expression of today's architecture. I feel at this point that the magazine as a whole completely misses the fundamental issue that architecture is for people. The educational value of your selections under the title of architecture ranks in my book, and in that of many of my colleagues, as garbage. I expect in the very near future to bring this topic and this letter to view among the members of this state, hoping to begin an effort to instill responsibility and credibility to the literary vehicles of our profession.

If we see much more of this "comic book" architecture without equal space devoted to discussion of an architecture for the populace, we will cancel our subscription at our next renewal date.
James A. Cox, Jr., AIA
President, Colorado North Chapter
American Institute of Architects
[We have asked the writer to show us what the "people" of Northern Colorado are getting from members of his chapter. We hope none of it is "garbage."—Editors]

[*Views continued on page 15*]

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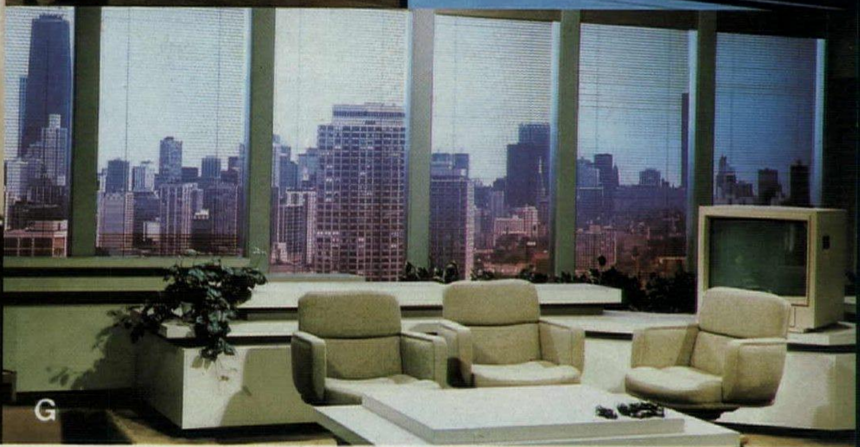

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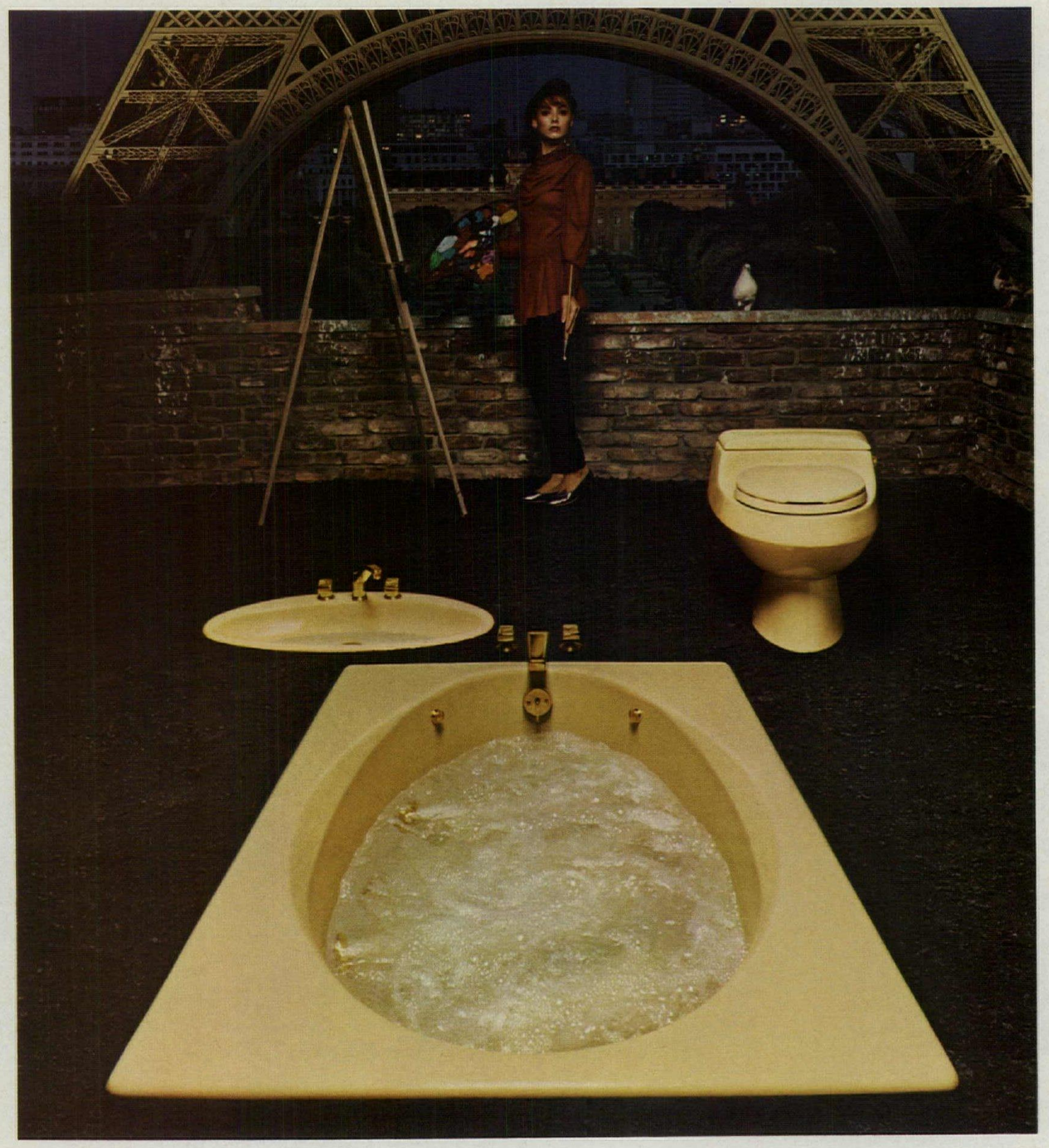

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Views continued from page 11

I would like to comment on the 29th P/A Awards winners, as presented in your January issue.

I was greatly perturbed to see that most of the award winners' projects were fashioned in stripped-down neoclassical or historically derived forms.

I find it appalling for so many seemingly mature, articulate, and sophisticated architects to be caught up in what is fashionable and trendy, rather than "honest" expression. I seriously doubt that these historically derived forms were developed on the basis of the design process or even programmatically derived; more likely they were contrived to satisfy the architects' conscious or subliminal yearning to be on the leading edge of this supposed new trend. Presumably a few years ago they were designing with modern forms and imagery, yet now they've jumped on the bandwagon to bury the old and bring in the archaic. A fast about-face to say the least, especially in the interest of fashion.

It's apparent that most of the award winners were unimaginative and just plain ugly, with the only real award winner the Gwathmey-Siegel Long Island residence, which is the only entry which even begins to explore the potential of contemporary architecture. I find it very disillusioning as a student to see many experienced and influential architects suddenly abandoning modern architecture as hopeless, only to regress to forms and images relevant many years ago to entirely different cultures.

Why don't we leave the forms and images of the past back in the context and culture where they originated and were appropriate, and put a lot more effort into synthesizing the architecture of 1982 into something more cognizant and rational in its own context and culture?

William J. Curran
Architecture Student
Hamilton, Ontario, Canada

[If the writer would look around Hamilton, Ontario, critically, he might see more serious reasons why "modern forms and imagery" are being questioned and the "archaic" reappearing.—Editors]

Credit corrections

Except for the Daylight Diagram and the scored example, illustrations for the New York City Midtown Development Project Bulk Regulations submitted to the P/A Awards program by Davis Brody & Associates and Kwartler/Jones Architects (Jan. 1982, pp. 182–185) were taken from the final Midtown Development Study prepared and illustrated by the New York City Planning Department staff.

The house illustrated in the *Passive Solar Construction Handbook* (P/A, Jan. 1982, p. 171) was the work of Barth & Ramsbottom, Inc., Knoxville, Tn; sponsor was General Shale Products, Johnson City, Tn. This correction has been made in the current edition of the *Handbook.*

United States Steel was inadvertently omitted from the acknowledgment list for the Pre-engineered Metal Buildings Technics article appearing in March P/A.

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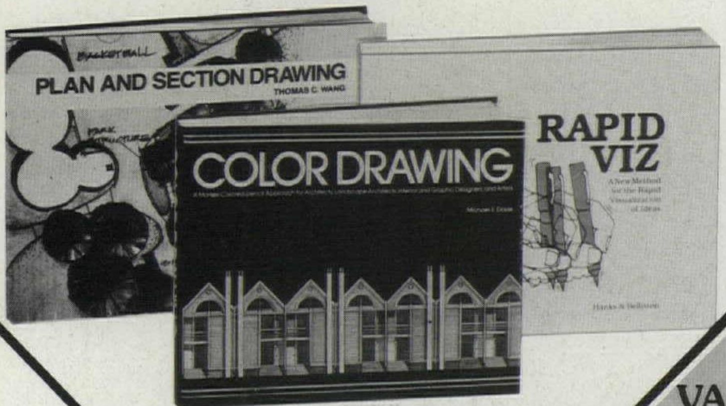

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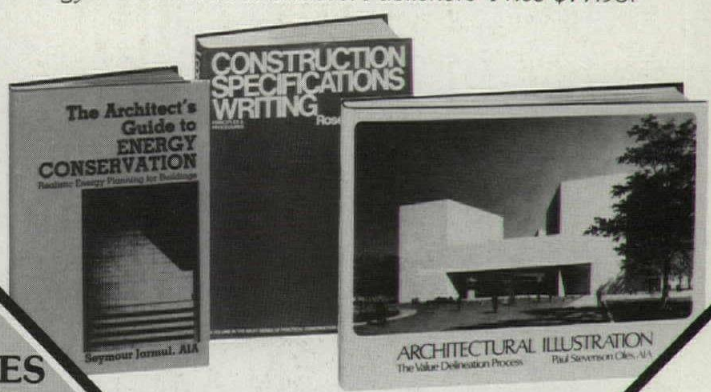

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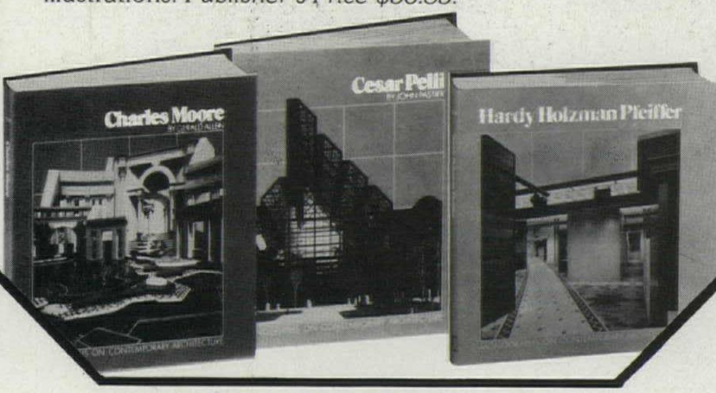

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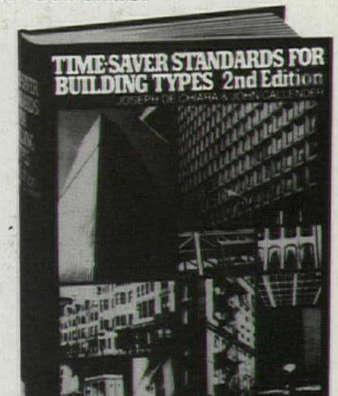

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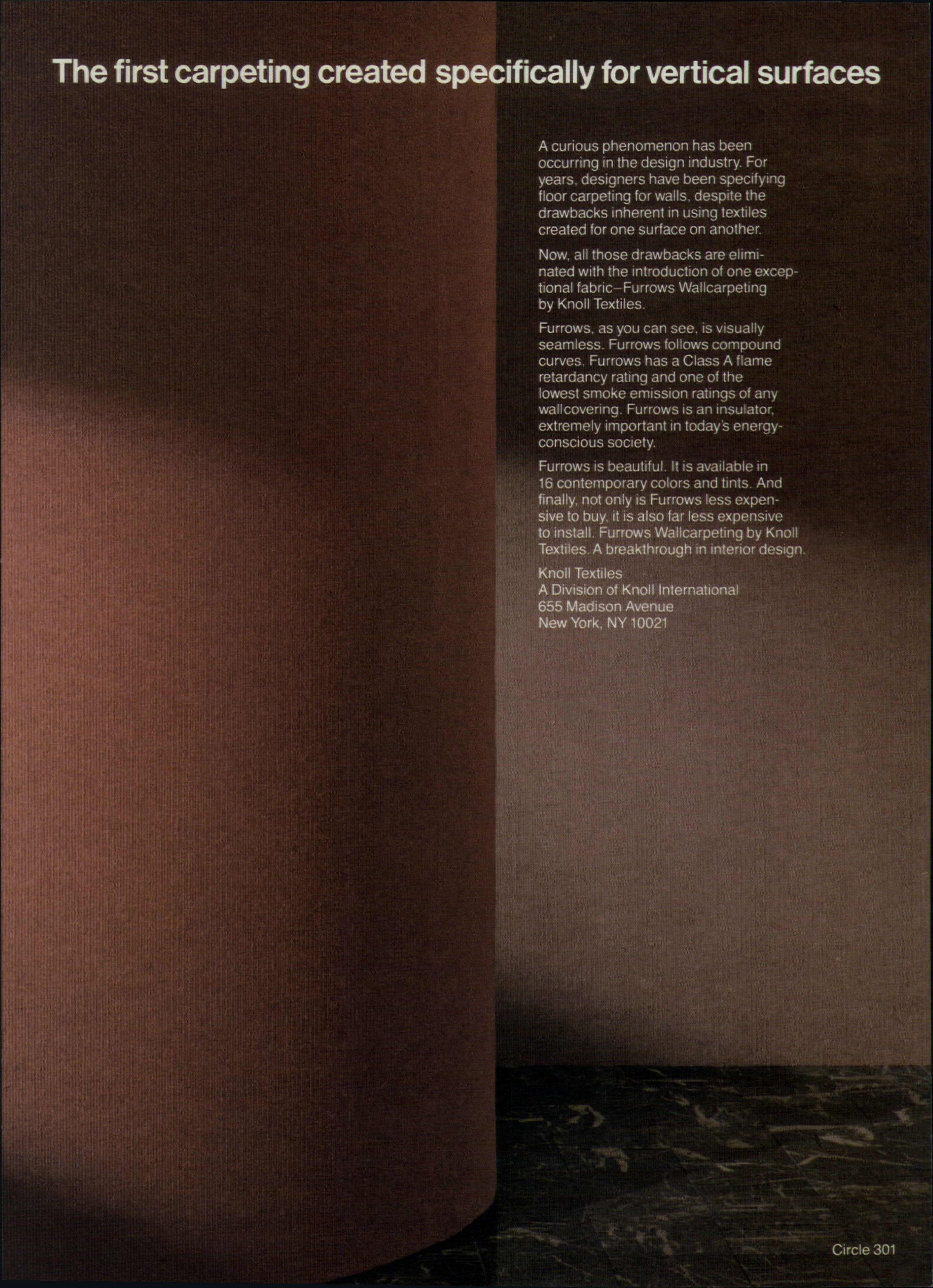
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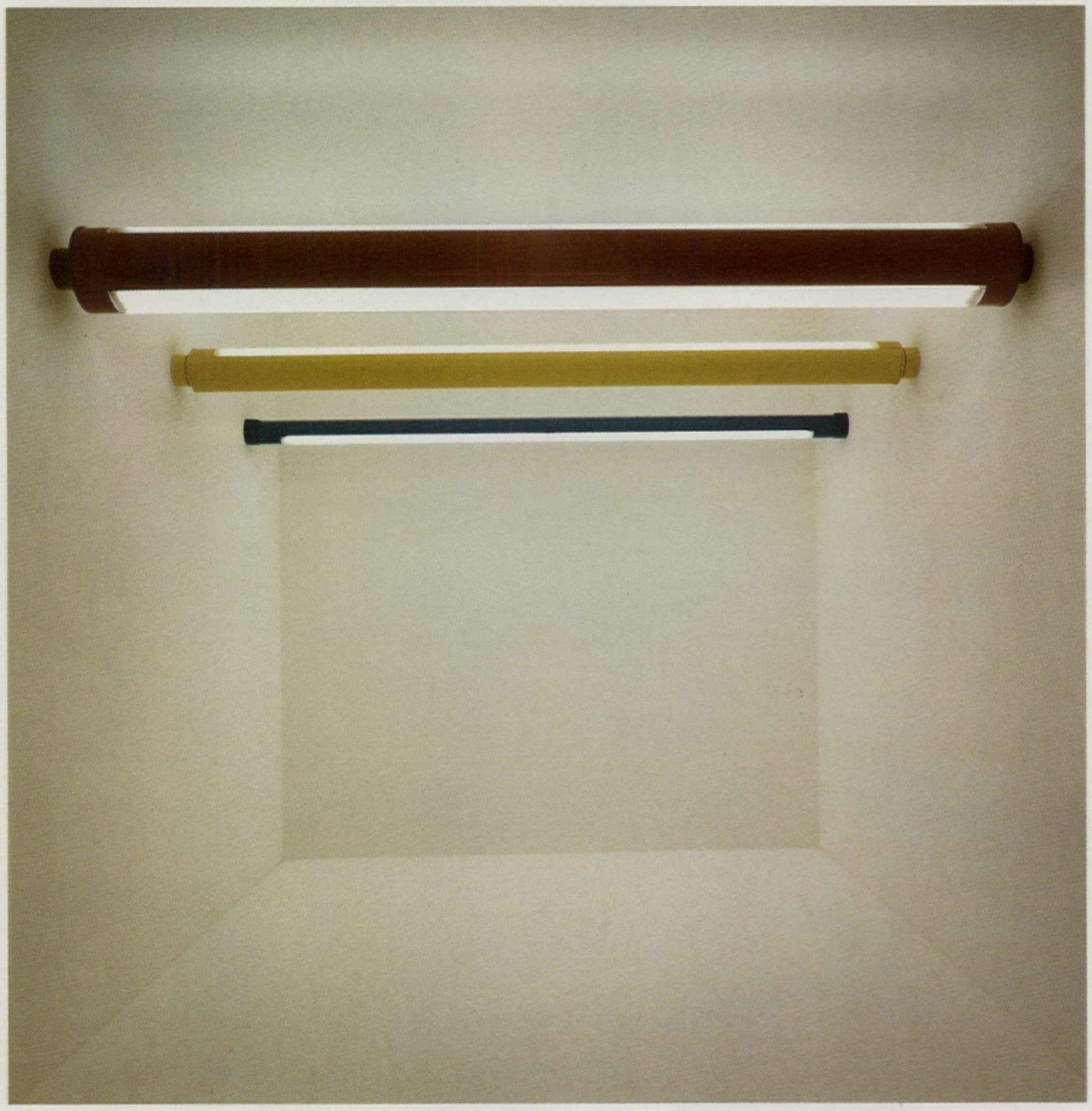

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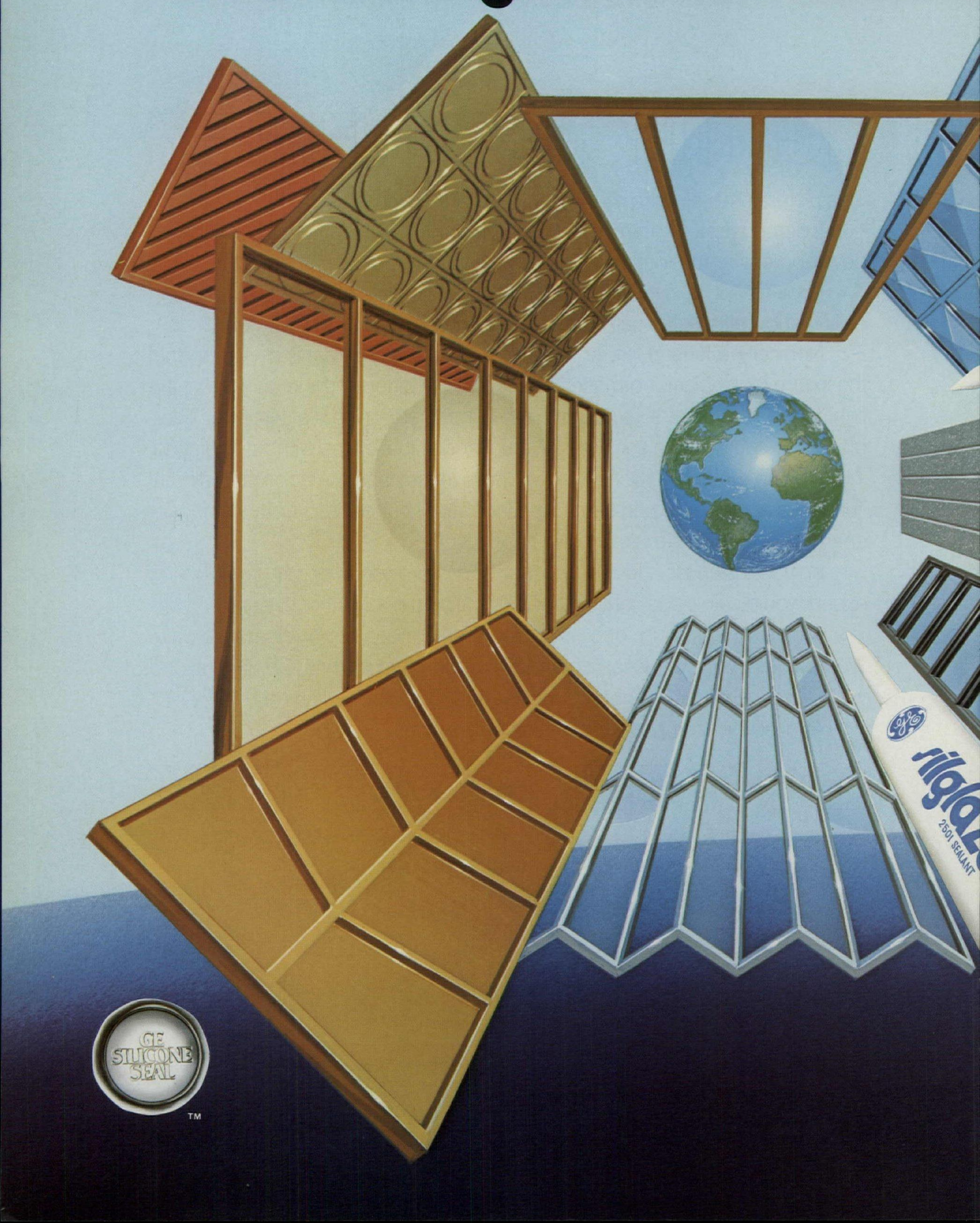

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Manville

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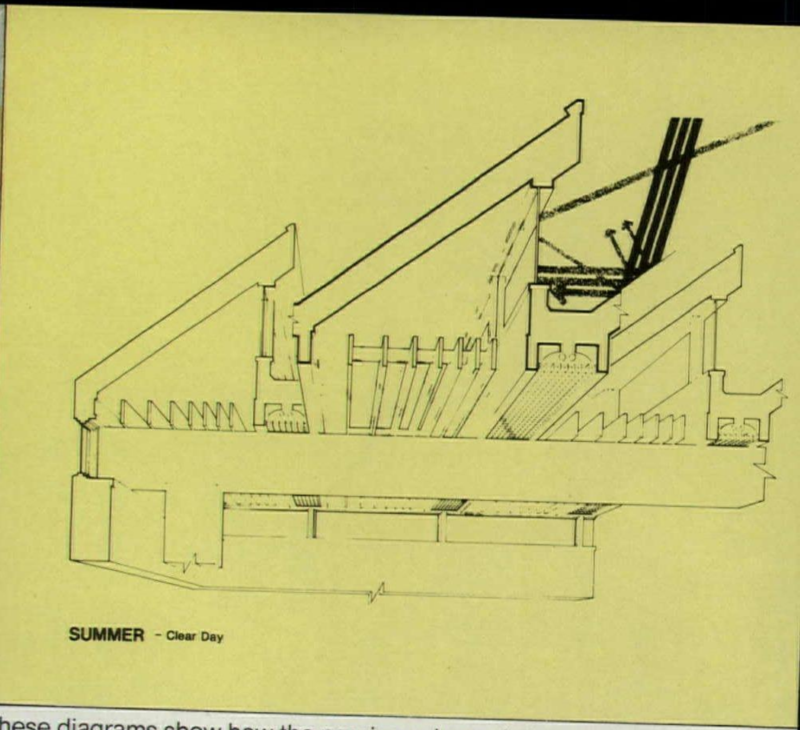
Design provides 90% of lighting needs through clerestory windows. At the same time, the interior concrete masonry mass stores solar heat while providing security and uninterrupted shelf space.



These diagrams show how the passive solar and daylighting design works in summer and winter.

Another view of the exterior and the five rooftop clerestory windows.

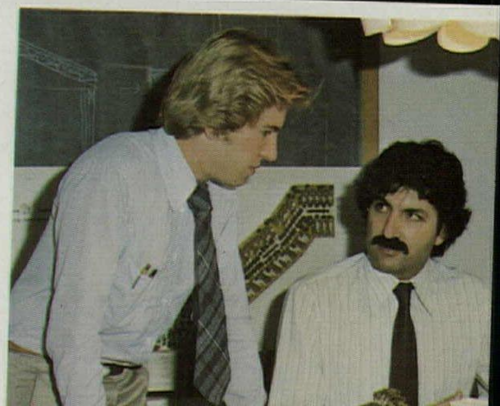
"Concrete Masonry Mass stores solar heat admitted during winter, buffering against temperature swings, and, in summer, delays the thermal impact of the sun and outdoor temperatures."

—Mazria/Schiff & Associates, Inc./Architect

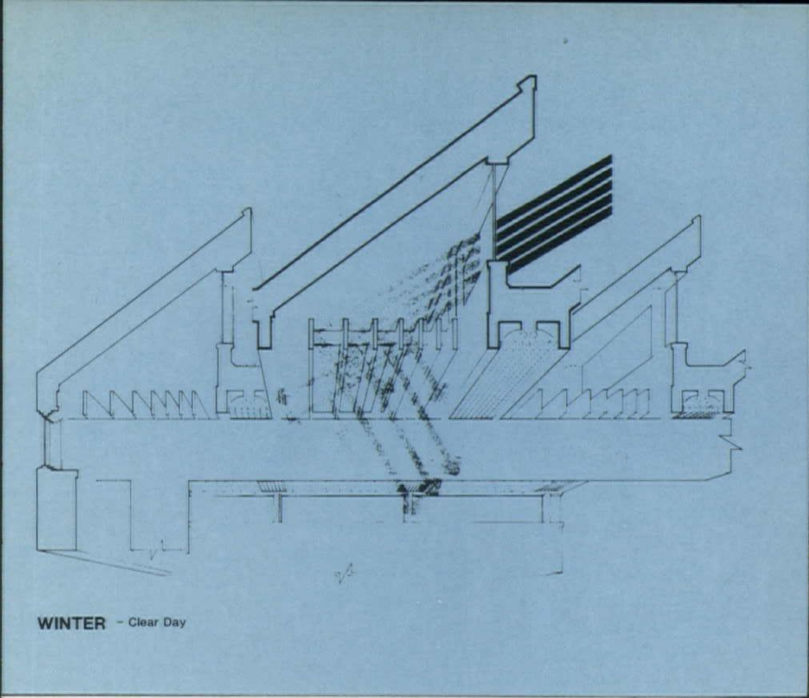
Trust Pharmacy, Grants, New Mexico

Concrete Masonry passive solar design saves energy both winter and summer.

Wall detail showing how the concrete split ribbed and split block units are employed in the design.



Marc Schiff (left) and Edward Mazria, designers of the Trust Pharmacy and principals in Mazria/Schiff & Associates, Inc.



The entrance to the pharmacy, showing the series of clerestory windows providing both lighting and solar heating. The structure is faced with split ribbed concrete masonry units, accented with split block.

Located on a high, flat desert site, the Trust Pharmacy is heated primarily by a direct gain passive solar concrete masonry system. The building is a solid concrete masonry structure, with the concrete block's cores fully grouted. The building's design provides a large masonry wall surface area in a basically open plan. This large mass not only stores solar heat gain in winter, buffering against large temperature swings, but in summer delays the impact of the sun in high outdoor temperatures.

Additionally, clerestory windows provide 90% of the building's lighting requirements.

The design and function of the Trust Pharmacy establishes that concrete masonry functions effectively for both passive solar heating and cooling.

A concrete masonry column provides part of a handsome entrance to the pharmacy.

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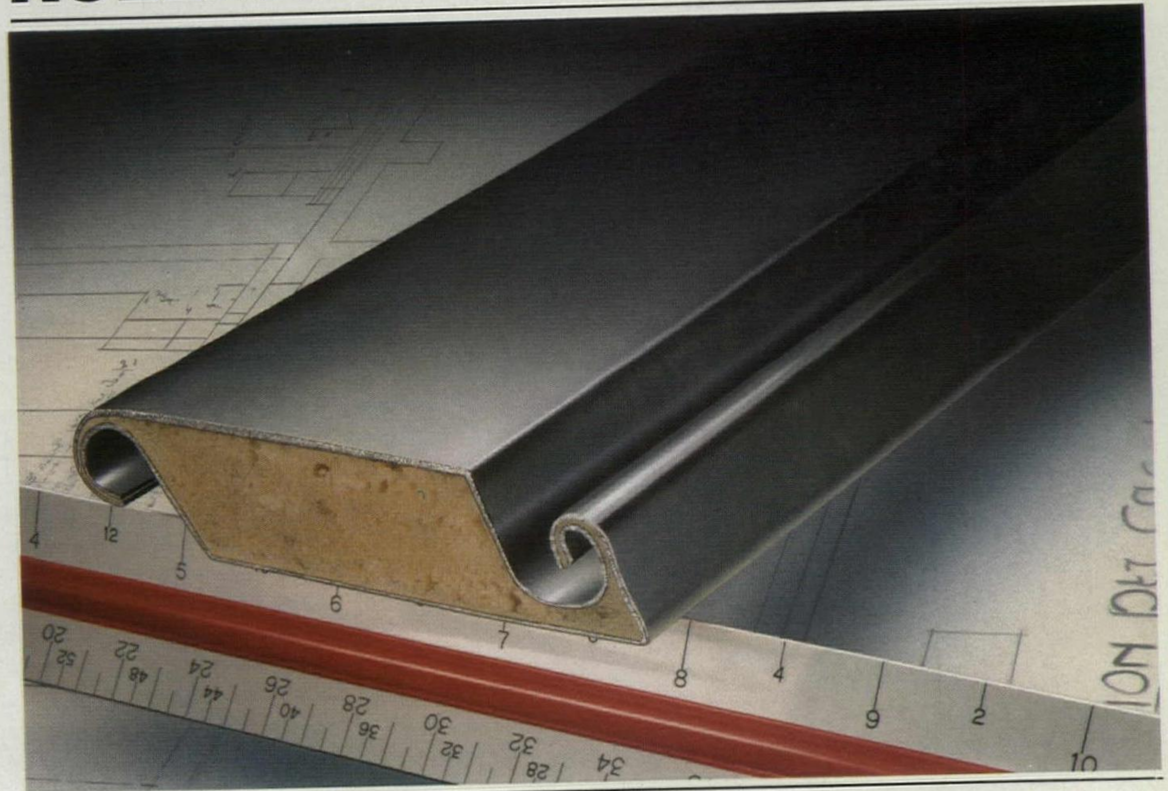

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For more information about Thermal Series rolling doors and these new options, contact Atlas Door Corporation at 116 Truman Drive, Edison, N.J. 08817, or call (201) 572-5700.

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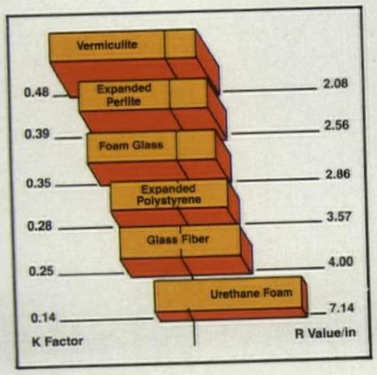

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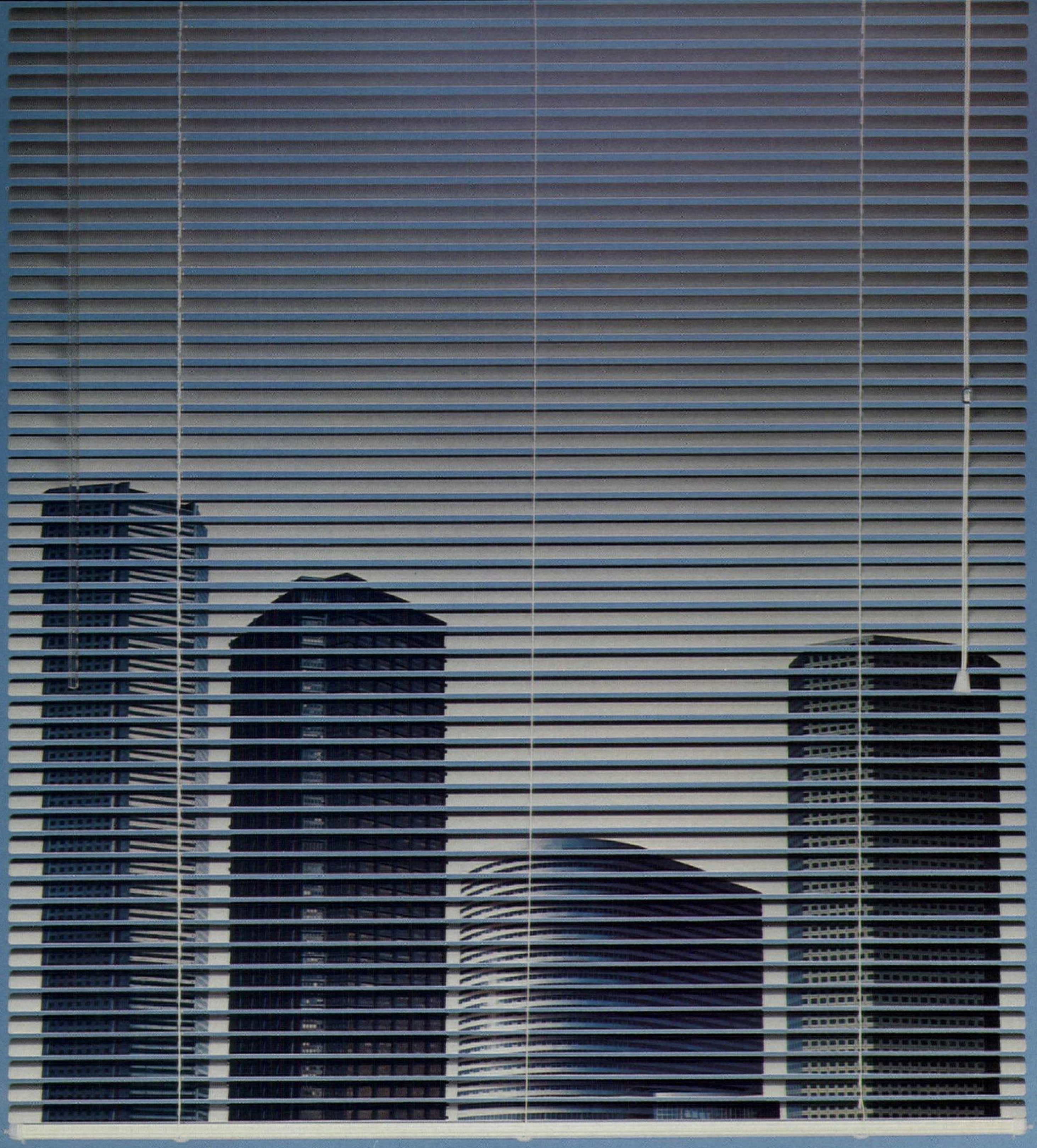

Texas Commerce Tower, Houston
Architect: 3D/International
Contractor: James Contract Draperies, Inc.

U.S. Steel Building, Pittsburgh
Architect: Harrison & Abramovitz

Twin Towers, Arlington, Va.
Architect: Hellmuth, Obata & Kassabaum, P.C.
Contractor: Kenfair Manufacturing

Capital Bank Plaza, Houston
Architect: Lloyd Jones Brewer & Associates
Contractor: Contract Drapery, Inc.

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Pencil points

Cummins commission
Roth & Moore Architects of New Haven, Ct, have been awarded the commission to design a recreation center for employees of the Cummins Engine Company, on the 350-acre Ceraland Park in Columbus, In. Architects competing for the project included:
¶ Jorge Silvetti, Boston;
¶ Taft Associates, Houston.

Canada chooses Erickson for DC
Arthur Erickson Architects has been selected from among 11 Canadian finalists to design a new Canadian chancery building in Washington, DC.
¶ The site: on Pennsylvania Avenue, facing the new John Marshall Park and opposite the West Building of the National Gallery of Art.

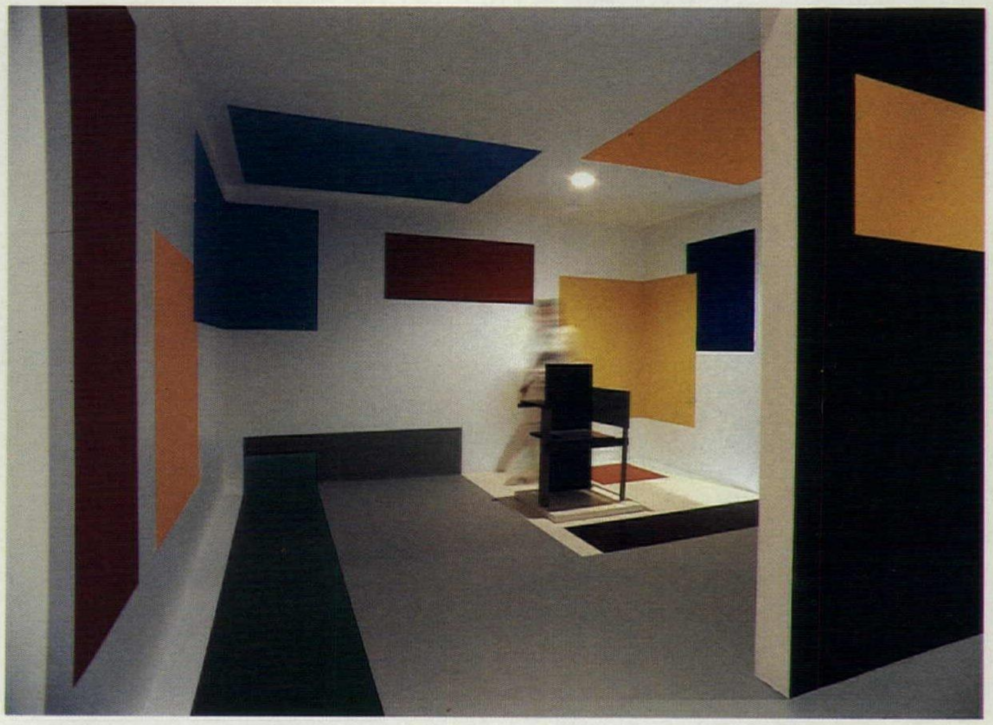
Former commission
I.M. Pei has resigned as the architect for the renovation of the Eero Saarinen/Jo Mielziner-designed Vivian Beaumont Theater at New York's Lincoln Center. The reported reason:
¶ irreconcilable differences between Pei's and acoustician Cyril Harris's designs. Possible successor:
¶ Johnson/Burgee, now working on the renovation of Johnson's New York State Theater at Lincoln Center.

Landmark Hall renovation
Carnegie Hall, New York, is beginning the first phase of its renovation by architect James Stewart Polshek & Partners, with the creation of new recital hall entrances and lobby and the restoration of the original 19th-Century façade. Funding:
¶ the Federal Development Administration and the Vincent Astor Foundation. Possible future development:
¶ expansion of the Hall's facilities and private development on the adjacent parking lot; impetus for private development on the brownstone sites to the east.

Kennedy Center expansion
The Federal Commission of Fine Arts has approved an addition by Hartman-Cox to Edward Durrell Stone's John F. Kennedy Center for Performing Arts in Washington, DC. The entire structure will be underground, and terraced gardens with light wells will replace the existing grassed area on the city side of the building.
¶ The four-level addition will hold extra parking spaces, a recital hall, a small theater, as well as studios for a new conservatory of music.
¶ Funding for the $25-million structure will come from private sources.

More DC Fine Arts
The Commission of Fine Arts has also approved a triumphal arch on Washington's Pennsylvania Avenue: not across it, mind you, but along side it, at an angle, and with limited vistas.
¶ The 10-story-high arch (the country's largest), designed by Conklin & Rossant, is
[*Pencil points continued on page 49*]

P/A News report



Rietveld and Husgar, Greater Berlin Exhibition Room, 1923.

De Stijl in U.S.

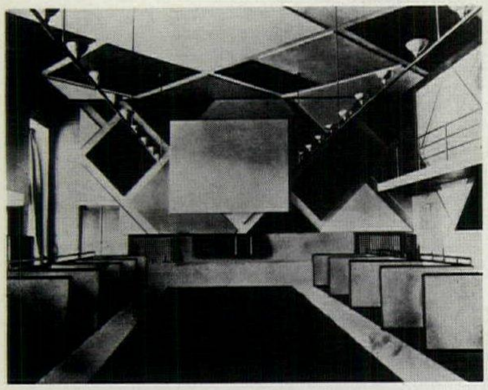
If you missed the exhibition "De Stijl: 1917–1931, Visions of Utopia," which just closed at the Walker Art Center in Minneapolis, Mn, don't despair. The show, which was organized for that institute by its curator of design Mildred Friedman, will open at the Hirshhorn Museum in Washington, DC, on April 18 and run through June 27. If you don't see it in Washington, you will miss one of the most important art and architecture exhibitions to be seen in this country for some time, and the first major De Stijl exhibit mounted here in over 30 years.

After June, the 275 works including paintings, drawings, architectural models, furniture, graphic design, and partial reconstructions of historic interiors and exhibition spaces will be divided between the Stedelijk Museum in Amsterdam and the Kroller-Muller Museum in Otterlo for exhibit from August 8 to October 3. Then the show will be disbanded and the material—by Jean Arp, Theo van Doesburg, Cornelis van Eesteren, El Lissitzky, Laszlo Moholy-Nagy, Piet Mondrian, J.J.P. Oud, Hans Richter, Gerrit Rietveld, Kurt Schwitters, and others—will be returned to the eight Dutch museums and the collections in Germany, Switzerland, France, and the U.S. from which it came.

Although De Stijl was not a formally organized movement, its main focus, and the vehicle for the propagation of its philosophy, was a journal of the same name published by van Doesburg from 1917 to 1931. Coming on the heels of the chaos of World War I, its basic idea, simply, was that if harmonious relationships could pervade all aspects of the visual environment, the realization of universal harmony could be hastened. But this, of course, was not to be: social and political forces were to shape the future rather than aesthetic ones. Nevertheless, De Stijl was to exert one of the most powerful influences on the art and architecture of our time through its early achievement of total abstraction. Using simple planes of primary colors and black and white in gridlike configurations, utopian ideals of harmony shaped an astonishing variety of utilitarian artifacts with an eloquence that transcended time and place to achieve true universality.

The Walker Art Center's orthogonal arrangement of spaces, interrelated through subtle variations of floor levels, enhances the works in a way that may

News report continued from page 41



Van Doesburg, Cinema-Dance Hall, Café Aubette, Strasbourg, 1928.

not be possible in the doughnut-shaped Hirshhorn. The recreation of van Doesburg's cinema-dance hall of the Café Aubette in Strasbourg of 1926–1928, so stunning as the entrance to the Walker exhibition, is likely to be less effective at the Hirshhorn. Other reconstructions, such as Mondrian's 1926 Paris studio re-created with vintage photographs and paintings of the period, Vilmos Huszar and Rietveld's room for the Greater Berlin Exhibition of 1923, and Piet Zwart's Celluloid Manufacturers' Stand of 1921 should fare better because of their smaller size.

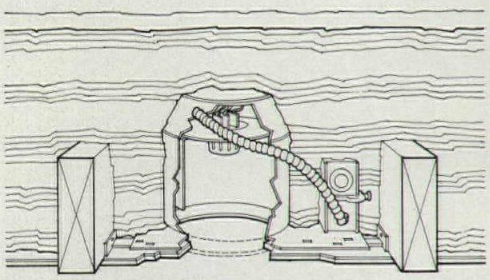
The bulk of the show is made up of artifacts and art works and includes nine important pieces of furniture by Rietveld and the original model and some drawings of his Schröder house in Utrecht of 1924. A bonanza of over 30 drawings and paintings by Mondrian are included, some of which are related to each other but have never before been seen together. There are over 80 prints, drawings, and paintings by van Doesburg showing spaces in the Café Aubette in addition to those of the cinema-dance hall; six drawings by Oud, with some of the Café de Unie in Rotterdam of 1925; and 11 drawings by van Eesteren that include some magnificent views of the University of Amsterdam of 1921–1922 and of the Rokin (quay) development of 1924 incorporating H.P. Berlage's Amsterdam Stock Exchange.

If there is a complaint to be made of this exhibition, it is that it will not be in this country longer and in more places. But some consolation can be gained from an authoritative and beautiful catalog of 255 pages containing 70 color and 150 black-and-white illustrations, with 12 essays by experts, edited by Mildred Friedman and co-published by the Walker Art Center and the Abbeville Press of New York. [DM]

Thermal protection for recessed fixtures

The enthusiasm for increased energy efficiency in recent years has on occasion had ill effects, when energy motivations interface with other important building requirements, such as fire protection (P/A, April 1981, pp. 173–177). A noted problem has been that of retrofitting the space around a recessed light fixture with additional thermal insulation. The light fixture that was designed to "breathe" or expel its heat naturally is caused to overheat, producing either wiring fires or, more commonly, fires in the insulation itself.

Effective April 1, 1982, the National Electric Code has issued one response to the problem: Section 410-65(c) Recessed Incandescent Fixtures. The code states: Incandescent fixtures shall have thermal protection and shall so be identified as thermally protected." Although not exclusively applicable to residential construction, the code will have the most impact in the residential sector. Conventional office "suspended ceilings" do not risk retrofitting with insulation and are not affected by the new code. Fluorescent fixtures with a Class P ballast have a thermal protector built into the ballast, which causes the light to shut down when it becomes overheated.



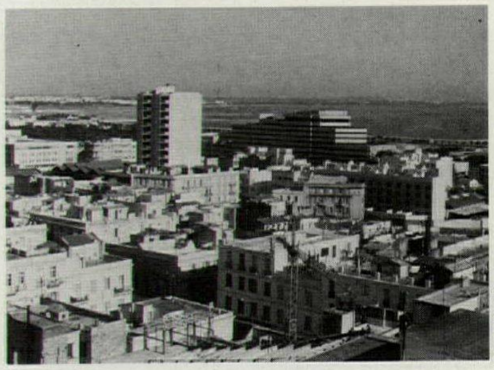
RECESSED FIXTURE IN INSULATED CEILING

Underwriters Laboratories has three separate listings for recessed fixtures: UL 1570 for fluorescent fixtures, UL 1571 for incandescent, and UL 1572 for HID. There are two main ways of dealing with the problem, one passive and one active.

If the fixture itself is so large that plenty of room is permitted around the hot light source, the heat will dissipate naturally, and the problem will not occur. It is also possible to create a smaller fixture, but include a protective device that will keep the insulation away from the heat source and allow the heat to dissipate. Several manufacturers have recessed fixtures that are listed in "passive" compliance with the code.

The active approach is to include an electrical device within the lighting fixture that will shut down the system when it senses an advanced temperature. Two companies that have developed active thermal protection devices are McGraw-Edison and Progress Lighting.

Although only a few states adopt the National Electrical Code verbatim (Minnesota and Oklahoma, for example), the next few years will certainly see the increased application of thermal protection in recessed lighting. As one UL official put it: "After April 1, if they are going to be listed as recessed fixtures, they had better be thermally protected." [RR]



Tom Vonier

Downtown Tunis.

Oil producer has energy problems

There has been little discussion within the U.S. architectural community—its already limited concerns for energy having been devoted almost exclusively to matters American—about the energy situation in developing countries. The more one learns about this subject, the more one is convinced that, in terms of troubles with petroleum-based energy, the U.S. and the world haven't seen anything yet.

The Agency for International Development recently took a small group of American architects and energy analysts to Tunis, in hopes that insights from U.S. experience with building energy efficiency might be shared with members of the Tunisian government. As one member of the group, I brought back more insights than I left and none of them is especially reassuring.

Tunisia's situation is instructive. The country is characterized as "typical" of many other developing nations; reports prepared for AID place Tunisia—along with Mexico, Egypt, and a host of others—in a category called "non-OPEC oil-producers," noting similarities in patterns of economic development, trade balance, demographic change, and energy use.

With just over six million citizens, Tunisia is considerably smaller than many of its presumed counterparts, but this seems of little consequence to the basic issue: by 1985, non-OPEC oil-producing Tunisia will become a net energy importer.

Presumably the situation is not to be very much different for other developing countries, including Mexico. Increasing energy demand is by no means the only factor at work in these nations. Over 50 percent of Tunisia's population is under 20 years of age, and more and more people are moving to the cities. With this urban growth and an increasing appetite for the style of living practiced just a short distance across the Mediterranean has come a set of aspirations, if not expectations, carrying an enormous energy burden.

Downtown Tunis looks like a Mad magazine conception of American Graffiti Meets 1001 Arabian Nights; cars, taxis, trucks, and mopeds scurry nonstop past shops and cafés, the most fashionable of which are situated on the ground floors of gigantic new buildings that would hold their own in Midtown Manhattan. Less is definitely not more in the Third World.

Nor should it be. The American architects' oft-expressed appreciation for examples of energy-conscious design from the vernacular buildings of North Africa is not widely shared. "That's all well and good, but it's past," said a frustrated Tunisian energy official when confronted with color slides of the "exemplary" southern Tunisian troglodyte dwellings made famous by Bernard Rudofsky in *Architecture Without Architects.*

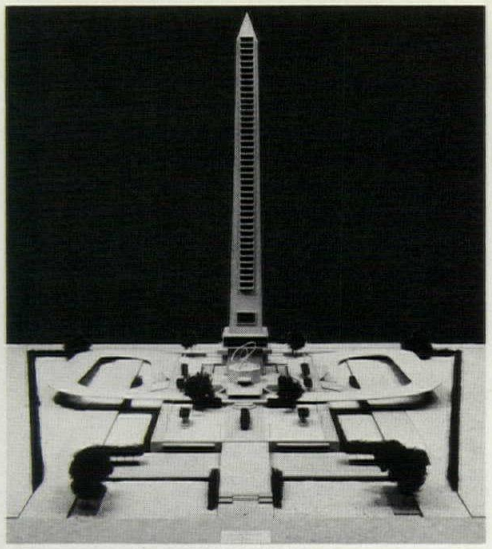
Today one sees huge window air conditioners protruding through the beautiful latticework bays of traditional, passively cooled Tunisian dwellings in Sidi-Bou-Said. The new housing around Tunis—as in Cairo, Athens, and a score of other developing places—is totally dependent on automobiles and buses. The concomitant living patterns, complete with fast-food outlets and supermarkets, is highly dependent on energy and on money from energy that simply will not be there in a few years.

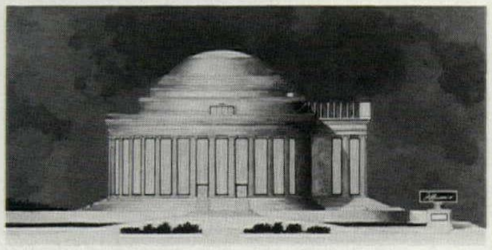
The Tunisians know that they face a problem and they are concerned. No simple prescriptions emerged as the sessions in Tunis drew to a close. More questions came and with them the conviction that U.S. architects, some of whom know a great deal about very specialized aspects of energy, have much to learn about the world around us and ways to help it prepare for what will surely be the greatest energy crunch yet. [Thomas Vonier]

Watt: me worry?

WASHINGTON, DC, April 1—This nation's three major presidential memorials—the Washington Monument, the Lincoln Memorial, and the Jefferson Memorial—are to receive more intensive use, Secretary of the Interior James G. Watt announced today.

"In keeping with the Reagan administration's commitment to seek new sources of funding for the federal government and in the spirit of private enterprise that this administration champions, I have accepted a plan to adapt these memorials to their highest and best use," the Secretary said. He added that the plan was another step in his efforts to improve "our existing national parks and facilities."





Washington Monument Condominiums (top). Jefferson's, a restaurant (above).

Watt accepted lease proposals developed by David Stainback of Arlington, Va. The Washington Monument would be converted into an exclusive group of 40 one-level condominiums. The only changes would be addition of balconies at each level on the west face of the shaft and an enclosed elevator on the east. The alterations would be in keeping with the original design.

For the Lincoln Memorial, a bank is planned. Changes would include the installation of solar black glass between the columns and sympathetic drive-up facilities on each side. A mezzanine would be installed for loan offices and the teller stations would surround the base of the Lincoln statue by Daniel Chester French.

Within the Jefferson Memorial an elegant restaurant would be created. An outdoor dining terrace and a cocktail terrace would be installed on the exterior of the dome, which would be altered to allow installation of a skylight.

"I don't see how any American, or even a liberal, can object to these far-reaching concepts," said Watt who revealed that developer Stainback is now taking a close look at the White House.

The announcement stunned Washington. "This must be a joke," said one bureaucrat who wished to remain anonymous. "It is April Fools' Day." [Carleton Knight, III]

'Zeroing out' no joke

Does the Reagan administration's right hand know what its left hand is doing? Consider this:

In February, the administration announced that its federal budget for 1983 would include zero funds for historic preservation matching grants from the U.S. Department of the Interior to the states and to the National Trust for Historic Preservation.

But according to documents obtained by *Progressive Architecture,* it will cost the federal government more to "zero out" the program than to restore it. The documents, prepared by the National Park Service for Secretary of the Interior James G. Watt to use in his budget deliberations, show a cost increase of 14–18 percent for 17–35 percent less work. It would also require a massive staff increase.

As it now stands, the states receive monies from the Historic Preservation Fund to operate their state historic preservation offices. In return for these matching funds—roughly $18 million this year, down from a high of $50 million in 1979—the states perform various federally mandated activities, such as giving preliminary certification to rehabilitation projects utilizing the preservation incentives in the Economic Recovery Tax Act of 1981, preparing nominations to the National Register of Historic Places, and administering grants to local groups.

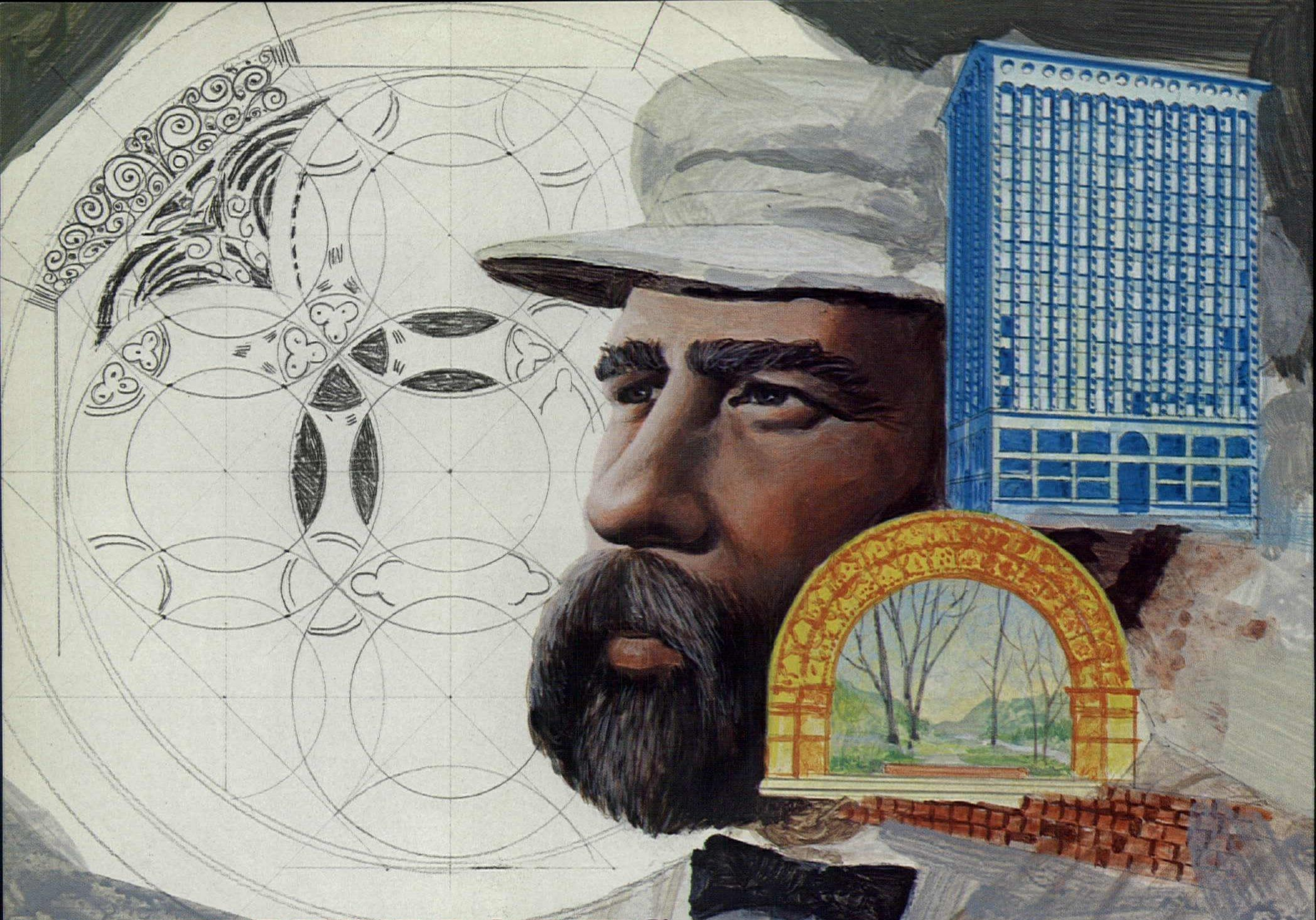
This work is required by federal law, the documents point out, and if the states do not receive their funds, "it is virtually certain" they will no longer do the work. But the work still has to be done, and thus the federal government will either have to do it itself or contract it out to the states or others on an unsubsidized, actual-cost basis.

According to the documents, a program for next year similar to this year's and utilizing the existing federal/state partnership would cost $21 million and require a staff of 49. If the federal government were to try to undertake the job itself, according to the documents, it would cost nearly $25 million and require a staff of 508. Contracting the job out would cost almost $24 million and need a staff of 229.

A study by the Task Force on Federalism and Preservation of the Advisory Council on Historic Preservation predicts even harsher consequences—a 100 percent increase in cost and a substantial increase in personnel.

The documents point out that the cuts threaten the preservation tax incentives program, which Secretary Watt has described as the "cornerstone" of the administration's preservation efforts. His own staff has warned him of the dangers in "zeroing out" the fund. Congress rejected the administration's similar efforts last year. Why he persists is anyone's guess. [Carleton Knight, III]

[*News report continued on page 45*]



News report continued from page 43

The Manila Hotel.

Tourism and preservation in partnership

More than 250 delegates from 21 countries met in Manila in November to discuss solutions that promote the uniqueness of a nation's cultural heritage while recognizing the growing interdependence of tourism and preservation. They were attending the Second Tourism and Heritage Conservation Conference of the Pacific Area Travel Association, a trade association serving the tourism industry.

Lord Duncan Sandys, president of Europa Nostra, a federation of European preservation groups, set the tone in his keynote address when he said, "Preservation of the architectural heritage of mankind has become the joint responsibility of all of the peoples of the world." He called on the tourism industry to exercise its influence on government officials and planners.

The conference locale, the historic Manila Hotel, is a perfect example of the partnership of tourism and preservation, and it served as a case study at the conference. The site was chosen by Daniel H. Burnham; and William Howard Taft, the first American governor general of the Philippines, selected a New York City Beaux-Arts-trained architect, William Parsons, to design the facility.

The most famous resident was Gen. Douglas MacArthur, who lived in the fifth-floor penthouse overlooking Manila Bay from 1935 until the Japanese invasion in 1942. The years during and after the war were not good to the hotel, and in 1974, President Ferdinand E. Marcos ordered it nationalized and restored to its former elegance. The $33 million project that included a new 18-story tower was carried out by architect Leandro Locsin with Dale Keller Associates and was completed in 1976.

The contemporary tower is placed to the rear of the H-shaped, California Mission style building to preserve existing views. The roof and balcony overhangs of the tower match the old building in color (green) and form. The magnificent, wood-paneled interiors are filled with native crafts, shells, and art.

The hotel, which was built in 1908 to draw American tourists stopping off on their way to the Far East, now draws visitors from all over the world desiring a taste of the Philippine culture. Manila may be a city teeming with eight million residents and, it would appear, almost as many horn-blaring vehicles, but the Manila Hotel offers a spot of serenity. It provides the kind of unique experience that the conference suggested, and its success demonstrates that preservation and tourism can work hand-in-hand to the benefit of each.
[Carleton Knight III]

The flagship TVA: minus the sails

Construction of the Tennessee Valley Authority's 1.3 million-sq-ft Chattanooga office complex, the "flagship" TVA energy effort, is now well underway. It won't be quite the building originally designed, however (P/A, April 1980, p. 117); gone are several of its most innovative features, including the complex external mirrored louvers that were to have covered a large central atrium and a planned groundwater thermal cycling system.

Designed by a large and expert team (The Architects Collaborative, Caudill Rowlett Scott, Van der Ryn Calthorpe & Partners, Syska & Hennessy, and William Lam Associates participated, among others), the building's basic form is unchanged and will still employ other concepts that were part of the original scheme.

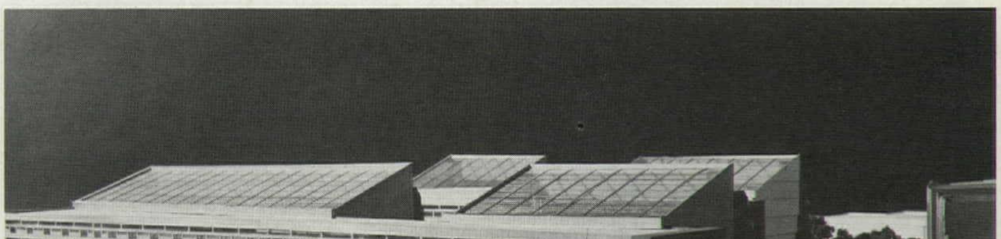
The atrium louvers were separated from the main construction contract and were pursued as far as possible. "It's not really accurate to say we lost them," said a TVA official, "because we never really had them; we had an idea and couldn't build it." The reflective glass now planned will rob the atrium space of some of its drama, but will not affect total energy performance greatly.

TVA also pursued the groundwater-assisted heating and cooling system until very recently, but gave up when a suitable aquifer could not be located. Costs and performance concerns also influenced decisions to drop these features.

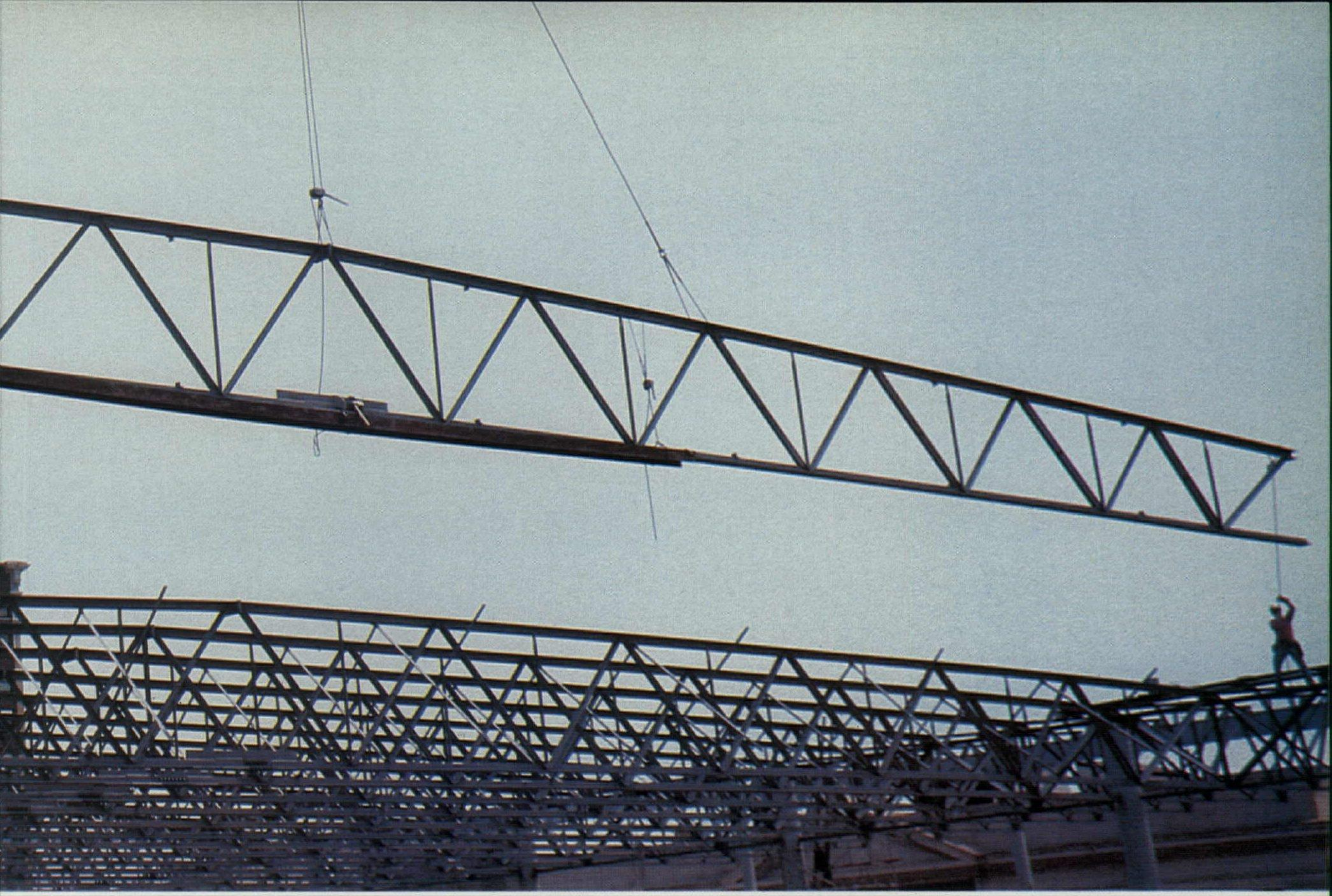
These disappointing developments prompted one member of the original design team to cry foul: "TVA didn't ask us to provide the most cost-effective, performance-assured building possible. They asked us to innovate." Recalling the stunning interior model photographs and acclaim that surrounded the initial atrium design, he summed up his frustrations: "It will be a sound, energy-conserving building, but it won't be the embodiment of a first-generation innovation that we worked for."

Annual energy use is estimated at about 35,000 Btu per sq ft. The project's computer center is topped out, and structural work for the office portion is in progress. [Thomas Vonier]

[*News report continued on page 62*]



The Tennessee Valley Authority office complex, original design.



172' super long span joists were used in the St. Joseph Civic Arena.

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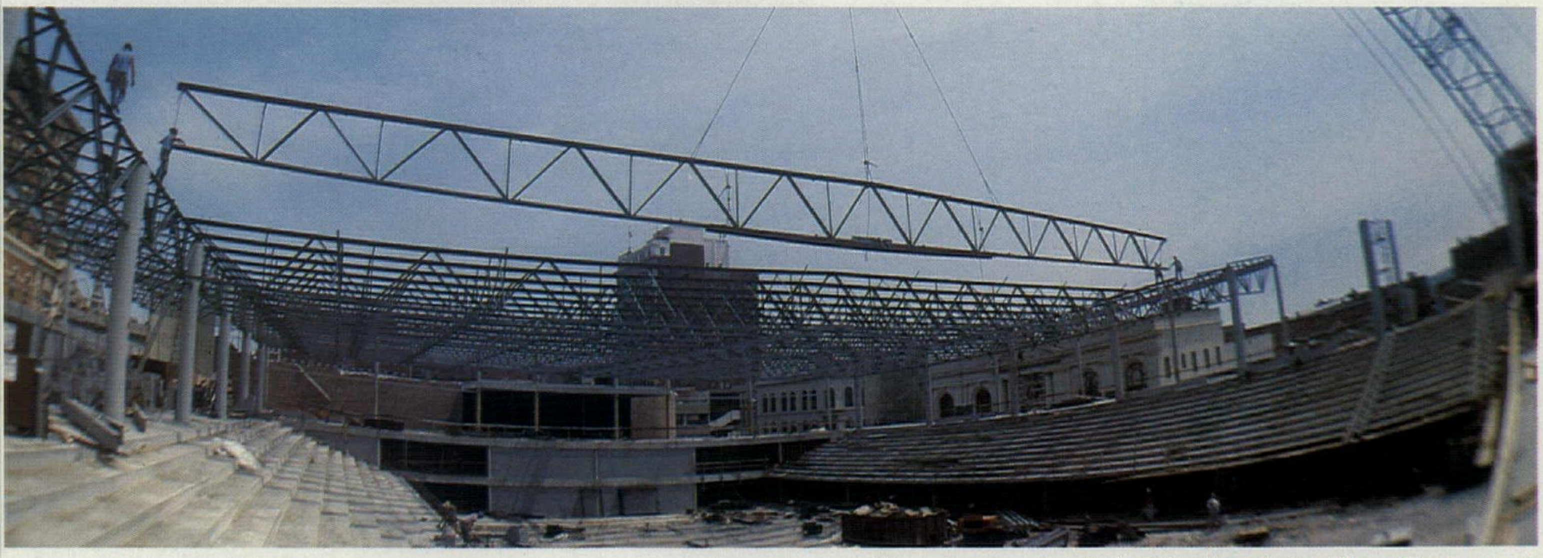

The main arena area is 232' x 224', and was designed for multi-purpose use.

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Steel Fabricators: Midland Structural Steel Inc. Steel Erectors: Havens Steel Co.

Pencil points continued from page 41

a memorial to the U.S. Navy and contains a band shell between its legs.

¶ *The otherwise undecorated arch has two pairs of Ionic columns on the Avenue side, and a single column on the other side, so that it, too, will be "dressed for a party" like the buildings across the street, says National Gallery of Art director and Fine Arts Commission chairman J. Carter Brown.*

International Center update

The International Center, an embassy complex off Connecticut Avenue in Washington, is growing. Seven chanceries have had designs prepared for buildings in the complex.

¶ *Israel's embassy is complete.*

¶ *So is Bahrain's.*

¶ *Kuwait's, by SOM, is under construction.*

¶ *Adjacent to that site, Intelsat will be building a $50 million competition-winning scheme by John Andrews.*

¶ *The National Capital Planning Commission has approved expansion of the chancery enclave by 16 additional sites.*

FDR Memorial, finally?

Five days before FDR's 100th birthday in January, the Senate Rules Committee approved plans for his memorial in West Potomac Park, Washington—the first time a design for the memorial has proceeded this far along the approval route.

¶ *This design, by Lawrence Halprin, has a series of gardens with reliefs and inscriptions on meandering walls.*

¶ *Estimated cost (three years ago): $23 million.*

Portal Site winner

A development team that includes architect Vlastimil Koubek has again been selected by the District of Columbia; this time, to design a scheme for the 10-acre Portal Site, one of the largest undeveloped properties in DC.

¶ *Nonwinners include SOM, Arthur Cotton Moore, Welton Becket, and Anderson Notter Finegold.*

¶ *Winner gets to impose his egg crates on a site with problems: poor location, bisected by a railroad line.*

Hollein in New York

Viennese architect Hans Hollein is designing a retail shop in the New York Trump Tower atrium (see p. 31).

Columbia adds

Robert Kliment and Frances Halsband have designed a $5.2 million Computer Science building on a thankless site on New York's Columbia University campus, squeezed between a McKim Mead & White building and the recent Engineering Terrace building.

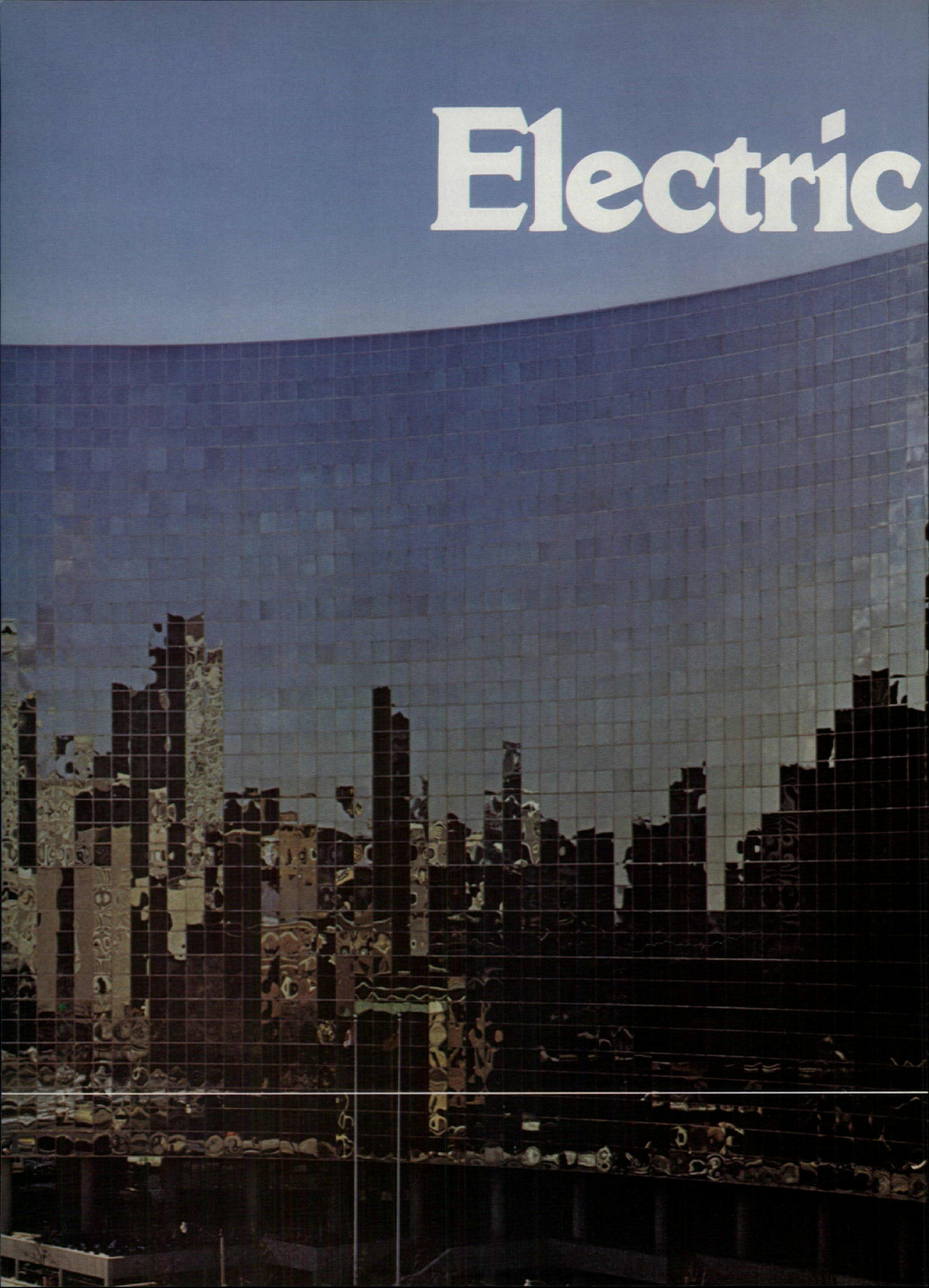
¶ *The new two-story structure sits on an unused terrace and incorporates a little-used lounge space.*

¶ *The new façade uses limestone with bluestone and granite insets.*

V & A & Conran

London's Victoria and Albert Museum has a new exhibition hall with a low-brow

[*Pencil points continued on page 53*]


Electric

Pencil points continued from page 49

name: The Boilerhouse Project, used to exhibit industrial design, is actually located in the old museum boiler room. The first exhibit—Art and Industry, A Century of Design in the Products We Use; the gallery's donor—a known name: Terence Conran, of Habitat and Conran stores fame.

Presidential renovation
George Washington's Mount Vernon, Va, home is being repainted in colors (bright in comparison to the earlier notion of chalky "Williamsburg" shades) authenticated by New York architectural conservator Matthew J. Mosca. The two-year, $90,000 program is about half complete.

Embassy redecoration
Fabric designer Laura Ashley and decorator David Hicks are among 10 British decorators and 26 British companies helping to spruce up the 1930 British Embassy in Washington, designed by Sir Edwin Lutyens. They are using modern and period design, and following a "country-house" theme.

Zoo renewed
A cageless scheme with three climatic zones is being proposed for the Central Park Zoo in New York. Architects: Roche/Dinkeloo Associates.

Luxurious tax abatement
A 32-story residential condominium building nearing completion in Sutton Place in Midtown Manhattan, with 106 apartments priced between $1/3 million and $7 million, has received a 421a tax abatement: for 10 years after completion, it will pay reduced property taxes.
¶ Architect of the superluxury St. James Towers is Emery Roth & Sons.
¶ The builder, American City Construction Corporation headed by Michael Stevens, received the abatement as a spur to residential construction on a site that had "previously been underutilized" (it had three one- and two-story buildings). Among other New York buildings receiving this abatement is Trump Tower on Fifth Avenue.

A movable seat
Perhaps the most captivating item at Batimat 82, Montreal's international construction trade show held Feb. 23–Mar. 2 with 250 exhibitors from 10 countries, was Speedynett.
¶ Speedynett is a French toilet with three seats. At any one time, one seat is in a rear cabinet being washed, one is being dried, and one is sitting quietly (it is hoped) in place ready for use. (Conrail, are you listening?)

Honors, awards, appointments
Architect, educator, and author Charles Moore has been appointed the Harvard Graduate School of Design Eliot Noyes Visiting Design Professor in Architecture for Spring 1982. Moore, professor at UCLA, is working in studio with Harvard students, holding a major exhibition of his work, giving a public lecture at Harvard.
[*Pencil points continued on page 56*]

Pencil points continued from page 53

¶ The American Society of Landscape Architects has honored 31 landscape architects for mastery and originality in specific projects. The highest honor, the President's Award of Excellence, went to Richard Haag Associates, Seattle, Wa, for Gas Works Park, Seattle (P/A, Nov. 1978, pp. 96–99).

¶ Charles Luckman, FAIA, of the Los Angeles firm The Luckman Partnership, is the first architect ever to be awarded the Henry Laurence Gantt Medal by the American Management Associations and American Society of Mechanical Engineers. Former Gantt medal winners have included business leaders Thornton Bradshaw of RCA and David Packard of Hewlett-Packard. Luckman is a former president of Pepsodent Company and of Lever Brothers. The Luckman Partnership, entirely employee-owned since 1977, is responsible for

¶ Madison Square Garden, New York;

¶ Prudential Center, Boston;

¶ Los Angeles International Airport;

¶ Johnson Space Center, Houston; and many other projects.

More honors

¶ Jocelyn Brainard, an architectural designer with The Grad Partnership, Newark, NJ, has been elected president of the Alliance of Women in Architecture.

¶ The National Gallery of Art's Center for Advanced Study in the Visual Arts has awarded four fellowships for visiting scholars to pursue research at the Center in Washington during this academic year:

¶ Jörg Garms, Director, Austrian Institute, Rome, will study the architectural fantasies of Piranesi;

¶ Gridley McKim-Smith, New York, will compare two similar paintings by El Greco at the National Gallery and the Prado;

¶ and Francesco Dal Co of the Instituto Universitario di Architettura di Venezi and Erica Cruikshank Dodd of the American University of Beirut have recently completed their fellowships.

AIA Awards

¶ The American Institute of Architects has selected Sir John Newenham Summerson, Hon. FAIA, British architectural historian and curator, to receive the 1982 medal honoring recorders of architectural accomplishments. Other 1982 AIA honors:

¶ Oppositions, *the magazine of the Institute of Architecture and Urban Studies, New York, is receiving a medal recognizing "individuals or organizations responsible for a specific project related to architecture";*

¶ The MIT Press of the Massachusetts Institute of Technology, publisher of architectural books and journals for many decades, is being honored by a medal for its efforts to "inspire or influence the architectural profession";

¶ the AIA's Twenty-Five Year Award is being conferred upon the Commonwealth Building, formerly the Equitable Savings and Loan Association Office Building, Portland, designed by Pietro Belluschi, FAIA;

¶ French artist Jean Dubuffet is the recipient of the medal recognizing artists and craftsmen whose work relates to architecture;

¶ Historic New Harmony Inc., the nonprofit organization directing and coordinating the historic preservation of New Harmony, In, is receiving the AIA medal recognizing "individuals or groups responsible for specific accomplishments demonstrating the interpretation of several disciplines related to architecture";

¶ San Francisco architect Ernest Born, FAIA, and art historian Dr. Walter Horn are being honored with an AIA medal for their three-volume book, The Plan of St. Gall, *illustrating European monastic life and architecture in the Age of Charlemagne;*

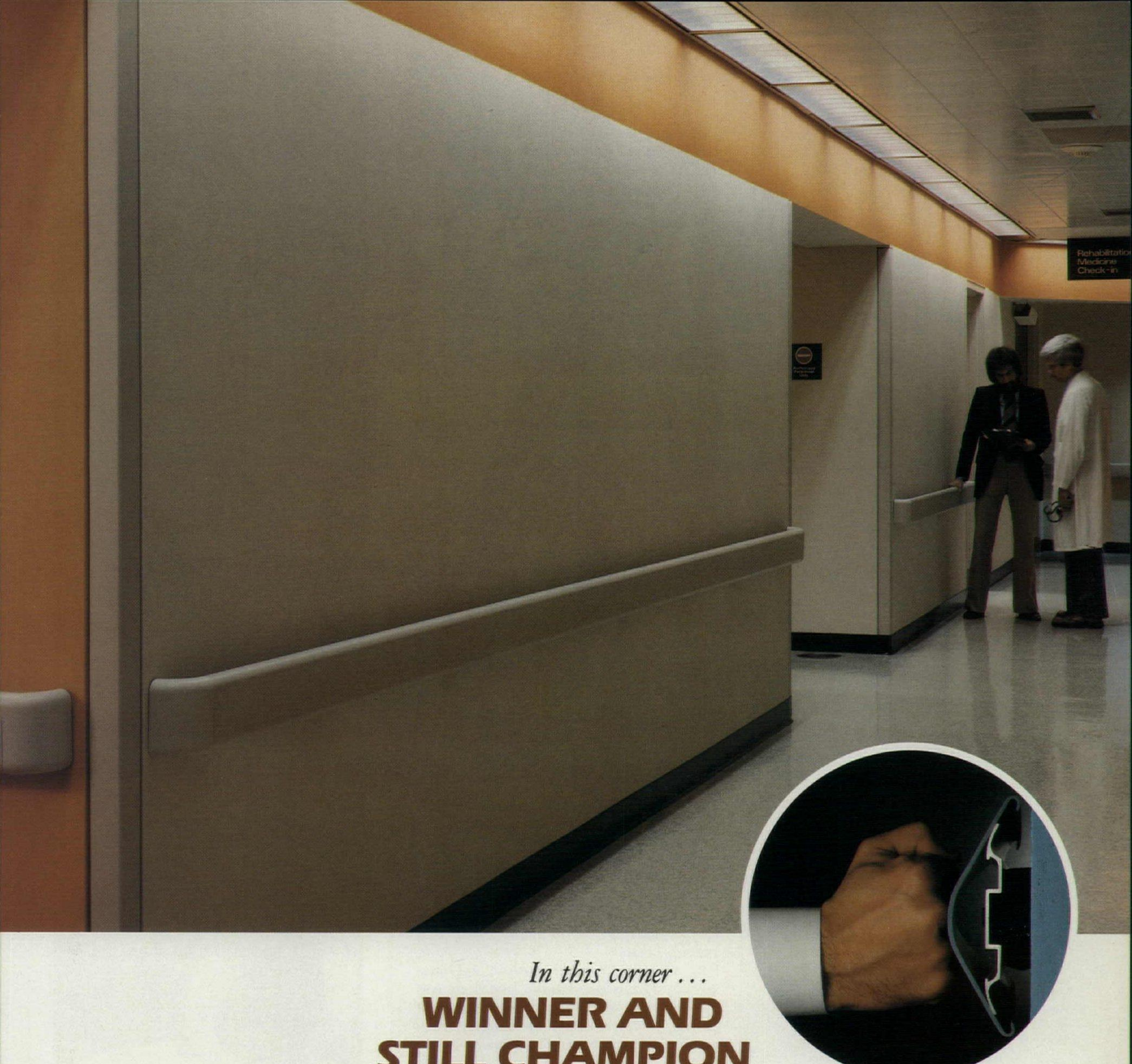
¶ and ten foreign architects have been named Honorary Fellows of the AIA: A. Ian Ferrier, Australia; Sir George Grenfell-Baines, Great Britain; Stanislaw Jankowski, Poland; Swoo Geun Kim, Korea; Padraig Murray, Ireland; Renzo Piano, Italy; Aarno Ruusuvuori, Finland; Shozo Uchii, Japan; Aldo van Eyck, Netherlands; and Abraham Zabludovsky, Mexico.

¶ All of the above honors will be bestowed at the AIA's 1982 national convention in Honolulu, June 6–9.

¶ The AIA, together with the National Easter Seal Society, has announced the presentation of the Leon Chatelain Award to Washington, DC, architect Edward H. Noakes, FAIA, for "outstanding leadership in advancing barrier-free environments for elderly and disabled people." Noakes initiated the first AIA task force on barrier-free design.

Energy points

1300 tons of municipal garbage will generate 25 megawatts of electricity daily in foreign-oil-dependent Massachusetts, when the Commonwealth Electric Company [*Pencil points continued on page 58*]



Pencil points continued from page 56

builds a $124 million plant near the historic town of Plymouth. To be completed in 1985, the plant, an improvement over similar such installations in the Northeast, will save 30 million gallons of oil a year and also will produce ash for road-building and for concrete block production.

Cutting down on salt

SERI-designed salt gradient solar ponds may provide pumping power for a U.S. Army Corps of Engineers project to reduce the salinity of Texas's Red River. A 25-acre solar pond, to be completed in 1984, is the first of five modules in a 135-acre system that will use solar-produced heat to operate turbogenerators to produce electricity to power brine-pumping for the Tulsa District Army Corps of Engineers' chloride control project.

Grain storage, heat storage

Those vast and silent forms that inspired Le Corbusier's eloquence may serve a new purpose, suggests architect Robert White. One of the idle grain elevators on Montreal's waterfront, with 52 six-meter-diameter by 25-meter-high silos, can store 130,000 cubic meters of water heated by 14,000 sq meters of collectors placed on adjacent warehouses.

¶ In the summer, cool water can be drawn from the harbor to provide air conditioning in the area.

AD awards: happy mixture

The British magazine Architectural Design *has announced the winners in the second of its reinstated annual Project Awards competition. Gold medals went to*

¶ Ahrends, Burton & Koralek for their completed building, the Cummins Engine Co., Shotts, Lanarkshire; and

¶ Zaha Hadid, for a conversion, as yet in the project stage, of 59 Eaton Place, Belgravia, London.

¶ In addition, 9 silver medals, 3 bronze medals, 11 commendations, and 6 student awards were selected, a happy mixture of projects, studies, exhibition designs, restorations, and completed buildings.

And happy competition

AD is also holding a Doll's House competition. Stage One, open to all, is now being judged.

¶ Stage Two will include winners of Stage One, as well as invited participants. Among the latter: Mario Botta, Hans Hollein, Rob Krier, Charles Moore, Richard Rogers, Robert Stern, Allan Greenberg.

¶ Jury includes Vincent Scully, Bruno Zevi, James Gowan, Robert Maxwell, and Andreas Papadakis.

¶ Also, an independent jury (none of the above may apply) will consist of 12- to 15-year-olds.

¶ The entries will travel as an exhibition in Europe and the U.S., and later will be sold, profits going in part to the "Save the Children Fund."

[*News report continued on page 62*]

Baptist Memorial Hospital East, Memphis
Walk Jones and Francis Mah, Inc., Architects

BAPTIST HOSPITAL FIGHTS THE HIGH COST OF MEDICAL CARE WITH WALLS OF SGFT

Structural Glazed Facing Tile was the obvious choice for this high-traffic corridor at Baptist Hospital, Memphis. In-the-wall cost is competitive with that of less durable building materials, as this chart reveals:*

Standard Size Face Brick	$6.50
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One reason for its initial economy is that SGFT provides both wall and finished face in one unit. It reduces on-site labor because it is installed in one step by one trade.

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And now SGFT is available in the 8" x 8" size shown here for more design flexibility.

In hospitals, schools, manufacturing or food processing plants —wherever *both* initial and life-cycle cost savings are a consideration—consider SGFT. The savings go in when the walls go up.

For immediate product information, see Sweet's section 4.4/St, or for complete cost comparison data, call or write Stark Ceramics, Inc., P. O. Box 8880, Canton, OH 44711. Call toll free 1-800-321-0662. In Ohio, call collect (216) 488-1211.

*Per square foot in-the-wall cost for a 4" wall. This information is copyrighted by Robert Snow Means Co., Inc. It is reproduced from *Building Construction Cost Data 1982*, with permission. SGFT cost is for the functional color group, 8" x 16" units. Stark Cost Cutter Tile cost is our best estimate using a comparable scale.

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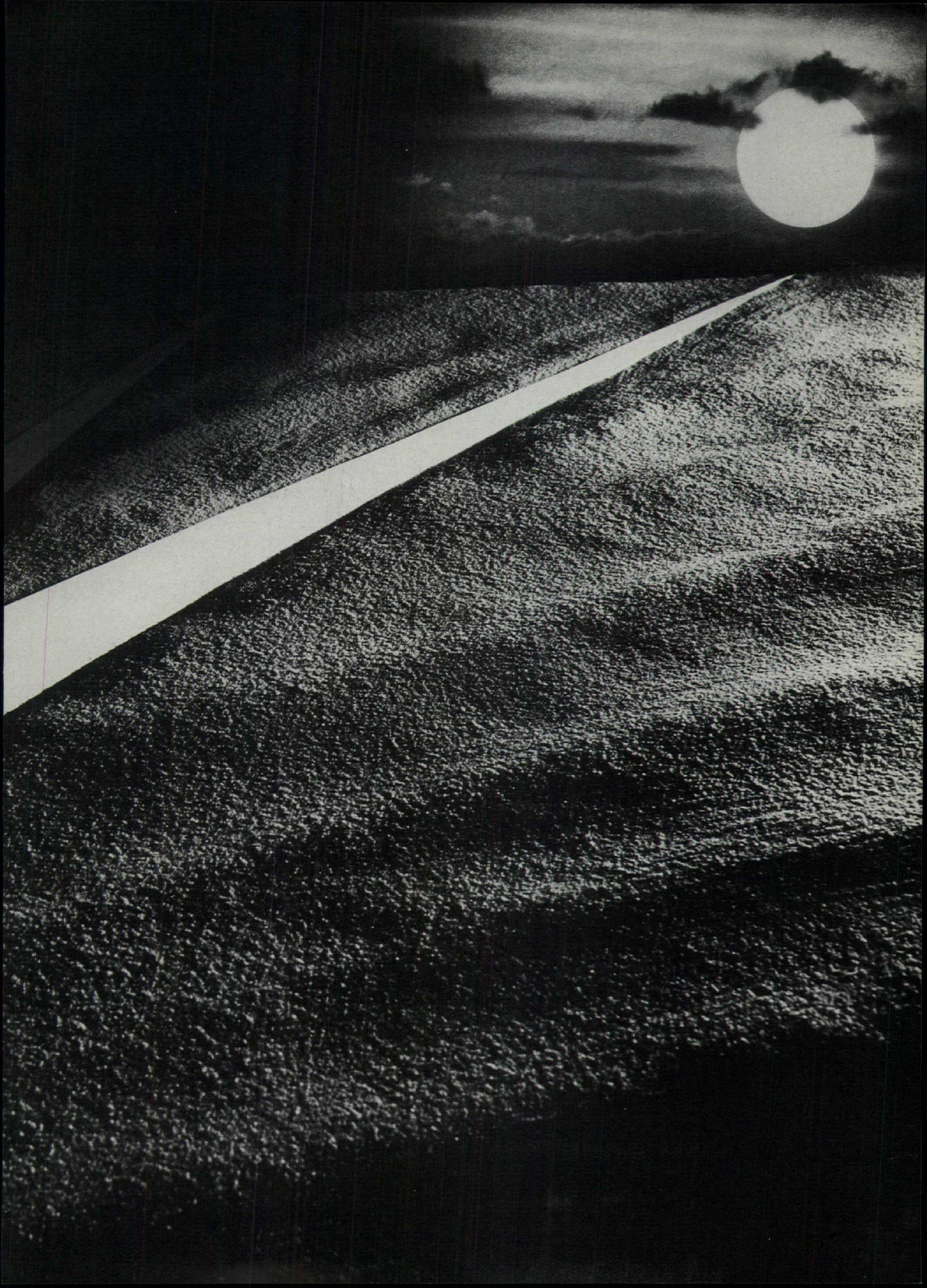


News report continued from page 45

Calendar

Exhibits

Through Apr. 22. Cambridge Observed: Three Hundred Years of English Collegiate Images. Gallery at the Old Post Office, 120 W. 3 St., Dayton, Oh.
Through Apr. 28. Drawings of James Gamble Rogers. Yale University Art Gallery, 1111 Chapel St., New Haven, Ct.
Through Apr. 30. Drawings of Andrea Palladio. Brooks Memorial Art Gallery, Memphis, Tn.
Through May 2. "Architectural Fantasy and Reality." Cooper-Hewitt Museum, 2 E. 91 St., New York.
Through May 2. Original drawings by Peter Bonnet Wight. The Octagon, 1799 New York Ave., Washington, DC.
Through May 9. New Chicago Architecture. Accademia di S. Luca, Rome. Subsequent dates: **May 22–June 30,** Padiglione d'Arte Contemporanea, Milan.
Through May 9. Columbus (In.) Architecture in Photographs, Balthazar Korab. Indianapolis Museum of Art, 1200 W. 38 St., Indianapolis, In.
Through July 4. Edward H. Bennett, Architect and City Planner: 1874–1954. The Art Institute of Chicago, Michigan and Adams, Chicago.
Apr. 10–May 1. "Studio Portfolio," a collection of drawings and models by 10 young architects. Painting Space 122 Association Gallery, 150 First Ave., New York.
Apr. 10–May 9. Transformed Houses. Lehigh University, Architecture Department, Bethlehem, Pa. Subsequent dates: **Oct. 23–Nov. 21,** UCLA School of Architecture and Urban Planning, Los Angeles.
Apr. 16–May 1. Drawings by Architects. Exhibition, sale, and silent auction to benefit Committee to Save City Hall. British Art Center, Artwork Gallery, 44 High St., New Haven, Ct.
Apr. 17–May 16. America's Architectural Heritage. Landmarks Foundation of Montgomery, Montgomery, Al. Also: California State College Library, San Bernardino, Ca.
May 11–June 12. Paul Rudolph: Architectural Drawings. Kelmscott Gallery, 410 S. Michigan Ave., Chicago.

Conferences, seminars, workshops

Apr. 21–25. 35th Annual Meeting, Society of Architectural Historians. New Haven, Ct. Contact SAH, 1700 Walnut St., Philadelphia, Pa 19103.
Apr. 26–27. "The Next Generation in Housing Technology," National Institute of Building Sciences, Orlando, Fl. Contact William Brenner, NIBS, 1015 15th St. NW, Washington, DC 20005 (202) 347-5710.
May 10. Deadline, call for 250-word abstracts, "Designing and Managing Energy-Conscious Commercial Buildings: An Intensive Workshop," sponsored by U.S. DOE and Pacific Northwest Labs, July 19–20, Denver. Contact Marrianne McCarthy, MCC Associates, Inc., 8534 2nd Ave., Silver Spring, Md 20910 (301) 589-8130.
June 1–5. American Section/International Solar Energy Society conference and exhibition. Albert Thomas Convention Center, Houston, Tx. Contact Russell Smith, Texas Solar Energy Society (512) 472-1252 or Griff Ellison, The Energy & Communications Group (303) 629-5449.
June 6–10. AIA Annual Convention "A Quest in Time." Honolulu, Hi. Contact AIA, 1735 New York Ave., NW, Washington, DC 20006.
June 13–18. International Design Conference in Aspen. Contact IDCA, P.O. Box 664, Aspen, Co 81612 (303) 925-2257, 925-6265.

Competitions

May 18. Registration deadline, Second European Passive Solar Competition 1982. Submission deadline, Aug. 27. Contact CEC Competition Organizers, Ralph Lebens Associates, 4 Tottenham Mews, London, W1P 9PJ, U.K.
June 1. Registration deadline, design competition in conjunction with 7th National Passive Solar Conference. American Section/International Solar Energy Society (AS/ISES) in cooperation with *Progressive Architecture.* Contact Design Competition, Box 541, Brattleboro, Vt 05301 (802) 254-2386.

[*News report continued on page 67*]

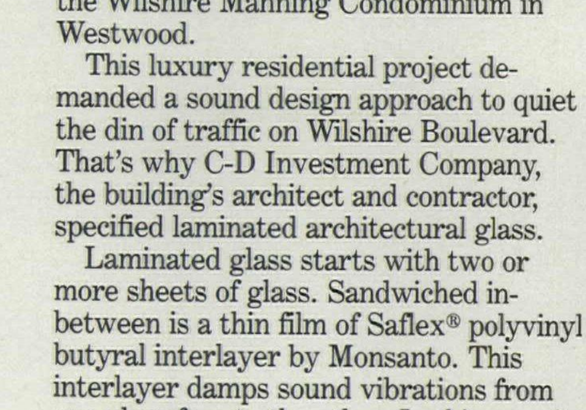
Laminated Architectural Glass.

To give this California condo the silent treatment.

California's Title 25 sets tough standards for sound control. A code that's especially challenging for buildings like the Wilshire Manning Condominium in Westwood.

This luxury residential project demanded a sound design approach to quiet the din of traffic on Wilshire Boulevard. That's why C-D Investment Company, the building's architect and contractor, specified laminated architectural glass.

Laminated glass starts with two or more sheets of glass. Sandwiched in-between is a thin film of Saflex® polyvinyl butyral interlayer by Monsanto. This interlayer damps sound vibrations from one glass face to the other. In this way, it acts as an excellent noise barrier over the entire sound frequency range.



The fact is, tests demonstrate that laminated glass muffles noise more effectively than either air-spaced or monolithic glass.

Laminated glass will further add to the comfort of the residents due to its solar benefits. The color of the glazing is achieved through a bronze-tinted Saflex interlayer which reduces glare by allowing only 28% of visible light to pass

through. Because it also screens ultraviolet and infrared energy, the laminate will help ease air conditioning loads, to account for significant energy savings.

And as always with laminated glass, safety is part of the beauty. The Saflex interlayer functions as a shock absorber, to dissipate impact shock and resist penetration. Even though the glass itself may break, the fragments adhere to the interlayer, minimizing the danger of glass fallout.

Find out more about laminated glass and why it is used in so many of today's most advanced building designs. For complete information and a list of suppliers, write: Monsanto Plastics & Resins Company, Dept. 804, 800 North Lindbergh Blvd., St. Louis, MO. 63167.

SAFLEX

PLASTIC INTERLAYER BY **Monsanto**

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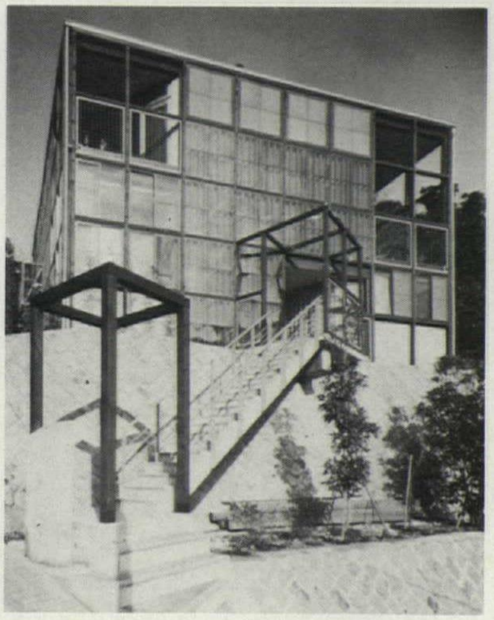
All glazing for this project handled by Fenestrol Corporation of Carson, California.

Perspectives

Energy portfolio

This month's Perspectives section covers energy-related projects, both built and in the planning stages, and includes a review of photovoltaic developments.



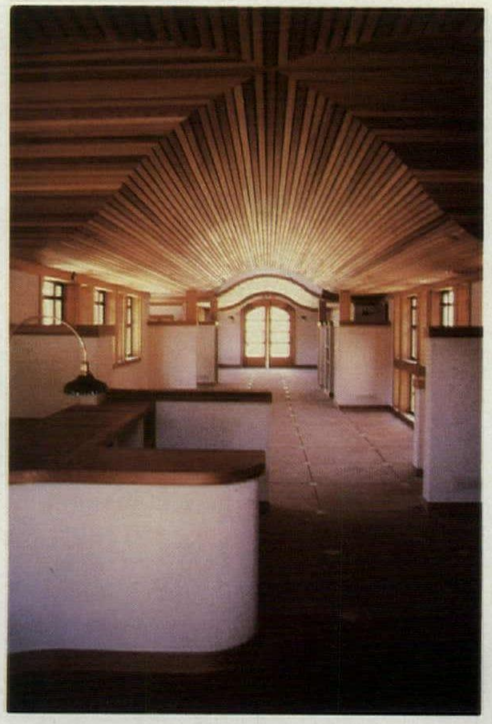
The Endo house.

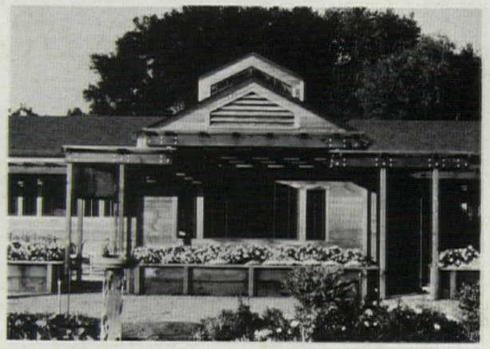
Solar air heating in Japan

Architect Seiichi Endo designed this two-story, 2500-sq-ft wood-framed house for himself on a hillside in the historic area of Kamakura, Japan. For reasons of durability, simplicity, and cost, a liquid solar collector system was rejected, and a solar hot air system was chosen instead.

The solar collectors, whose surfaces total only about 750 sq ft, or 30 percent of the floor area, consist of hot air circulating within 5-ft-square panels of steel sheets covered by polycarbonate sheets. Two 80-liter storage tanks are located in the basement. Hot air for space heating must pass through these tanks as well as through a gas furnace to supplement the heat provided by the solar collectors.

Similarly, domestic hot water heated by the solar-heated storage tanks is supplemented by electric hot water supply tanks. [SD]





Mudd's Restaurant.

Ecological responsibility in California

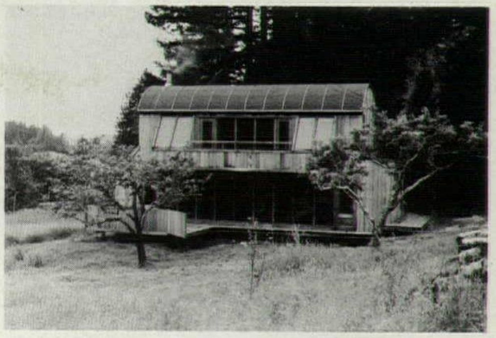
A small-is-beautiful restaurant and ecology center in suburban San Ramon, Ca, realizes its owner's dream for responsible land use and appropriate building technology.

Mudd's Restaurant and Crow Canyon Institute, by architects Max Jacobson, Murray Silverstein, and Barbara Winslow, required an unusual integration of site and buildings. The nine-acre site combines a lightly wooded area on a canyon's edge and farmland, the southern part of which supplies the restaurant's produce. The restaurant's public spaces face the gardens, visually reinforcing their relationship. Kitchen and service spaces are on the north side.

The cruciform plan, with end wings that enclose outdoor dining courts, provides the maximum number of window tables with the advantages of natural light and small serving areas. Eventually, vines will cover the southern trellises, embowering the courts and blocking summer sun.

Energy conservation through natural lighting and ventilation, proper orientation, summer shading, and zoning is enhanced by heavy wall insulation and a concrete floor slab. A two-stage evaporative cooler mitigates heat generated by the kitchen and the summer sun. The tower set above the main crossing has vents connected to ducts above the slatted wood ceiling. Warm air is pulled up through the tower; comfort is achieved by varying the air flow. Solar collector panels fuel the domestic hot water system. The backup furnace is rarely used.

The gable-roofed wooden buildings clad in rough cedar echo the rural vernacular forms that once comprised the local building stock. Inside, the arched cedar-slat ceilings curve down over the window tables, conveying the image of a wooden diner. The result is both timely and timeless. [Sally Woodbridge]



House in California.

Hybrid solar heating in Northern California

A small, two-bedroom house in Occidental, Ca, uses local standard building practices while providing an innovative solar heating system. Designed by San Francisco architect Peter Calthorpe of Calthorpe/Fernau/Wilcox, the two-story wood-framed structure has a hybrid system that employs active and passive methods to store and distribute the sun's heat.

A 1500-cfm fan draws heated air from the cavity in the south-facing windows, depositing it in the rock bed in the 2-ft crawl space and returning cooler air (60 F) to a diffuser high in the second story to prevent overheating at the upper level. Dark, heat-absorbing Venetian blinds within the south window cavities prevent glare and large temperature swings while still allowing views and [*News report continued on page 68*]

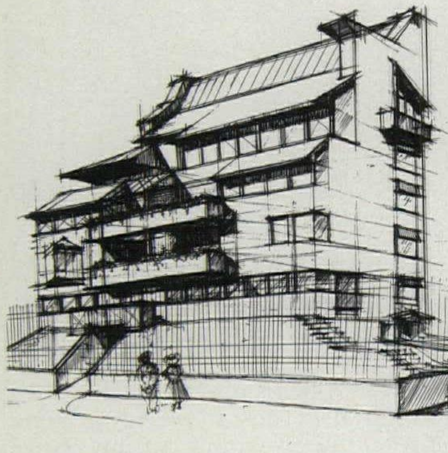
News report continued from page 67

light from the windows; the blinds can be raised on overcast days to allow direct heat gain and closed at night for insulation and privacy.

The hot air from the windows is distributed evenly over the crawl space area, eventually sinking as it cools to enter the lower drainpipe plenum (4-in. perforated plastic pipe laid over the slab at 16-in. on center) to be returned to the building's top.

The passive heat distribution system functions like radiant floor systems, with 100 F air from the windows, for example, providing 80 F floor surface temperature. As the floor cannot be turned "on" or "off," the area of the radiant floor must be designed to handle the average heating load, differing from climate to climate and for each house design. For unusual peak loads, floor registers can be opened to allow natural convection to deliver additional heat. Two Casablanca-type fans high in the two-story spaces prevent extreme temperature stratification. A simple wood burner provides backup heat. A redwood grove to the north provides winter wind protection.

Shading and ventilation are the primary cooling devices of the house, with the balcony and solar domestic hot water collectors above shading the lower south windows, and reflective Venetian blinds shading the upper windows. The rock bed also can be used to store night coolness. [SD]



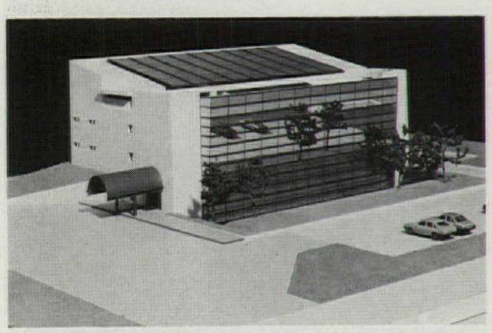
Solominium I.

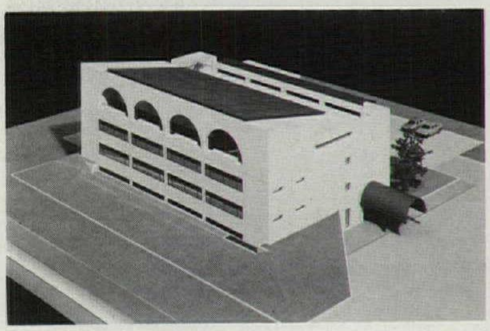
Montreal condominium uses solar energy

Though it is modest in size, with only 8500 sq ft of rentable space, Solominium I is a mixed-use urban project, and the first such project in the Province of Quebec to be committed to the maximum use of actively and passively collected solar energy. Located in Downtown Montreal, it contains five residential apartments, including a large 1900-sq-ft executive suite on the ground floor and two two-story penthouse units, each with its own terrace and at least one fireplace; and, with a separate entrance, two ground-floor offices and a 1000-sq-ft commercial space below. Parking occurs below grade.

Water circulating in plastic roof panels is heated both by the sun and by a gas-fired furnace. Exhaust from the furnace, located in the "energy center" just beneath the panels, is retained as an additional heat source for the panels. The water passing through the panels is also used for domestic hot water. The space-heating agent, on the other hand, is hot air, and each apartment has its own heat exchanger. Fireplaces will provide additional heat.

Cross-ventilation and shade trees will reduce the need for air conditioning in the summer. The project is designed by architects John Schreiber and Ron Williams. [SD]





Tokyo office building.

"World's lowest energy consumer"

A Tokyo office building aims to have "the world's smallest annual consumption" of absolute energy—36,000 Btu per sq ft per year. The Ohbayashi-Gumi Technical Research Laboratory also aims to achieve energy conservation at a minimum cost.

The 37,750-gross-sq-ft building, with three stories, a basement, and a penthouse, has double glazing in a greenhouse-like configuration on its south side, preheating air in the winter and, with the help of louvers, preventing heat radiation at night and moderating heat gain in summer.

Evacuated-tube high efficiency solar collectors, with a surface of 2200 sq ft, are located on the top floor and combine with a high heat storage tank to provide a heating system, supplemented by geothermal energy. Roof-mounted photovoltaic cells are expected to generate a peak power of 1 kW to operate the solar collector pump.

On the south side of the building at basement level, earth is excavated to provide a sunken garden, while on the remaining three sides, the earth is bermed at the first-floor level; the insulating and heat-storage capacity of the soil is utilized, storing excess heat generated by the solar collectors during the low energy demand period in autumn.

Rooms that do not need heating or air conditioning are located on the east and west sides of the building, subject to the effects of solar radiation.

To minimize floor-to-floor height, thereby also reducing exterior wall space and improving energy conservation, the building will use flat-slab reinforced concrete construction. This will also allow the free location of ducts.

Reduction of electrical lighting is an important consideration. Windows are provided in rest rooms and stairways; daylight sensors are installed in office spaces and research rooms, to turn off lights when sufficient daylight exists; and task/ambient lighting is employed in research rooms, with two small task lights at each desk and minimum luminaires on the ceiling.

For optimization and prediction of energy needs and supply, computer techniques are used, including microcomputer networks, mass-produced personal computers, and optical-fiber compatible transmission systems. [SD]

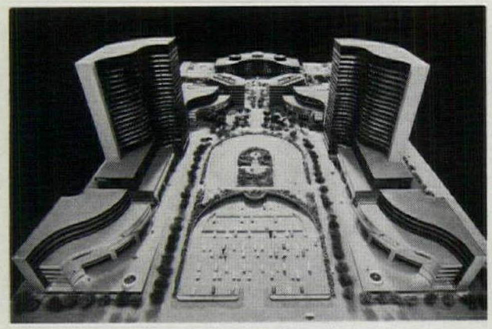
PV-powered horserace

Who seems to be winning the solar horserace depends on where you're sitting. Unless you're seated behind a column, it is clear that photovoltaics—PV—is moving up from behind, fast. Making valuable electricity rather than low-grade heat, PV equipment is easily packaged and easily retrofitted to existing buildings. Each increment of power is immediately useful: no waiting 15 years for a new power plant. Fed into our greatest public work, the U.S. power grid, an electron produced in a well-heeled bedroom community can find its way into the ghetto, whereas solar heating must be consumed—or wasted—on site. The technology offers an embarrassment of possibilities.

For their own selfish reasons, large companies, hoping to take the lead with secrets developed by their own R&D departments, join with small business in applauding Reagan's abrupt halt to the successful and well-run DOE PV program, which cost $157 million in 1980, the price of a sophisticated missile. With a 1983 budget request of $27 million, Reagan seems confident that the DOE had nothing to do with our strong (but now rapidly dwindling) lead in PV development. Tax credits may replace the [*News report continued on page 70*]

The structure, to be completed this summer, incorporates 1760 1′ x 4′ photovoltaic panels integrated within the upper chord of the space frame. The panels produce 62,500 watts on peak days to charge the 12 lead-antimony batteries located in a separate battery room, where direct current is converted into alternating current and fed into 116 light fixtures symmetrically arranged on the lower chords of the space frame.

Adjacent to the solar arrays, flush-mounted shade panels, in a geometric pattern intended to suggest Islamic art forms, provide almost 100 percent shade. In all, the space frame "trees" are about 70 percent self-shading, creating a shifting pattern of light and shade. [SD]



Woodbranch Energy Plaza.

Sensible solar from the Sunbelt

Not only has Houston long had the image as "energy capital" of the U.S., but it also has been associated with buildings exhibiting a lack of concern for long-range issues of conservation. A research project and a commercial development have begun to change this conception, however.

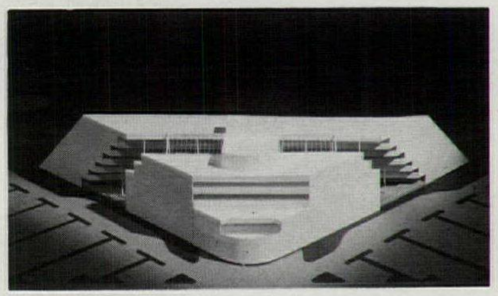
Photovoltaic retrofit

A joint venture by the Houston architectural firm 3D International and the Minnesota-based Technology Strategy Center of Honeywell, Inc., has undertaken an investigation into the design of buildings to be readily retrofitted with photovoltaic cells, using the direct conversion of solar radiation into electricity. Since such conversion is expected to be cost effective by the late 1980s, retrofits of today's buildings are possible. The research is developing criteria for architectural and structural implications, as well as for the distribution and storage systems required by photovoltaics, which generate direct rather than alternating current. The concerns include energy management, interior planning concepts, and marketing programs.

search does point to variables, by which the supply of electricity by photovoltaics would vary as a part of a larger strategy of overall energy management in conjunction with available utilities.

Energy-wise wall system

The recently announced Woodbranch Energy Plaza development of Duerr-Dealy Investments, Inc., features a wall system designed to limit solar loads by means of reflective glass shielded by an exterior system of metal tubular heat reflectors. Developed by Gunnar Birkerts & Associates of Birmingham, Mi (in association with Houston's Morris-Aubry Architects), the tubular sunscreen will be painted muted shades of metallic blue and red with a soft, pewter-like finish. The concept is designed to reduce air-conditioning demand, as well as provide other energy savings through indirect lighting increased by diffusion onto the ceiling plane, thereby lessening the need for artificial light during working hours. The architectural effect, seen as a three-dimensional undulating curve, will still fit in with the sleek corporate styling long a part of Houston's landscape. [Peter Papademetriou]



Gulf Oil building.

Energy producer is energy-efficient

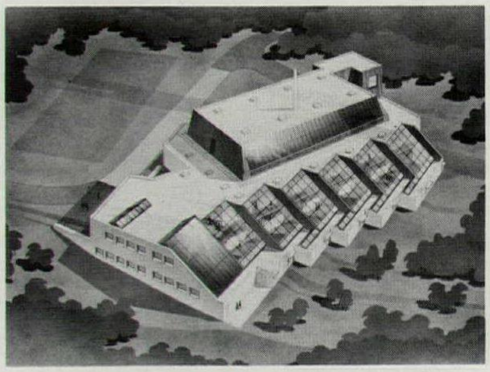
Energy conservation has influenced the form and orientation of a 270,000-sq-ft office building for Gulf Oil Corporation's Regional Exploration and Production division in Midland, Tx. Designed by Caudill, Rowlett, Scott, Inc., of Houston, the structure, on a flat, 13.2-acre site, will be triangular in shape, with two wings joined by a sky-lit enclosed atrium.

The north wing, six stories high (the maximum allowed by zoning regulations) and 60 ft wide, with a sloped northeast façade and stepped overhanging floors on the atrium side, contains office space. The south wing, five stories high, stepped back on the upper two floors, and with minimal fenestration, contains support facilities. Bridges joining the two wings cross the atrium, which accommodates the entrance lobby, reception, and dining areas.

The sloping northeast façade, which will overlook a landscaped park, maximizes the use of natural daylight. The stepped southwest façade of the north wing provides shielding from summer solar gain. The atrium provides light.

The exterior of the south wing is primarily opaque. Solid walls consist of a lightweight prefabricated wall system of insulated fiberglass-reinforced concrete panels. Fenestration in the south wing is protected by overhangs and vertical sun baffles.

Projected completion date is May 1983. [SD]



Vassar College laboratory.

Vassar lab economizes

A teaching and research chemistry laboratory building for Vassar College in Poughkeepsie, NY, is designed to use only 39,000 Btu per sq ft per year to satisfy requirements that traditionally use 190,000 Btu. Designed by Dubin-Bloome Associates of New York, the building will also realize savings by utilizing materials that need no additional finish—brick, concrete block, quarry tile, and concrete beams.

Energy conservation features include earth sheltering, with trees and existing buildings providing natural shading and wind breaks; masonry and concrete walls providing thermal mass, with R-20 wall insulation and R-30 roof insulation; a solar court providing passive solar heating, natural illumination, natural ventilation through stack action and operable skylights, and sun-tempered make-up air for hood exhaust (normally major energy users in laboratories); and triple glazing on north windows, double glazing on all other windows. A heat recovery system, consisting of a run-around loop, transfers heat from laboratory hood exhaust air to tempered outdoor make-up air; a spray coil provides indirect evaporative cooling in summer. Liquid solar collectors provide service hot water.

High efficiency motors and transformers, variable volume control, enthalpy control for cooling, load shedding and leveling for peak electric demand control, power factor control, and reciprocating multicapacity chillers all reduce energy consumption. A microprocessor, [*News report continued on page 76*]

Victoria Station Restaurant, Fairfax, VA., *Architect*: Donald K. Olsen, Sausalito, CA., *Installation*: Krupnick Bros., Glen Burnie, MD.

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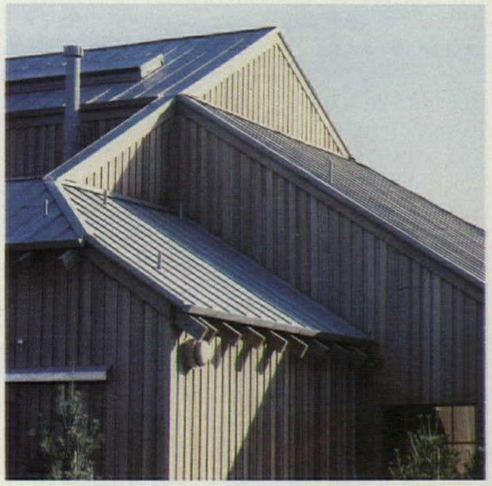


Circle No. 318 on Reader Service Card

News report continued from page 68

government's key role as buyer in creating a market to stimulate growth. Nothing can replace the now extinct federal role in persuading reluctant U.S. companies to meet severe product quality standards. While our firms rankle about overregulation, Japanese and European companies find these same standards far too lenient. When you choose your PV retrofit in 1990, you may find choices like those you now make between foreign and domestic cars, God save us.

Program reports

The cast-off government program left behind some interesting reports and experiments. At MIT's Lincoln Laboratory, soon to be out of the PV program, the monitoring of existing homes for the Northeast Residential Experiment Station showed that given 4 to 6 kW peak output arrays, about two-thirds of the power produced could not be used on site at the time of generation. Given the high cost of battery storage, these results show that the rates at which utilities buy back excess power, set under the so-called PURPA regulations, hold the key to a strong residential market. The MIT people also found that, with minor glitches, the arrays all work well, while the inverters—those devices which change the d.c. produced by the arrays into the a.c. we use—either didn't work, or produced power of unacceptable quality for most utilities. New inverters are coming onto the market, but they remain the Achilles heel of residential systems.

Sandia Laboratories chose paper studies instead of construction as a cheaper way to learn about a wide variety of system and building combinations. With the GE Advanced Energy Program Department as a contractor, assisted by Massdesign Architects and Planners of Cambridge, Ma, six technical reports on residential designs are now available through the National Technical Information Service (summarized in report SAND 81-7182). Total Environmental Action of Harrisville, NH, has completed a study for Sandia on the retrofit potential for residential PV, and finds it truly staggering, with over 20,000,000 1–4 family dwellings "retrofittable" with large arrays.

Sandia is now running both the Northeast RES and its southwest counterpart in Las Cruces, NM, along with the nine commercial experiments resulting from a DOE solicitation in 1978. These projects are: Wilcox Hospital, Kauai, Hi; Phoenix Airport, Az; BDM Office Building, Albuquerque, NM; Dallas-Fort Worth Airport, Tx; Lea County Electric Coop, Lovington, NM; Newman Power Station, El Paso Electric Co., Tx; West Side Community Development Corp., San Bernardino, Ca; Oklahoma City Center Arts and Science Building, Ok; and Beverly, Ma, High School. Totaling over 700 kW of peak capacity, all these systems should be operational by June. Other federally funded projects, frankly labeled "pork-barrel," are managed by Oak Ridge National Laboratory and include the Mississippi County Community College project featured in this issue; the new system at Georgetown University, for which solicitations are being evaluated; and a central station power-generating system for the SMUD—the jolly acronym for the Sacramento (Ca) Municipal Utility District.

Privately, the most visible nonresidential project is the proposed array for the Citicorp building in Manhattan (P/A, Jan. 1982, p. 33). Originally designed by architect Hugh Stubbins & Associates to receive a solar thermal array, which proved too costly, the building will now be used as a testbed for comparing direct use, storage, and sell-back operating modes. Most of the exciting private sector action takes place behind security screens, as companies race to develop the new thin-film technologies now well advanced in Japan, and which show signs of becoming the new industry standard to replace silicon wafers at greatly reduced costs.

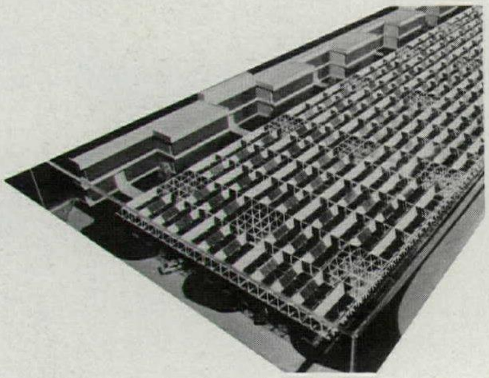
The residential sector

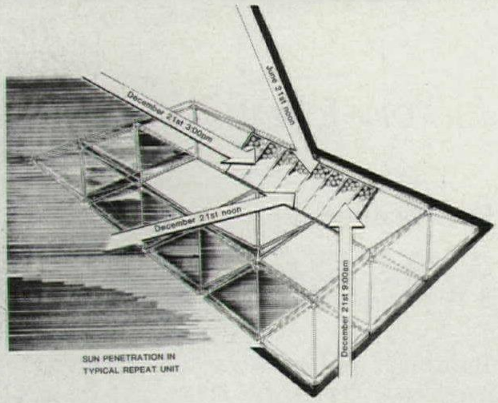
The residential sector has until recently been dominated by projects funded directly or indirectly by the feds. Examples are the Florida Power and Light demonstration house, and the first occupied PV house in the US, on Molokai, Hi. The Carlisle house, widely publicized last year, featured a $100,000-plus array paid for entirely by the government. Two other recent projects by Solar Design Associates, by contrast, are privately funded: a superinsulated, earth-bermed residence in Milton, Ma, and the Eldorado Photovoltaic House in Santa Fe, built for sale at a reported price of $200,000, including the array, by Mark Conkling of Rational Alternatives, Inc. Georgia Power and Light has just completed a PV house funded entirely by the utility, which, like the Citicorp project, uses Westinghouse design expertise.

Should you put a PV array on your next design? Figure an investment today of $15 to $20 per peak watt output for a no-storage, grid-connected system, which translates into 1.5 kWh annually in Boston, and about 2.2 kWh annually in the southwest. At 10¢/kWh, you get a first-year return, neglecting tax credits and buy-back ratios, of about 1 percent. By 1986, that number should be more like 8–10 percent. If you settle for a little d.c. power and do it yourself, explained Joel Davidson (General Delivery, Pettigrew, Ar 72752) at a 1981 solar conference, practically anyone can have PV for a price well within reason. If you live remote from power lines, PV "stand-alone" systems can be very attractive economically, since you save the high cost of running power lines to your site. Companies such as Solarwest Electric Co., in Santa Barbara, Ca, are springing up to serve the private sector's needs for remote site applications. Remote site projects have long been the bread and butter of the industry, as evidenced by the hundreds of village power and water pumping systems built under the Federal FPUP program here in the U.S., primarily at Indian villages in the Southwest. Remote village applications in the Third World provide good experience for American companies seeking to compete in a world market.

What of the near future? "Early users" will continue to put in PV, with the basic market being for remote sites. As R&D drives costs down, the race is on, among competing technologies and between the U.S. and the well-organized efforts of Japan and Europe. The nation might well encourage its builders, perhaps through subsidies, to salt away unshaded, south-facing roofs for the rapidly approaching day when buying a PV array is as routine as buying a car. [Gordon Tully]

Gordon F. Tully is president and cofounder of Massdesign Architects and Planners, Inc., Cambridge, Ma. He has broad experience in architecture and in energy-conscious design, and has been involved in PV design research for several years.





International airport, Jeddah.

Saudi Arabia airport demonstrates photovoltaics

An 88,000-sq-ft space frame parking structure for the King Abdul Aziz International Airport in Jeddah can collect enough solar-produced electricity in one day to light the entire parking area for five nights, according to its designers RSA Architects of Culver City, Ca.

[*News report continued on page 72*]

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minicomputer system will control and manage all loads and optimize energy savings.

Instrumentation will permit the mechanical and laboratory systems to become a part of the education program, with students participating in the energy and storage analyses.

Construction is expected to begin in the fall. [SD]

Sun and clay in Santa Fe

The sunlight, climate, historic precedent, and social attitudes in Santa Fe, NM, point to one logical solution: solar architecture. This natural match has helped define Santa Fe and nearby Albuquerque as centers of solar design and research for the past decade.

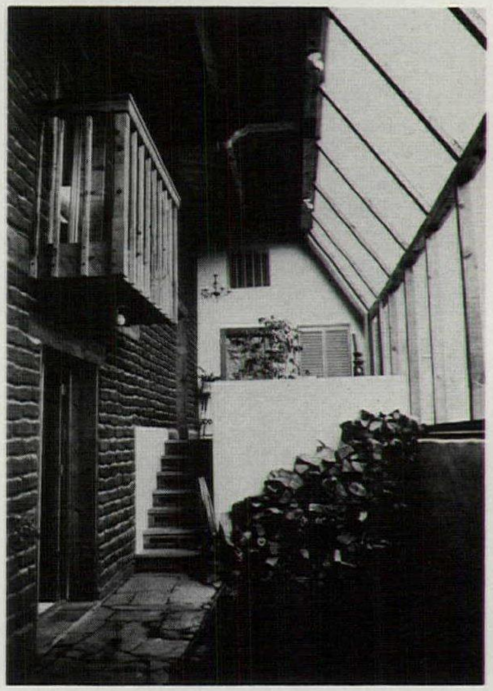
Not surprisingly, then, an inventive housing development has been born in Santa Fe. La Vereda, designed by Susan Nichols, is a collection of 19 single-family houses built simultaneously, all using primarily passive solar heating (70–90 percent) and all built to comply with the traditional Santa Fe "Spanish Pueblo" style.

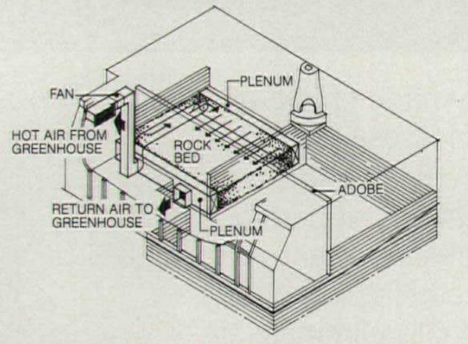
La Vereda represents more than just 19 families learning how to save fuel. The developer, Communico, Inc., has succeeded in capturing the interest and support of the local utility, Public Service Company of New Mexico, as well as Los Alamos Scientific Laboratory, the Electric Power Research Institute, and the Department of Energy. As a result, the houses were built with experimental output in mind, and the benefits are far-reaching.

Although the initial financial demands were formidable, the marketing of solar houses within a large project was more effective than selling the same 19 houses sprinkled throughout Santa Fe. The size of the venture, furthermore, provided the opportunity to plan for sensible land use continuity through the explicit covenant each house owner must sign. The covenant preserves the natural landscape around the houses, the physical and aesthetic maintenance of the total housing environment, and the solar access rights of its members.

Who forms the market for the homes? Communico responds: "Young professional people with two incomes and older people who are retired or approaching retirement." Some of the houses have been purchased as second homes. Those who bought before the project was complete were able to choose from among four house models.

Each house design had the same basic energy task: allow the sun to enter the space directly for daytime heat in cold weather, and use thermal mass to store the daily solar energy for use on winter nights. Each house has active solar water heating and a wood-burning fireplace.





A house in La Vereda (top), an interior (left), a view of the development (middle above), and a diagram of model 4.

Backup heating is done by electric baseboard units. In summer, direct sun is minimized in the interior spaces, and the thermal mass retards the warming of the houses until the evening. All houses are built at least three feet into the ground on all elevations but the south. Clerestory windows and skylights throw light into rooms with no direct sun.

Two strategies besides direct gain are used to capture and delay heat use: the greenhouse and the stagnated Trombe wall. Two models employ greenhouses. In one case, the small greenhouse heats up during the day. Its mass walls projecting into the space radiate at night. The other model uses a larger greenhouse, ducting excess solar heat to a rock bed storage.

Three of the models use stagnant Trombe walls, expressing the confidence the designers had in the principle. A trouble-free seasonal heater is created by providing triple glazing over a massive surface and not venting the air space thus formed. Besides using the traditional adobe for thermal mass, the developers also experimented with a water wall system consisting of rectangular metal tubes filled with water and covered with a highly efficient selective coating. Walls not used for storage employ heavily insulated 2″ x 6″ wood construction. Ceilings are equally well protected.

One of the homes in the project has been equipped with an electric heating mat buried in the ground below a masonry floor. The elements are controlled by computer to optimize their coordination with solar supply. The goal is to discover the appropriate strategy for keeping the electrical usage in cheaper, off-peak hours.

Another home is an experiment in water conservation. While all of the houses employ water-conserving fixtures and avoid lawn upkeep by using the natural landscape, this house collects and treats its gray-water for use in irrigation. A cistern is also used to complement the gray-water supply.

There is nothing timid about the project. The adobe and wood inside are as raw and gutsy as the site outside. It's in the air. If you don't like the baked earth underfoot or the dust in your eye, you probably don't live in Santa Fe anyway. [RR]

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In progress

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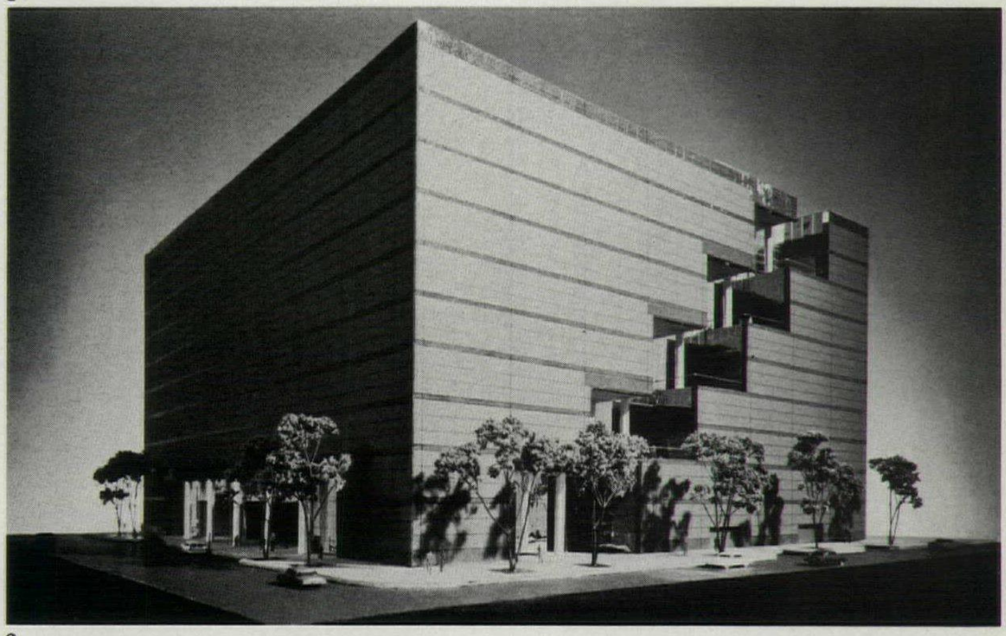

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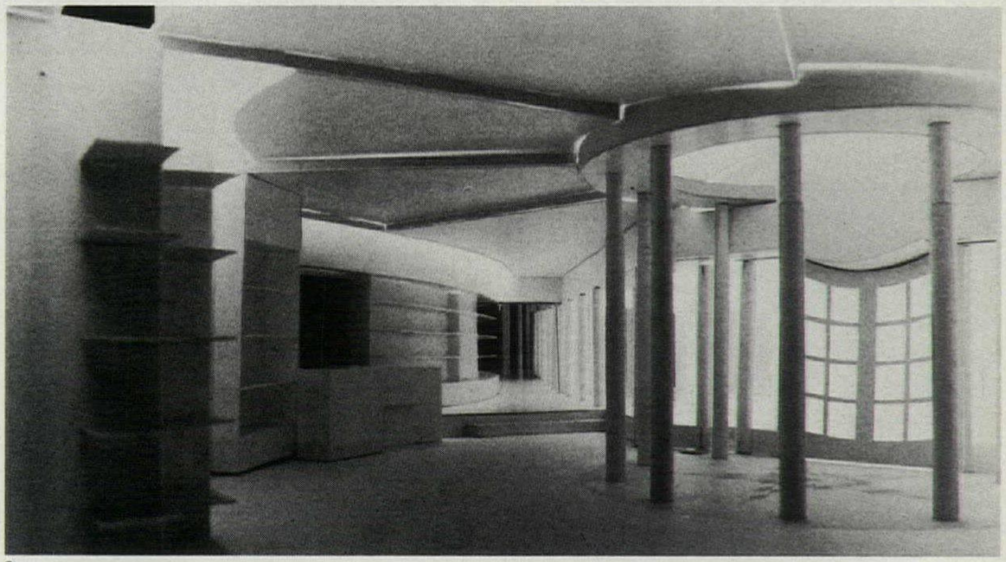


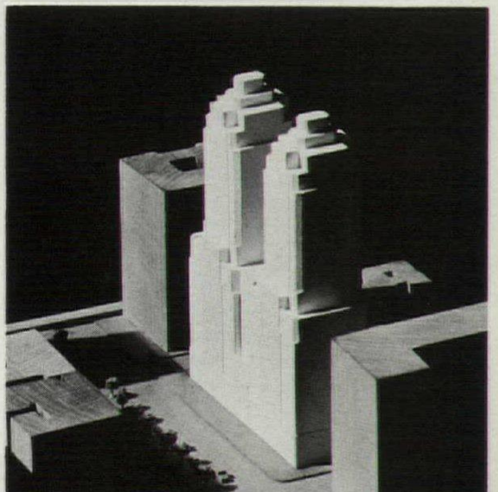
3

1 The Parkway, Brookline, Ma. *Architect: Goody, Clancy & Associates, Boston.* The former Free Hospital for Women designed in 1892 by Shaw & Hunnewell, with landscape by Frederick Law Olmsted (who designed the facing "Emerald Necklace" Parkway), will be converted into luxury residences at a cost of $11 million. The five existing buildings will be restored into 52 residences, while 34 new attached townhouses will be added with careful consideration of the steep, heavily wooded site and original Olmsted concept. Parking under the new units will divert traffic away from the residential quadrangle. The Women's Free Hospital is included in the National Register of Historic Places.

2 Houston Design Center, Greenway Plaza, Houston, Tx. *Architects: Cambridge Seven Associates, Inc., Cambridge, Ma, and Lloyd Jones Brewer Associates, Houston.* The 500,000-sq-ft Houston Design Center is a ten-story "designer warehouse" facilitating the centralization of the expanding interior design products and services market. A 30′ x 30′ structural bay and 13 ft-6 in. floor-to-floor height provide a flexible planning arrangement, while a series of escalator-linked wells form an offset diagonal "circulation canyon." This interior circulation cuts through the building's mass as a series of crystalline double-height windows contrasting with the exterior finish of rough-hewn gray and highly polished blade granite. The $70 million facility is the most recent expansion of Houston's mixed-use Greenway Plaza development. [Peter C. Papademetriou]

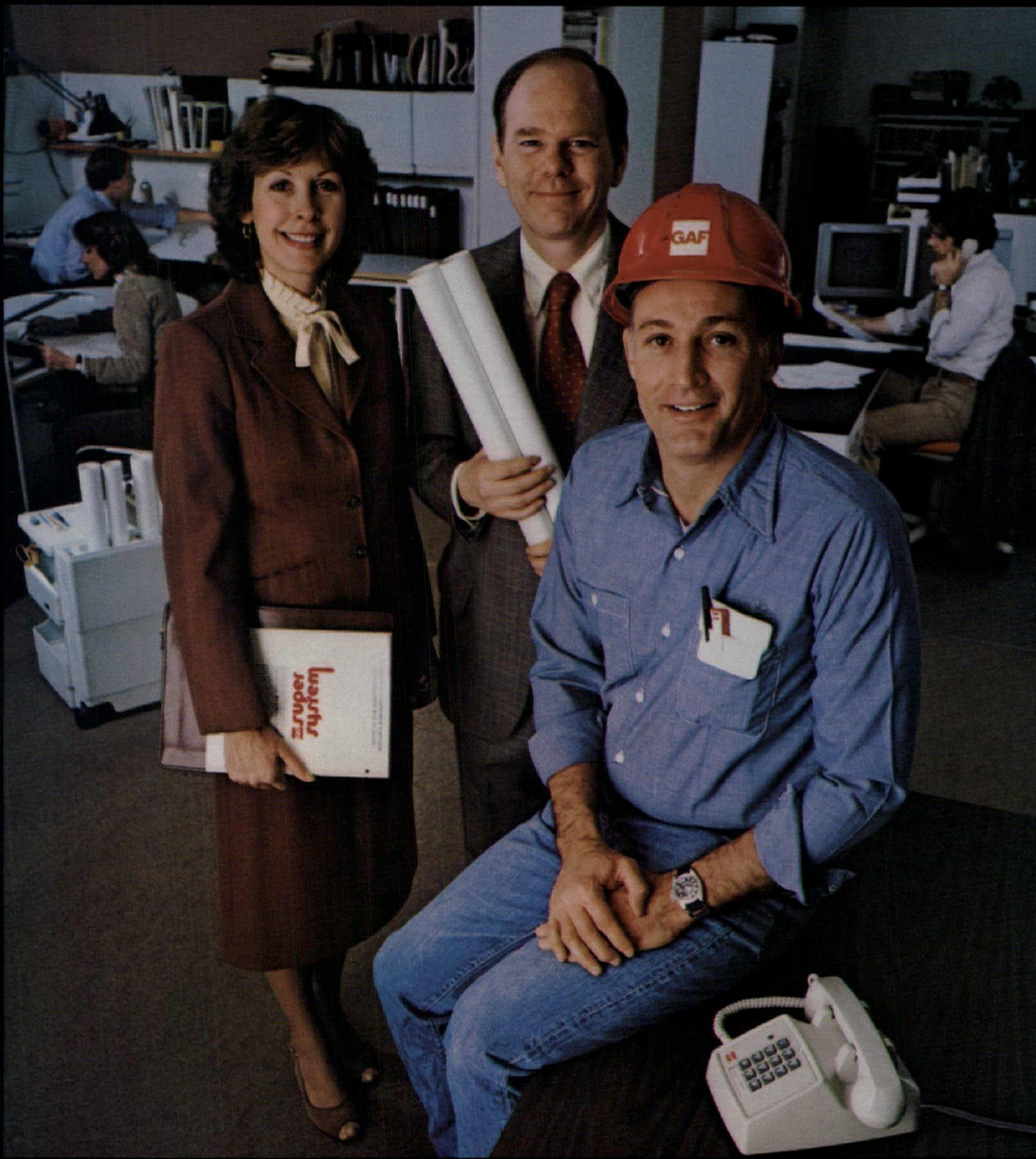
3 Ludwig Beck at Trump Tower, New York. *Architects: Hans Hollein, Vienna, in association with Swanke Hayden Connell Architects, New York.* This German-owned shop selling elegant accessories has hired Viennese architect Hans Hollein to design its 4500-sq-ft shop in the Atrium of Trump Tower, now under construction on Fifth Avenue. A Bavarian theme is followed. The entrance door, actually flat, seems to curve as muntins dip in perspective. Within the doorway is a rotunda with a sky scene on the ceiling and a multicolored marble Bavarian star set into the marble floor. The display areas fan out from this point. A double row of columns will be finished in either polished bronze or marbleized metal. The storefront pulls back from the base building's established line, but here Hollein's fantasy may be stymied: He wishes to "support" the usual cove with a real tree trunk, but Trump and Swanke Hayden Connell, unfortunately, object. [SD]

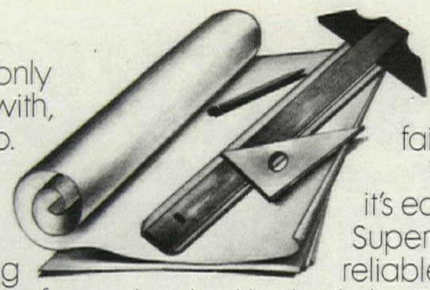
4 Apartment building, New York. *Architect: The Gruzen Partnership, New York.* This twin-towered apartment house, originally intended to be a single "as-of-right" tower, was redesigned to meet the new R10 infill zoning regulations that cover Manhattan's Upper West Side. The 13-story base matches the height and cornice lines of the neighboring buildings along Broadway, with the towers set back from the street wall. The central court contains a landscaped garden. Each floor above base level holds five apartments, and four duplex penthouses cap the towers. Façades of warm gray masonry blend with other West Side landmarks (the Museum of Natural History, for example), and the twin towers recall older notable apartments in the area. [RJ]



4


A BUILT-UP ROOF IS ONLY AS STRONG AS ITS SUPPORT.





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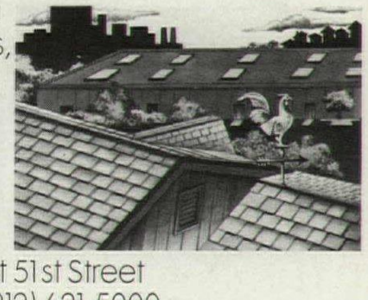

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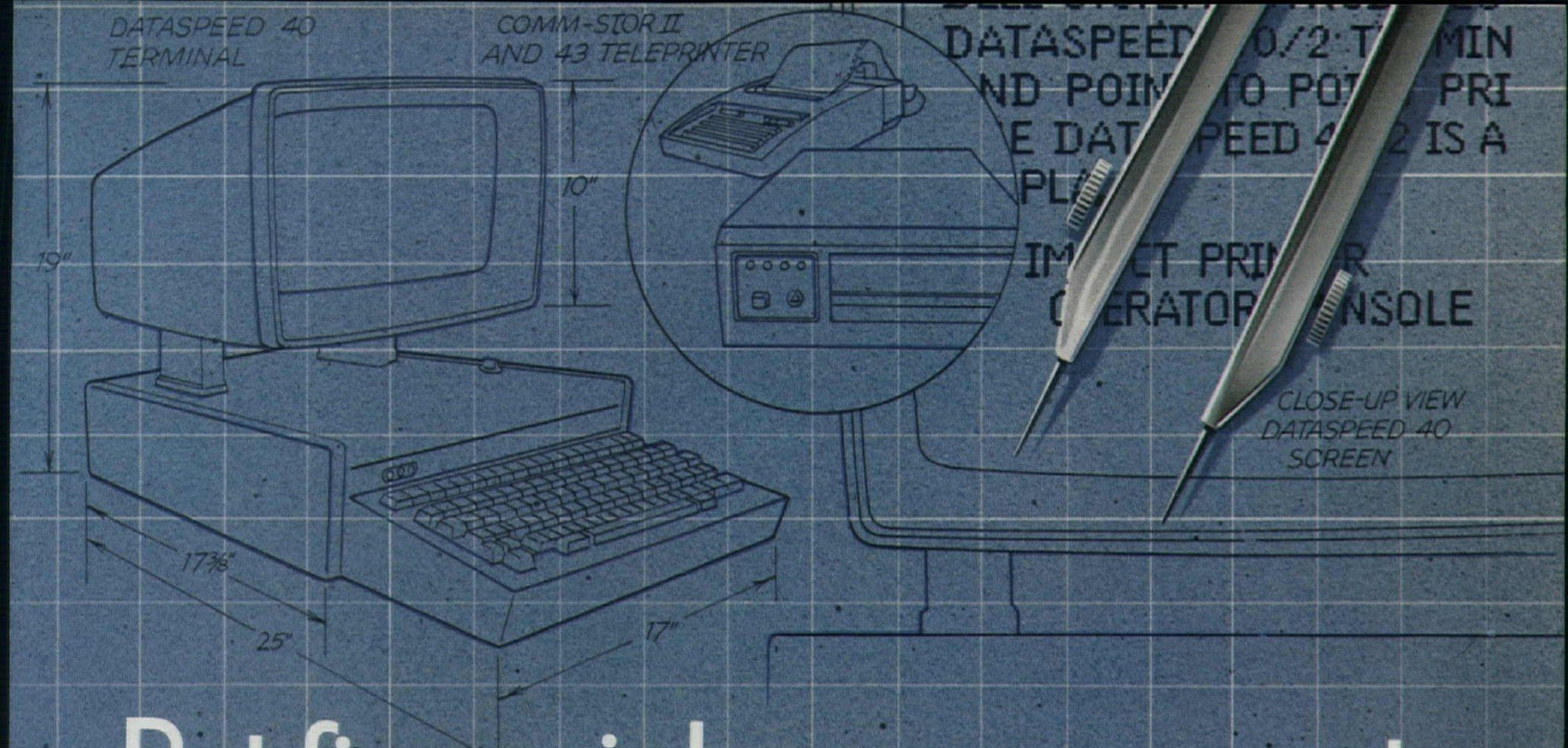

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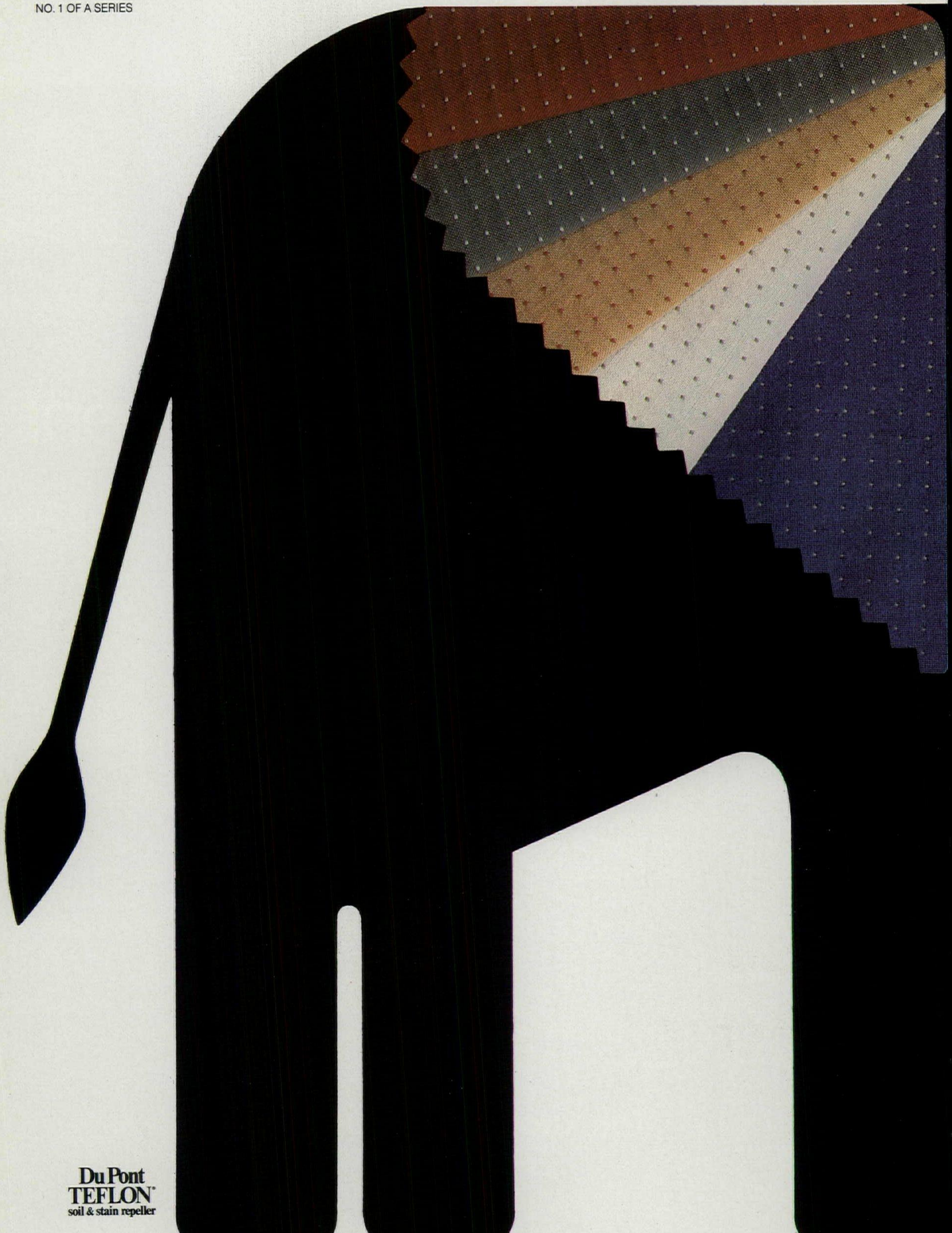
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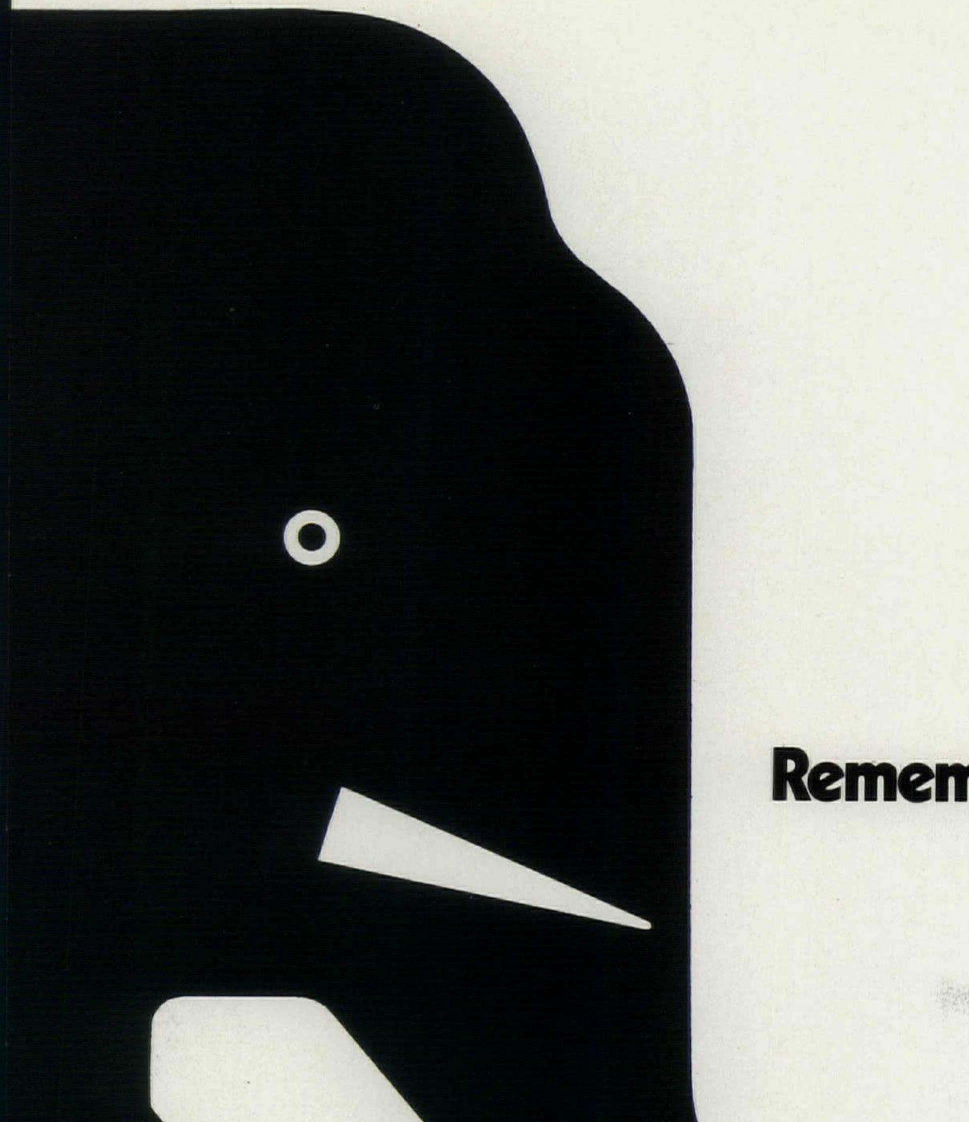

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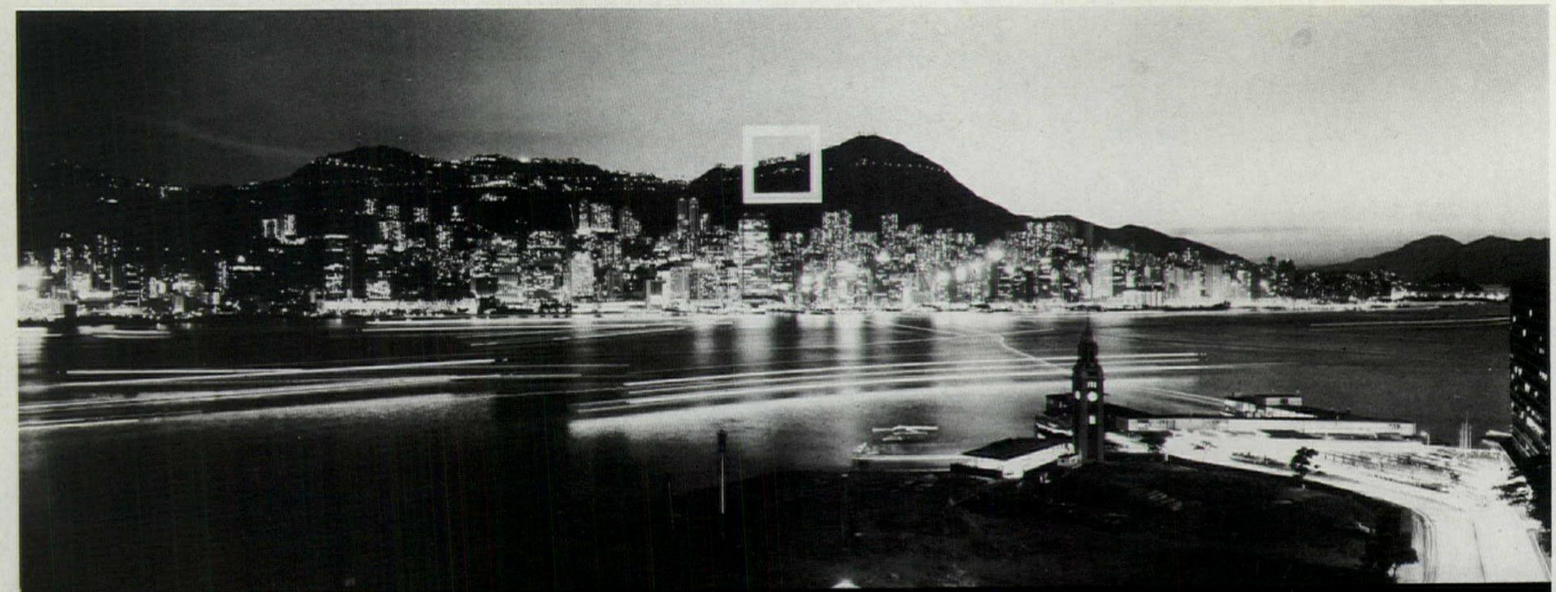


COMPETITION

"THE PEAK" HONG KONG

U.I.A./H.K.I.A. Sponsored
International Single Stage Architectural Competition

The Directors of OLS Holdings Limited invite designs for the redevelopment of three adjacent sites on the Peak, City of Victoria, Hong Kong.

Hong Kong is a vigorous commercial and financial centre, with a present population of six million. Its development has now embraced a stage where an increased awareness of quality in the environment is sought. The topography, landscapes and seascapes lend a drama and excitement to the city, complementary only to the vigour of the people.

The competition brief envisages the creation of a development of considerable luxury which will provide an outstanding example of architectural achievement. It will thus promote the idea of excellence in architecture and serve as a visible landmark. Although of relatively small volume (approximately 6,100 metres in gross floor area), the development is sited virtually on the skyline of the Peak and is visible from many parts of Hong Kong Island and Kowloon.

The accommodation will have residential units directly linked to club facilities whose emphasis will be on the provision of premises for social functions. Somewhat limited health club and sporting facilities will enhance the recreational provision, but the majority of the accommodation will provide for the activities associated with a traditional businessman's club. Flexibility in design is essential.

The Assessors for the competition will be Mr Richard Meier, Mr John Andrews and one other, together with the Hon. Michael Sandberg, Chairman of the Hongkong & Shanghai Banking Corporation, and Mrs Siu Hon Sum on behalf of the Promoters.

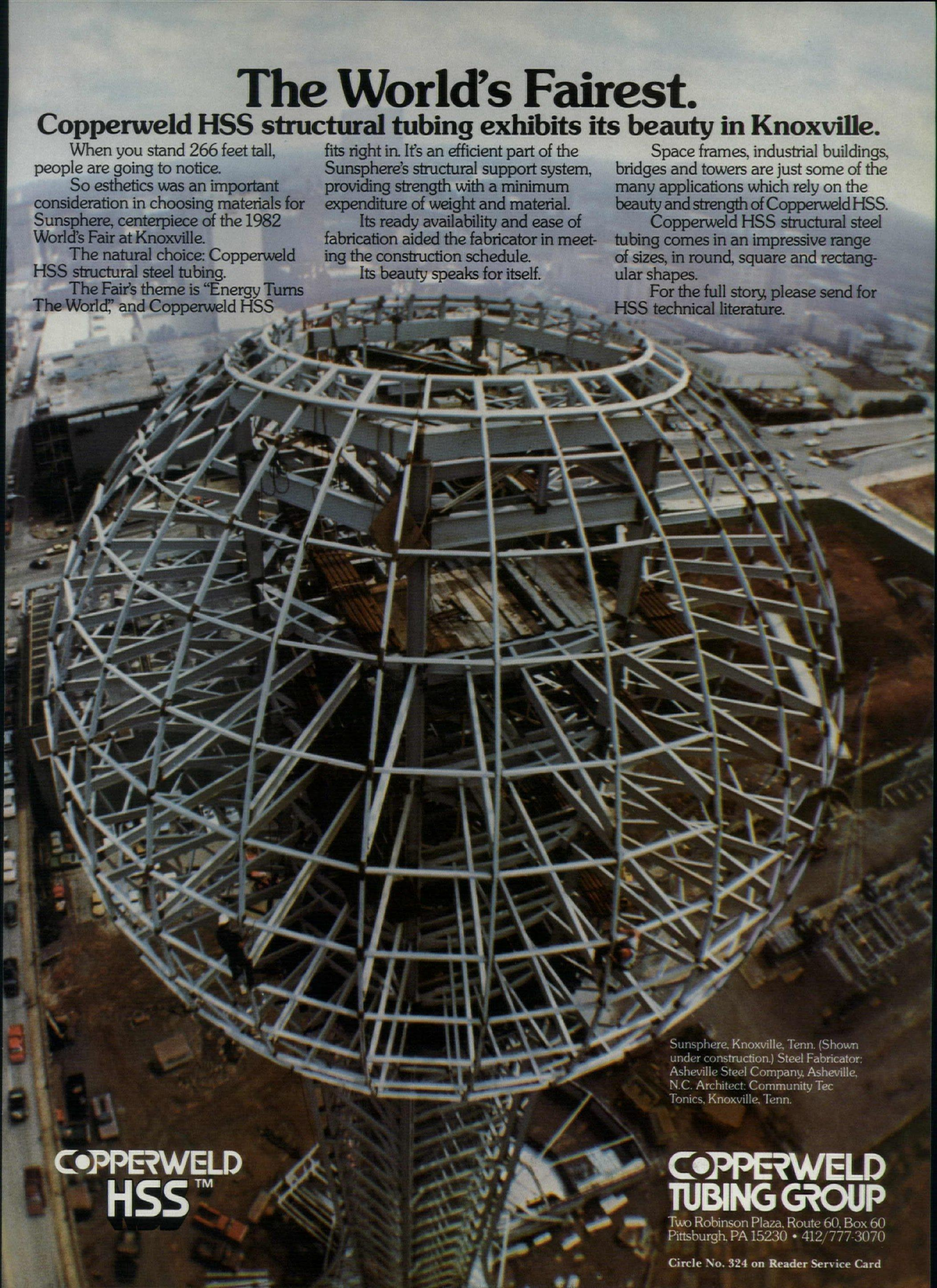
The Promoters will pay premiums of US$100,000, US$60,000 and US$40,000 respectively for the top three designs. A further US$100,000 will be allocated for special awards. It is intended that the winning entrant be retained by the Promoters to carry out the proposed design, subject to any amendment required by the Building Authority of the Hong Kong Government Public Works Department.

Full particulars of the competition will be deposited through U.I.A. with all affiliate and member institutes throughout the world.

Application for competition conditions should be made to the office of the Professional Advisor:

Mr Jon A. Prescott, 2-4 Sunning Road,
5th Floor, Causeway Bay, Hong Kong.

Registration will tentatively close on July 1, 1982. Assessment will be made during November 1982 and the competition results announced in December 1982.



Sunsphere, Knoxville, Tenn. (Shown under construction.) Steel Fabricator: Asheville Steel Company, Asheville, N.C. Architect: Community Tec Tonics, Knoxville, Tenn.

Introduction Part I

Energy design with confidence

For the fourth consecutive April, the issue theme is energy-conscious design. This dynamic and turbulent field has produced an equally volatile body of information, some of it untested and expendable. At the foundations, however, designers make use of solid data with increasing confidence.

Elizabeth Golz Rush

Late one afternoon on the train from New York to Washington, DC, I was drowsily mulling over some remarks to be presented later that evening at a panel discussion. I flagged the porter, requested, and soon received, a cup of coffee to help alert my senses. And it had that effect, even *before* I drank it.

What was placed on my lowered seat tray was another plastic tray of about the same dimensions with raised sides. In its center, on a pile of paper napkins, sat a brown plastic cup, filled to the brim with coffee. The instant the tray was in place, the train attacked the cup, creating a miniature coffee surf. The area around it was alive with tie and suit spots looking for a home. I mentally rifled my arsenal of defensive options while the jostling train and sloshing coffee held me a frozen prisoner.

To my amazement, the foray was settled quite neatly in the tray before me, without my help. The pile of napkins beneath the cup had caught every flying drop of coffee and the cup was peacefully rocking the remaining liquid.

As the sounds and sight of the surrounding train and other passengers regained my attention, my thoughts naturally turned to the cosmic significance of my narrow escape. The train and cup had cast aside the top inch or so of coffee and helped me to select that which I could safely and certainly use.

The field of energy information is witnessing a similar transformation. Out of the unparalleled storm of energy research, innovation, and design that has taken place in the past decade, an information and methodology base has resulted that designers and practitioners can use with confidence. Those who have not yet partaken of it may now do so without undue apprehension.

No single article or magazine—or book, for that matter—could ever succeed in presenting in one place such a vast body of knowledge. What we have attempted to do in the first part of this issue is select a team of authors who could encapsulate it, frankly hoping to stimulate further exploration by our readers.

There are four articles. In the first, while contemplating the origins (and destiny) of government sponsorship of energy research, legislation, and regulation, Tom Vonier takes on the current philosophical stance in Washington. The Department of Energy has dominated the creation of many of the design tools and much of the energy information base. While the government's participation has been far from perfect, anyone fully cognizant of the scale of the problem to be solved—and the magnitude of the vacuum left by DOE—cannot but gasp at the task now left to a disorganized private sector.

The second article is the introduction to a new series, which will be published in *Progressive Architecture* in the next year, in an attempt to bring a vast body of DOE-sponsored research to the architectural community. The role that energy-conscious design can play in the total spectrum of building is analyzed with the emphasis on applying the appropriate strategy to each generic building type.

The third feature, by members of the Princeton Energy Group, displays for the first time in the architectural press a full array of energy aids. These are nuts-and-bolts tools in use today for solving the specific energy problems confronted in each building.

In the fourth article, Vladimir Bazjanac completes the setting with an explanation of the role of energy analysis in the design process. Special emphasis is given to a specific tool, DOE-2, the main-frame computer program, which has been the base of the P/A Energy Analysis series for the last two years.

The emphasis in these articles is on the task of designing. The bulk of this information, however, is related to the analytical aspects of the task. The emphasis on the synthesis comes later. [Richard Rush]

Energy and government policy

Zero?

Thomas Vonier

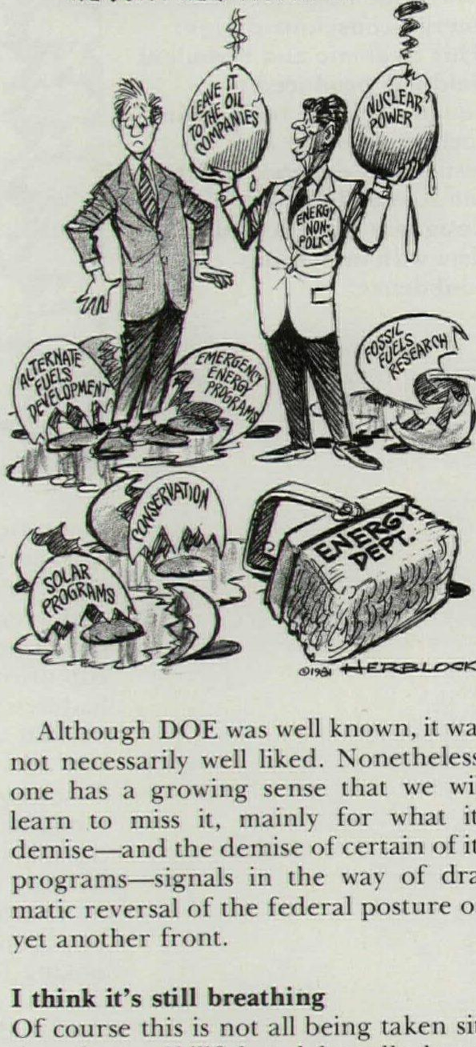
Nearly a decade has passed since the Mideast oil embargo and the onset of massive federal energy efforts. This year will witness the full force of the dismantling of the federal conservation and solar energy apparatus. What are some of the possible effects? Where will the voices be heard—and there are many—of those who urge a continued commitment? Here is a look at the past several years and a view of the changed outlook.

Last year at this time, just a few months after the presidential inauguration, P/A forecast the demise of federal energy conservation and renewable energy programs (April 1981, p. 31). The inertia of the federal system and a Congress willing last year to restore some of what had been excised from the president's first budget have left essentially untested the Reaganomics approach to saving energy in the built environment. It appears now that fiscal year 1983, which begins on October 1, 1982, will provide the first genuine test of the new approach. For 1983, the White House has proposed near-total federal withdrawal from this arena, and there is little convincing evidence that conservation and solar advocates will enjoy even a modest measure of last year's budgetary success. What little bureaucratic inertia now remains—in the form of money still available for spending and a hard core of stubborn employees—will by then have been thoroughly dissipated, too, leaving us with circumstances changed very much indeed.

Many tentacles

Of course it depends on precisely whose figures are used and which programs are included, but no matter how it's charted there is no arguing that the federal government has spent millions a year for several years on areas somehow related to encouraging energy conservation and solar energy in buildings. In energy, the federal government has made its presence known to nearly all elements of the building community at virtually all levels. Through joint funding and transfers of appropriated monies to other agencies, DOE's influence has been pervasive in ways that often escape attention—even the National Endowment for the Arts, itself facing a much-dismantled future, has an element of its design arts program funded by this giant creature of the Carter cabinet. So, as the department and its familiar acronym head for Washington's growing program graveyard and its funds go to other areas, it seems safe to think we'll notice.

"AND FOR THE EGGS THAT WE'VE KEPT, WE DON'T NEED A BASKET"



Although DOE was well known, it was not necessarily well liked. Nonetheless, one has a growing sense that we will learn to miss it, mainly for what its demise—and the demise of certain of its programs—signals in the way of dramatic reversal of the federal posture on yet another front.

I think it's still breathing

Of course this is not all being taken sitting down. Skillful and broadly based lobby groups have manned the battle stations on Capitol Hill, along with a host of narrower environmental and renewable energy industry groups. The Alliance to Save Energy, perhaps one of the most influential energy action groups, has mounted a very compelling campaign, armed with an array of convincing statistics on the benefits of spending tax dollars for conservation and renewable energy resources.

Other influential groups, not aligned with business interests or political causes, have also issued recommendations that are at odds with the administration's avowed course. Even the DOE's own Energy Research Advisory Board, a respected independent body whose advice is generally reflected in

Thomas Vonier is an architect, president of Thomas Vonier Associates, Washington, DC. He is a member of the AIA Energy Committee and a P/A Washington correspondent on government activities.

Reagan's 1983 budget for energy, was shot down on conservation and solar energy for buildings: "The administration was acting on other information," said a DOE official who acknowledged that the board had strongly urged dramatic increases for funding in these areas.

There is general agreement among those who should know that modest gains—that is, something more than zero—might be forthcoming from the budgeting process. But the prognosis is generally grim, and perhaps most telling of all, the massive firings, demotions, and general demoralization at DOE have led to exodus by many of its most capable agents on the hill—its key conservation and solar employees.

Some effects

Whether by skillful management, coincidence, or uncanny prescience within DOE's innermost reaches, it turns out that some of what will surely be eliminated was already set for phasing out. As if to defy commonly held beliefs about federal programs, some efforts were *not* intended to go on indefinitely. They were designed to accomplish objectives and then dissolve. Many were not very expensive, either, at least by federal budget standards:

Education. Working with schools of architecture and engineering, DOE had devised a set of student internship opportunities, design competitions, training institutes for faculty members, and curriculum resource development efforts. Most of these have reached fruition with generally excellent results and were slated for greatly diminished funding anyway.

Standards. The incoming administration and widespread industry dissatisfaction had already caused DOE to redirect its Building Energy Performance Standards effort toward a "voluntary information-based" program. DOE now expects that 1982 funds will permit issuance of a set of "guidelines" that will link the energy budgets with an upgraded version of ASHRAE's Standard 90. The BEPS program has cost millions and has disappointed many, but it *has* stirred the building community into unprecedented action and has helped to create a sound technical vocabulary for working with energy performance.

Demonstrations. In both solar and conservation areas, these efforts will not fulfill their original promise in many ways; key data from monitoring programs, intended for use in development of performance-estimating and analysis models, are not likely to be forthcoming. But valuable experience and even knowledge—at least of what *not* to do again—have been produced. Many architects who have been involved in these programs say the demonstrations were expensive and had produced as much as could be expected of them.

In these limited areas, one can almost agree that the time had come for a change and we are well advised to move on to other things. The problem is in part that we are not moving on to other things. What's more, many efforts of on-going usefulness will be left by the wayside:

Research and development. In this area of difficult debate between private industry and federal government, much that was started by DOE will not be finished. Of greatest concern to architects is work on design methods for daylighting, passive solar energy, and natural ventilation. Whole sections of

DOE's BUILDINGS-RELATED RESEARCH AND DEVELOPMENT BUDGETS (Millions of Dollars)

Conservation	FY79	FY80	FY81	FY82	FY83
Building Systems	18.500	18.100	20.065	27.067	—
	—	—	11.120	17.900	0
Building Equipment	20.350	29.600	22.240	23.275	—
	—	—	12.670	0	0
Community Systems	19.400	16.550	15.800	10.425	—
	—	—	8.608	0	0
Subtotals, Conservation	58.250	64.250	58.105	60.767	—
	—	—	32.398	17.900	0
Solar Energy					
Active Heating and Cooling	33.700	56.900	43.700	32.500	—
	—	—	38.400	11.500	0
Passive and Hybrid	3.900	27.950	33.400	31.950	—
	—	—	30.200	10.300	0
Subtotals, Solar Energy	37.600	84.850	77.100	64.450	—
	—	—	68.600	21.800	0

Top Figures: Carter Administration Budgets
Bottom Figures: Reagan Administration Budgets
—: Not Applicable in Fiscal Year
Source: U.S. Department of Energy

FATE OF THE ENERGY PROGRAMS UNDER REAGAN FY1983 BUDGET PROPOSALS

Low-income weatherization assistance grants	Eliminated
Energy audits and technical assistance for schools, hospitals and public buildings	"Close-out" funding FY83
State energy conservation planning grants	Eliminated
Industrial energy conservation research	Eliminated
Active and passive solar for buildings	Transferred and reduced*
Energy conservation for buildings	Transferred and reduced*
Regional solar energy centers (RSECs)	Eliminated
Alcohol fuels development	Eliminated
Small scale hydroelectric power development	Eliminated
Federal energy management program	Eliminated
Energy audits for small scale manufacturers	Eliminated
Energy extension service	Eliminated
Energy inventions program	Eliminated
Urban waste programs	Eliminated
District steam applications development	Eliminated
Appliance energy efficiency standards	Eliminated
Residential energy conservation service (RCS)	Eliminated
Energy storage systems	Eliminated
Building energy performance standards	Eliminated
Solar bank	Funds rescinded
Solar Energy Research Institute (SERI)	Reduced**
Residential tax credits for conservation and solar	Retained
Business tax credits for conservation and solar	Eliminated
Solar energy information programs (toll-free number, literature, etc.)	Eliminated

* These functions would be transferred to an independent "Energy Research and Technology Administration" within the Department of Commerce, in an "Energy Division" along with nuclear fusion and industrial and utility programs.
** SERI would receive no funds for a new building and would have no information or commercialization efforts.

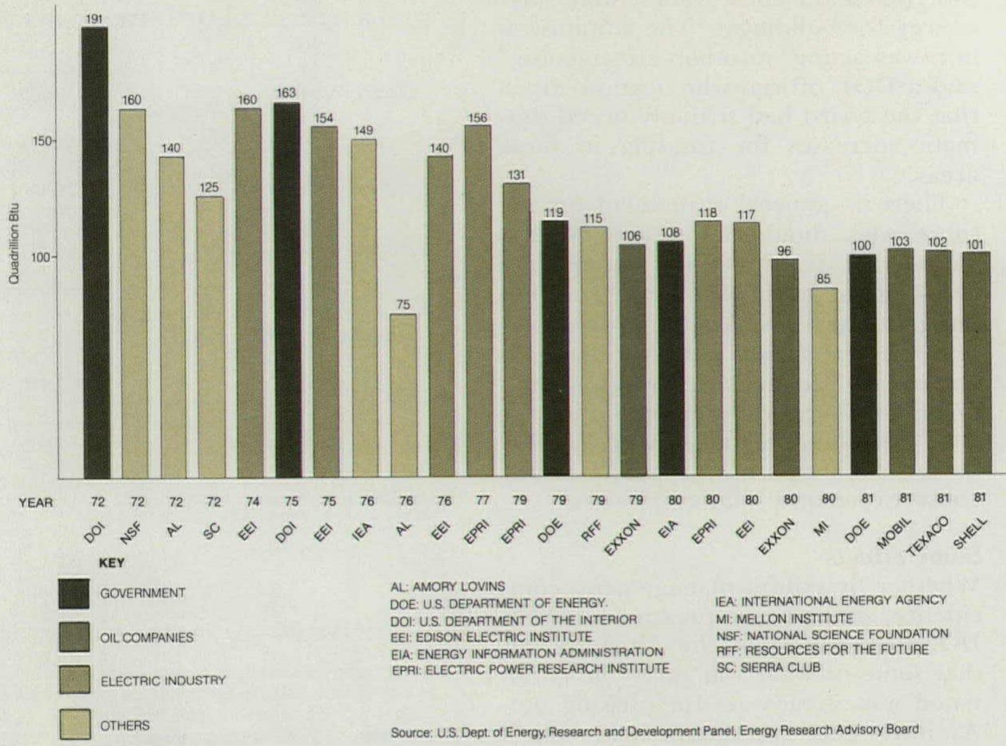
Developed in cooperation with the AIA Government Affairs department, as of Feb. 23, 1982.

The president's budget and management plan envision dismantling the Department of Energy and sacking its major conservation and solar energy programs. The few remaining long-term, high-technology efforts would be transferred to an independent subcabinet agency. Many DOE program officials report that the administration's aims, although not yet approved by Congress, are being implemented through delays in authorized FY82 funding disbursements and forced exodus of key technical employees.

universities and national laboratories that have been built up around these enterprises face relatively quick elimination as funds are depleted before the work is complete.

Information. As confusing and jumbled as it could often be, DOE was a fount of useful material on emerging energy technologies and design information. The constraints placed on printing and distribution of public-domain reports has already stemmed the flow, leaving hundreds of reports shelved and virtually assured of staying there.

Add to these and other discouraging effects the loss of income to architectural firms and schools from DOE grants and contracts—a figure that has been in the millions annually for several years—and one has a sense that, in the relatively short term, the effects will be felt. But these are not the implications that matter, really. There is something more fundamental at stake.



TRENDS IN U.S. ENERGY DEMAND PROJECTIONS FOR THE YEAR 2000

Energy and national purpose

Few in the building industry would deny that energy conservation and solar energy are a part of an inevitable course for the U.S., at least, and perhaps the world. A veritable industry has grown up around this premise and surely not all of it has been propped up by federal spending. Some, even those in the buildings and energy research community, believe that such endeavors will prosper without competition for federal funds from the expensive, extensive "shadow bureaucracy" of private consulting firms that exists around Washington's periphery and beyond. They believe that private industry and state and local governments will press on, driven by the dictates of pocketbook and conscience.

But one wonders: Will this really be possible, given the large advantages now clearly being extended to nuclear energy and fossil fuel development? Who in the alternate energy camp, after all, has the technical, political, and financial resources to compete on these terms without federal support? Even with all of the progress made and the continuing commitments on many private sector fronts, one can envision the country blithely headed on a course toward genuine energy disaster. Both industry and government will express confidence that the energy challenges of the late 20th Century are well met, while a trusting and sometimes gullible public marches steadily along . . . until the next real energy pinch, when the potential for national and international disruption and strife might well surpass anything we've yet seen or imagined.

The most ardent and convincing proponents of a renewable energy future, not all of whom are confined to the ranks of the "soft technologists," have never argued that nonrenewable energy should be conserved for its own sake. They have tended to go well beyond this assertion to address employment, national development economics, environmental quality, public health and, yes, even national security. To them and to a substantial number of us, the energy situation in this country has called for a fundamental rethinking of national and personal habits and aims. Now, with deft and very one-sided strokes of the budgetary axe, amidst mouthfuls of private enterprise boosterism, all this seems to have been cast aside.

This is the aspect of the "new policy" that is most disturbing. Imperfect as they have been, at least the initiatives of the other post-embargo administrations—from "project independence" to the "moral equivalent of war"—conveyed some sense that we, as a nation capable of being led, were committed to making a fundamental change in our misguided uses of energy. The sense was that much good would come of that on more than energy terms.

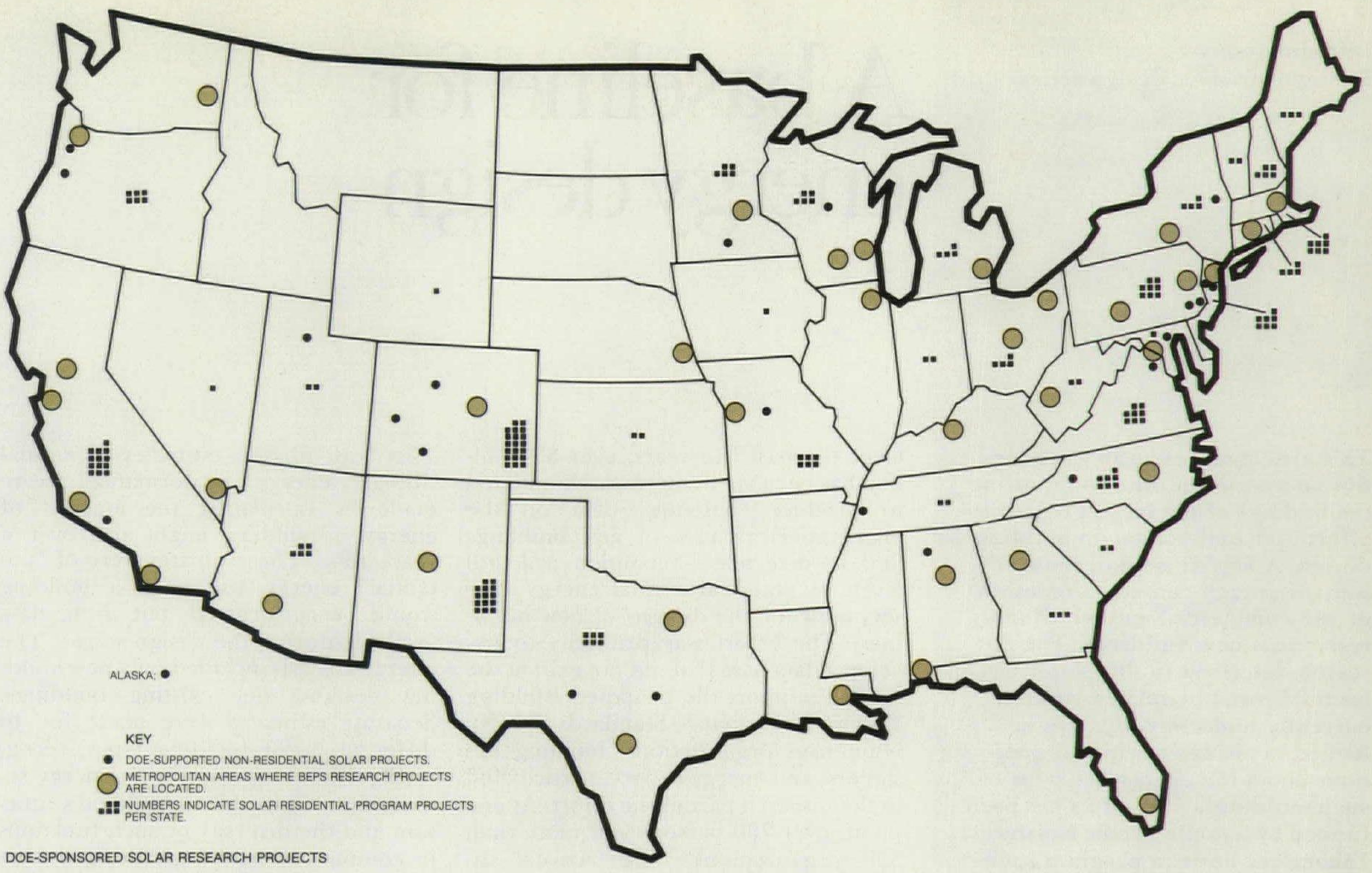
Now, if any sense at all is to be gleaned from the course of public energy policy events, it is that no "new" vision or course is needed; the marketplace and good old commonsense business will take care of this problem, if left unfettered by federal regulations and the burdens of "unnecessary" spending. It seems not to matter that military spending, conceivably the single least productive of all possible spending programs, is suddenly elevated to the status of utmost need and is redefined as a legitimate approach toward assuring a stable energy future, at least for the U.S.

The call for a better energy future through conservation and solar energy has been misconstrued, underestimated, and cheapened. The federal posture now seems to suggest that public motives are base, centering around concerns for enough gas at the pumps and cheap enough energy to be able to enjoy the benefits of modern life.

There is a nobler view. It suggests that Americans are also—even primarily—concerned with energy because of all it connotes about our attitudes toward life and the rest of the world. From this view we look to the federal government for leadership in helping—and, when necessary, financing or requiring—us to do a better job. This nobler view does not prevail in Washington today.

What about the architects?

And what of the architectural community in all of this? It has been the center of much influence in the direction of national energy efforts over the past eight or nine years. Energy, for the second year in a row, holds its place as "number one on the agenda" of the American Institute of Architects, yet the AIA has had difficulty attracting major numbers to its well-designed, low-cost two-day



Facing page: Major institutions in our society now seem to share a conception of the energy future based on similar views of the potential for conservation and solar energy. The distances between various estimates have narrowed substantially over the past nine years. (Oil companies did not publish long-range projections in the earlier years.) The reduced projections for the year 2000 are all predicated on strong public and private efforts, however; it is not clear how the "new energy policy" might change the picture.

Above: The federal energy presence has been pervasive. Shown on this map are locations of: the 23 commercial buildings involved in the passive solar demonstration program; metropolitan areas containing the 168 buildings redesigned in phase two of the Building Energy Performance Standards research; and states where the 162 houses involved in the first round of the HUD/DOE passive solar residential program are situated. Thousands of architects and engineers were involved in these projects.

continuing education seminars on energy. Of course the overabundance of energy conferences and the present economic downturn are partly to blame, but one senses that the real explanation may be that there still just aren't that many architects who are interested in energy. The publication of reviews about Tom Wolfe's latest clever book—which says nothing about energy concerns—has apparently stirred the ranks more than the total withdrawal of our government from an area that our most respected leaders tell us deserves our utmost concern.

The common post-mortem sigh among architects who have worked closely with Washington's programs is, "Well, we learned a lot and we'll certainly never design again like we once did." There is a significant number who can say this, and their influence will continue to be felt even after the federal energy gravy train has been derailed. But that's not really the point. A glance at the advertising in any architectural periodical reveals that the energy issue is not likely to recede among product manufacturers. Few architecture firms are likely now to omit at least some mention of energy in a client presentation.

The real question is leadership and where we will find the voice to say what is inarguably the case: that we are *not* finished, that the problem is not as simple as mastering the Trombe wall or getting a building to "beat" the number of Btu suggested by the ill-fated BEPS program. All of this seems really only a start, a first few and often crude steps on the way to what is increasingly described as the sustainable energy future.

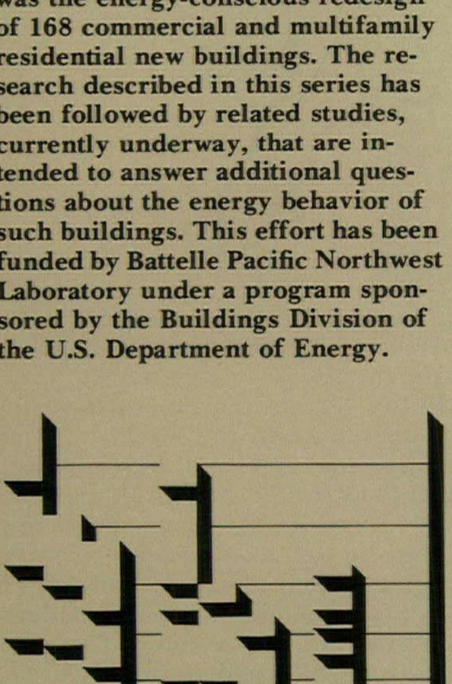
In this current climate one looks for but does not see the leadership that began to emerge from the architectural community in 1973. The AIA's influential energy policy statements and studies, as well as efforts by countless individuals, helped to shape an aggressive (if sometimes unwieldy) federal conservation and solar effort. The gains were frequently modest (one DOE employee was fond of pointing out that defense spending for military bands and parade units surpassed total spending for conservation, even under "liberal" administrations), but they made a difference. Where is the outcry as these hard-won initiatives are swept away?

Perhaps the revised outlook has not yet registered. More likely, other concerns take precedence, and a temporary oil glut gives reassurance. In any case, it is hard to believe that the architectural community, despite its clear position in the private sector of the economy, goes along with the notion that the persistent energy challenge can be met without strong federal support and leadership. In an unanticipated way, the Reagan administration has issued a genuine call to arms, as yet only weakly heeded. □

Introduction:
Energy-conscious design series

A baseline for energy design

This article serves as an introduction to a series of articles reporting the findings of the largest research effort ever undertaken on building design. A key element of the study was the energy-conscious redesign of 168 commercial and multifamily residential new buildings. The research described in this series has been followed by related studies, currently underway, that are intended to answer additional questions about the energy behavior of such buildings. This effort has been funded by Battelle Pacific Northwest Laboratory under a program sponsored by the Buildings Division of the U.S. Department of Energy.



Contributors: *A number of individuals and organizations have contributed to the development of this article. Principal researchers: Joseph J. Deringer, AIA, President, Gilford, Deringer and Company; Harry Misuriello, Principal, W.S. Fleming Associates.*

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Over the past five years, over $30 million has been spent on research initiated to produce "baseline" data on the energy performance of new buildings and to determine maximum practical levels of potential annual energy conservation for the designs of new buildings. The effort was primarily to develop a data base that did not exist at the time to support the proposed Building Energy Performance Standards (BEPS). Numerous organizations, building designers, and energy experts participated in the research part of the effort. At one point, over 700 persons and more than 350 organizations were actively involved. Literally hundreds of reports have been produced. The computer printouts alone for just the research on the redesign of 168 commercial and multifamily buildings discussed in this series are well over 100,000 pages.

Very little of this enormous research effort has been published in a format useful to the building community. In these articles, an extensive effort is being made to present in a useful format key results from the research. The series of articles will also try to explain what was not learned and will address many unanswered questions.

This particular article provides an introduction to the series, briefly describes principal individual elements of the research, and presents overall results and observations. Future articles in the series will examine design strategies and energy results in more detail for selected building types.

Research effort

The original effort was divided into two main phases (plus follow-on research). The objective of the first phase was to develop "baseline" data about the energy performance of new buildings. The purpose of the second phase was to determine potential levels of energy reductions that could be achieved from this baseline.

In both phases, estimates of annual "design energy performance" were made by calculating the amount of energy a building might use over a year's time. The estimates were of "potential" energy use once a building would be constructed, but using data available during the design stages. The energy analysis included only new building designs, not existing buildings. Separate estimates were made for 16 different major building types, recognizing the strong impacts on energy requirements caused by a building's function and the diversity of such functions in commercial buildings. Designs were selected from 37 cities to examine a range of climatic impacts. Factors that could significantly affect the energy use of a building, but which are not under the control of the building designer, were either normalized (e.g., hours of operation) or eliminated from consideration (e.g., "process" energy to perform a service or conduct a business or off-site electric energy conversion losses).

Under the management of The AIA Research Corporation, the first phase of this research in 1977 included the statistical selection and development of an annual energy performance "baseline" for over 1600 buildings designed and built in the mid-1970s. The energy estimates were made from summary building design information supplied voluntarily by architects and engineers.

In the second phase of the research, during 1978, a subset of 168 buildings was statistically selected from the first-phase sample. Annual energy estimates were made for these "original" 168 buildings, this time in great detail. Also, an important experiment was conducted: To determine the possible levels of energy efficiency that could be achieved, these 168 buildings were "redesigned" by their original architect and engineer design teams, who were placed under contract to do the redesigns. To launch the redesign experiment, the design teams participated in a three-day workshop in energy-conscious design concepts and strategies, and received an energy information workbook. At two subsequent points over a period of months, they presented their work and received a detailed peer review and feedback from energy consultants.

Although the design teams had few constraints on their redesign efforts, they were required to adhere to the building owner's original program requirements, the site, and the general range of the construction budget. They were encouraged to use "passive" techniques, including natural ventilation and daylighting. Active solar systems were not permitted unless included in the original designs (there were four).

The designers completed computer input forms for both the original buildings and the energy-conscious redesigns. This information was analyzed by the research team using a sophisticated energy analysis computer program (a method similar to that used in the recent P/A "Energy Analysis" series) so that the various design energy performances could be compared in a controlled and consistent manner. The comparison focused on the physical characteristics and design strategies of the buildings (rather than on variations in hours of operations, which can radically impact energy performance). Standard operating conditions were developed for each space function (e.g., classroom, gym, cafeteria) within a building type by averaging the estimated hours of operation supplied by the design teams.

The redesigns were designs completed essentially only through the schematic phase, but with sufficient additional data to conduct a detailed energy analysis. The redesign exercise was therefore a large experiment. One could speculate that significant energy reductions were possible through the redesign, but it was not known at the outset whether the efforts would result in a 5 percent or a 50 percent energy reduction. Also, it was not known if such a large number of designers, many of whom were unfamiliar with computer energy analysis, could prepare meaningful data processing input.

Summary estimates of first-cost differences between original and redesign were submitted by the designers as part of the exercise. At the end of this phase, on the average, the redesigners reduced energy use by 38 percent and increased first cost by less than 5 percent from the

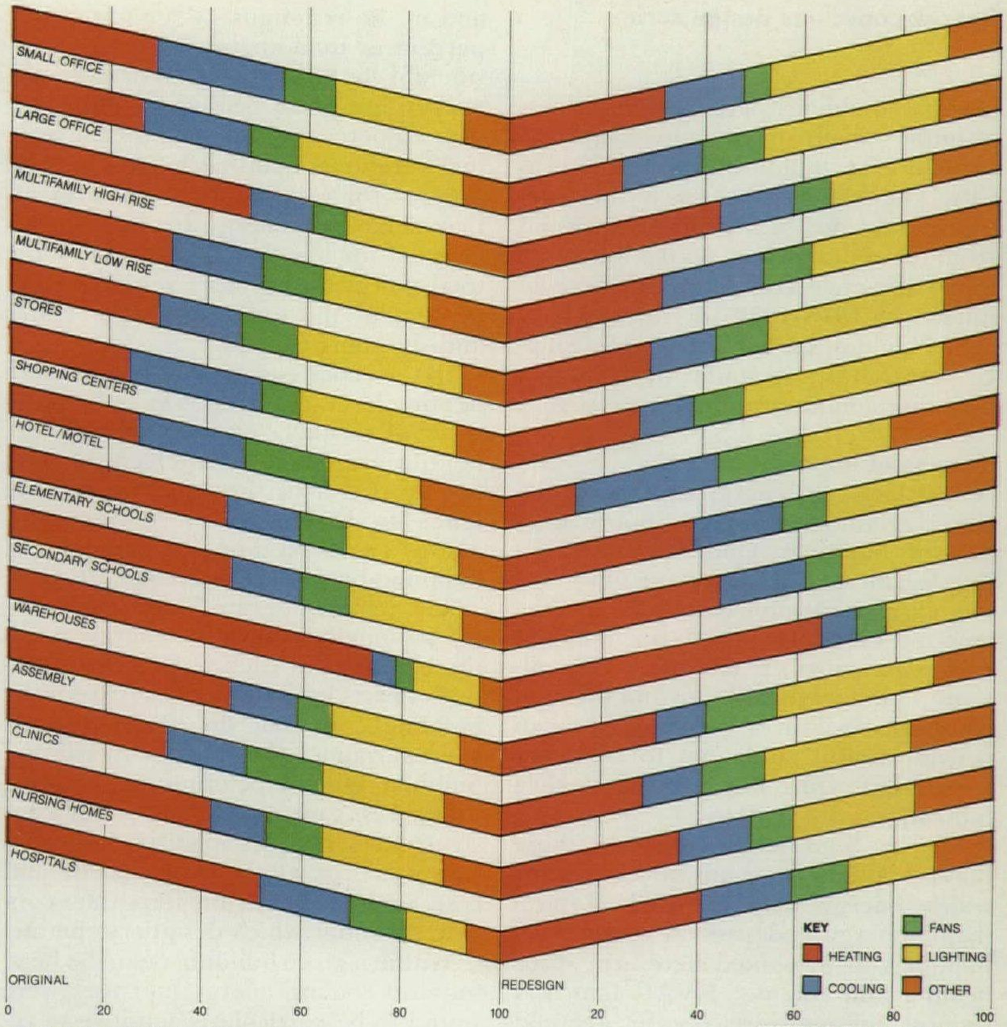


FIGURE 1 ENERGY END USE PERCENTAGES

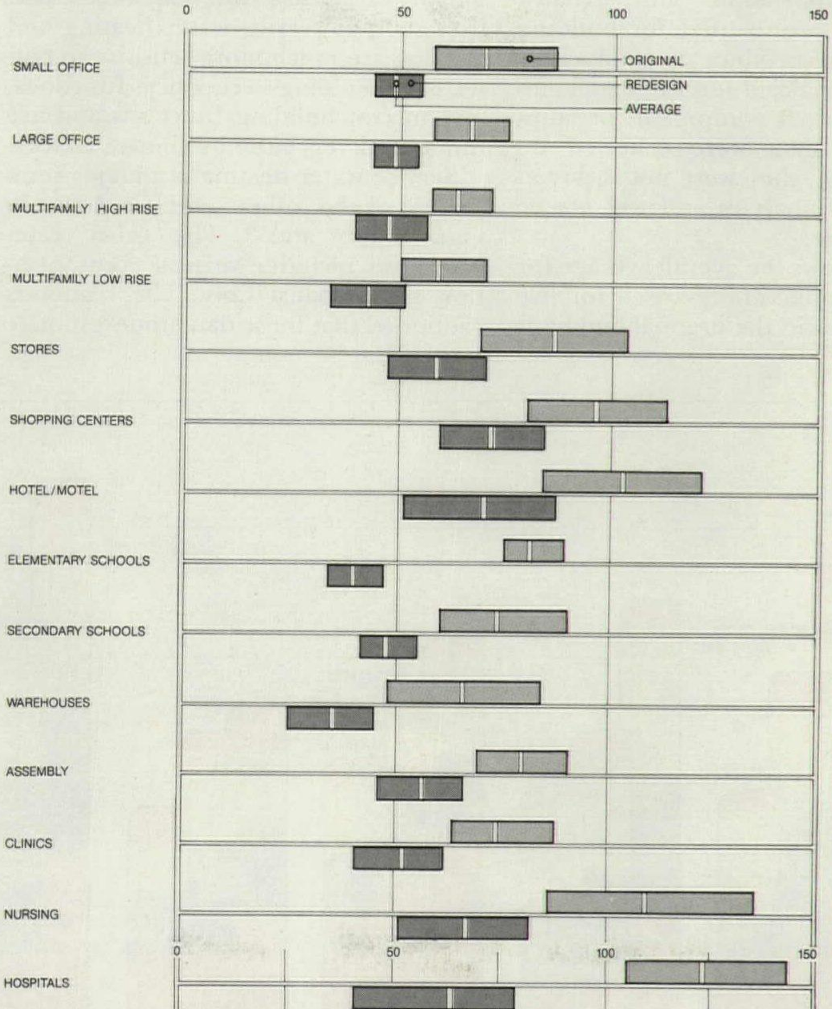


FIGURE 2 ENERGY PERFORMANCE RANGES

Figure 1 *Bar sections indicate original and redesign energy and use percentages for each building type.* ***Figure 2:*** *Bars show original and redesigned building energy performance ranges for Kansas City, to represent an average or national climate condition. The center line in each bar indicates the average (actually the 50th percentile) for each range. The ranges shown exclude the extreme 20 percent at each end.*

original buildings. Figure 2 indicates example ranges of annual energy performance by building type for Kansas City. The cost effectiveness of the redesigns could not be adequately assessed from the redesign data, and a follow-up initial life-cycle cost analysis was conducted in 1979–1980 for three typical office buildings from the sample. Similar research is now under development for other commercial building types.

Targets of opportunity

A key factor in energy-conserving design is an understanding of how energy flows in buildings. One aid in identifying broad targets of opportunity for energy conservation is to examine the amount of energy used for building energy functions or "end uses." A familiarity with energy end uses and their relationships within a building type can provide useful guidelines for focusing the design effort where it might have most significant impact.

Energy "end uses" refers to those major building functions or services for which energy may be used. Typical major energy end uses in commercial buildings as presented here are: space heating and cooling; HVAC fans and pumps; lighting; service water heating; vertical transportation; and exhaust fans. Energy is also used for building "processes" to produce a product or provide a specialized service: e.g., computers; laboratory equipment; or laundries. While data were collected on process energy, they were not included in the energy analyses and will not be addressed here.

Figure 1 shows the overall average for percent of annual energy used for five major end uses in the original buildings and in the redesigns. As indicated, the percent of total energy use varies considerably by building type. For example, energy for space heating accounts for over 75 percent of the total for the original warehouses studied, but less than 30 percent for original large or small offices. Likewise, energy for lighting accounted for less than 15 percent of the total energy for hospitals, but close to 35 percent of the total energy for stores and shopping centers.

In the redesigns, major reductions in lighting levels occurred. Yet in the redesigns of virtually every building type, lighting increased as a percent of total energy use. This suggests that lighting tends to become a more important energy consideration as commercial buildings become more energy efficient.

The percentages in Figure 1 indicate the national averages for energy use in the buildings of each type. These summary charts indicate general patterns by building type, but do not necessarily show variations that can occur within a building type depending on regional influences such as climate, local construction techniques, material usage, design practices, and fuel availability and cost. Such factors define important constraints under which designers operate.

Within a given building type, the heating and cooling energy end uses were found to be particularly sensitive to regional variations, whereas other end uses such as service water heating and lighting are much more sensitive to patterns of building occupancy, functions, and mix of building functions and are influenced very little by climate factors.

Service water heating is a major component of the "other" end use shown in Figures 1, 2, and 3. The "other" category also includes vertical transportation and exhaust fans. The reader is cautioned that these data underestimate the extent of the often substantial energy used for heating service water in hotels, motels, and hospitals for such uses as laundry and food storage and preparation, because of the decision to exclude such "process" loads from the research analysis.

Results of the redesign process

The redesign experiment produced significant reductions in projected energy use. The average unweighted reduction for all redesigned buildings was 38 percent. Figure 3 shows the average results of the redesign process for the sample buildings in each building type.

One important factor was the amount of variation in the results. The average decrease varied considerably by building type. It was greatest for warehouses (55 percent), and for small offices (50 percent), and smallest (26 percent) for hotels and high-rise residential.

The range of annual energy usage for most redesigned building types was smaller than the usage range estimated for the original buildings. This is illustrated in Figure 2, and suggests that carefully selected design strategies can temper overall regional influences on both energy use and percentages of end use.

In the redesign exercise, certain building energy end uses were reduced by significantly larger absolute amounts than others. This was directly related to their predominance as end uses in the original buildings. Heating energy was reduced more than the other end uses. Especially for "skin," or external-load-dominated building types, reductions in heating energy were significant, while reductions in cooling energy were small. Likewise, building types that tend to be predominantly internal-load dominated, such as shopping centers, offices,

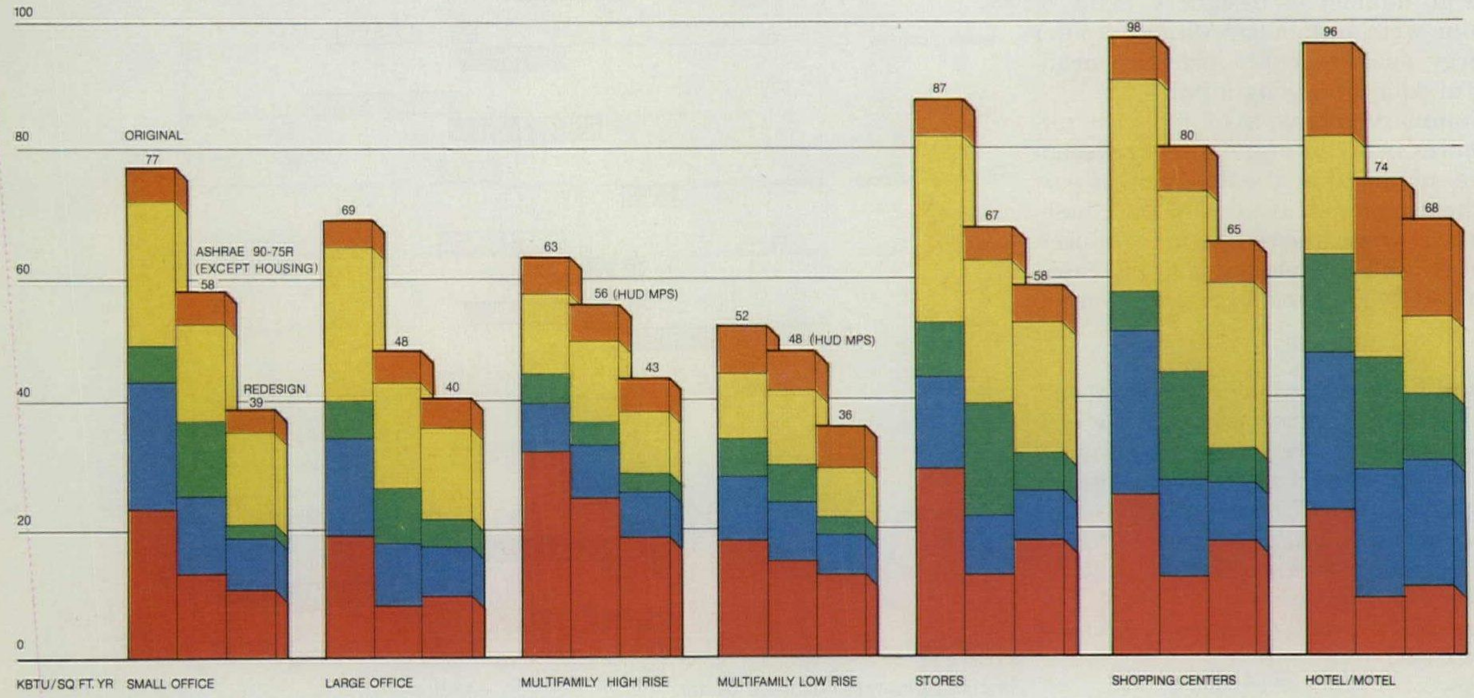


FIGURE 3 AVERAGE END USES FOR TYPICAL BUILDING TYPES

and stores, achieved the greatest reductions in cooling energy.

Limits of the energy analysis method: A reasonably comprehensive energy analysis computer program was used to estimate the energy use of the building designs. Like most such energy analysis programs, then and now, the program was capable of analyzing many of the design strategies, but not all.

For example, two strategies used in many redesigns had significant potential energy savings that could not be evaluated—daylighting and "deadband" thermostatic controls. It is the authors' opinion that if the impacts of these two additional strategies had been estimated, the average percent energy reductions of the redesigns would have been closer to 45 percent instead of the 38 percent reported. (Additional discussion of limitations of energy analysis tools is contained in Energy Analysis overview articles in April 1980 and 1981 in P/A.)

Application of the component requirements of ASHRAE 90-75R to the original buildings also produced significant energy reductions. Exact conformance to the ASHRAE 90-75R minimum component requirements using the formal "Upgrade/Downgrade" approach resulted in a 22 percent reduction from the original buildings. Results of this approach are shown for 12 building types in Figure 3. The middle bars for multifamily high-rise and low-rise residences show the impacts of HUD MPS. The second "Upgrade Only" approach resulted in a 34 percent reduction from the original buildings.

What was learned from the research: Significant energy reductions are possible from design practice. Further, such reductions can be accomplished with a relatively small increase in average first cost. In some cases, first costs decreased.

For example, reduced heat gain from lighting permitted reductions in ventilation rates and in installed cooling capacities. While lighting system costs may have increased, these were more than offset by reduced costs for the installed cooling equipment. In three office buildings examined in detail, total energy was reduced about 30 percent and first costs were reduced as well.

The research provided estimates of the energy behavior for a number of building types, as well as some estimate of the impact of climate on each type. Also, from the results from the sample buildings, new building annual energy target ranges were developed for 16 building types in some 78 cities by using a statistical estimating procedure. Example results for one city are shown in Figure 2.

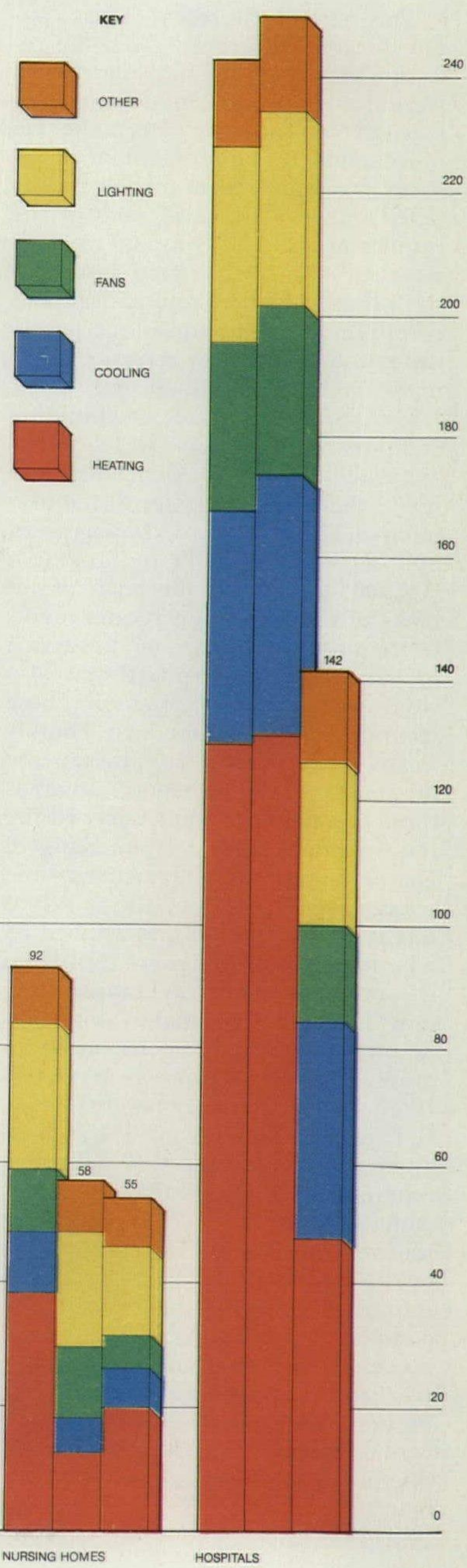
What was not learned: More correlation between design estimates of energy and actual consumption is needed. Extensive comparisons were not made between the design estimates of the original buildings and their actual consumption.

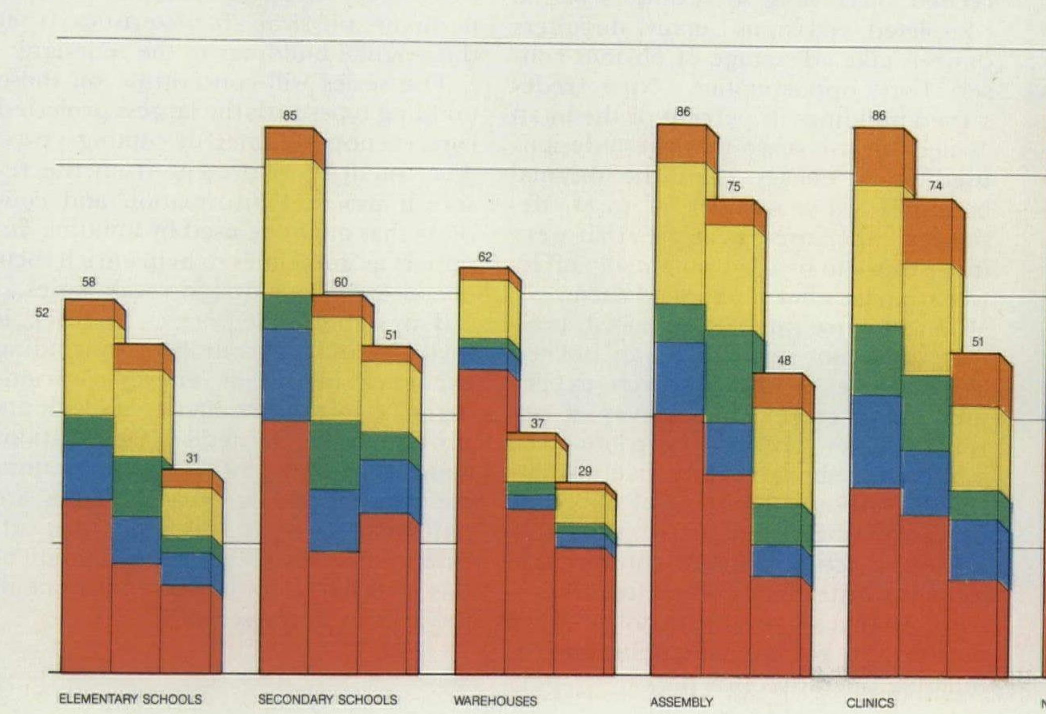
It is not known how much more conserving design practice is today, compared with when this study was done. Similar broad surveys of design practice have not been conducted since. A more recent summary analysis of characteristics of an existing sample of some 400 buildings, however, concluded that only minor increases have occurred in the use of energy conservation items.

Additional information is needed on cost effectiveness of energy-conscious design. In short, did the redesigns go too far or not far enough. Preliminary results of more recent research suggest that energy use levels at or below the redesign levels may be cost-effective from several economic perspectives. This work, however, is not yet complete.

Little effort was made in the research

Figure 3 *This figure shows the average energy use for each building type for three conditions: the original design, the ASHRAE Standard 90-75, and the redesign. Total annual energy and end uses are expressed in thousands of Btu/sq ft/yr for heating, cooling, fans, lighting, and other end uses, including service water, heating, elevators, escalators, and exhaust fans.*





ASHRAE 90-75R and HUD MPS

Another major part of the Phase 2 research effort was the application to the original buildings of the minimum component requirements of current standards. The objective here was to determine the annual energy performance impacts of the standards on a large set of actual building designs. HUD Minimum Property Standards (HUD MPS) were applied to multifamily high-rise and low-rise residences. ASHRAE Standard 90-75R component requirements were applied to all other commercial building types.

This part of the research was conducted very differently from the redesign experiment. The design teams were not involved in modifying their original buildings to meet the requirements of either standard. Instead, a research team made very detailed interpretations of each of the requirements. The component characteristics of the original buildings were then modified automatically via computer, using a consistent procedure, and new energy estimates were made using the modified data.

For ASHRAE 90-75R, the building components affected were either "upgraded" or "downgraded" to meet the exact minimum requirements. This "Upgrade/Downgrade" approach was thought to provide a "formal" measure of the range of impacts of the minimum requirements of the standards. A second approach to the ASHRAE standard was also conducted. In this approach, those components that failed to comply were "upgraded" to meet the minimum requirements, whereas those components that surpassed the requirements were left unchanged. Neither approach measured the energy impacts of how the standard might be interpreted and applied by a large group of designers. But from the research effort, it became clear that different "reasonable" interpretations of some of the component requirements could produce large differences in the energy results.

The requirements of HUD MPS applied mainly to the thermal transmittance of the building envelope, while ASHRAE 90-75R had minimum requirements for components of the building systems as well. This part of the work was refined and completed in 1980. As a result of that analysis, research is currently underway to examine possible ways to tighten the requirements of the current version, ANSI/ASHRAE 90A-80, on a cost-effective basis.

to isolate those strategies that were most effective in producing the reductions and in examining why the reductions occurred. A major thrust of these articles will be to begin to identify and describe such strategies by building type and region.

Many of these issues and questions are being directly addressed in current research on commercial and multifamily buildings as a consequence of what was learned from the redesign experiment. In the coming series, the authors will try to address some of these questions and possible implications.

The design teams

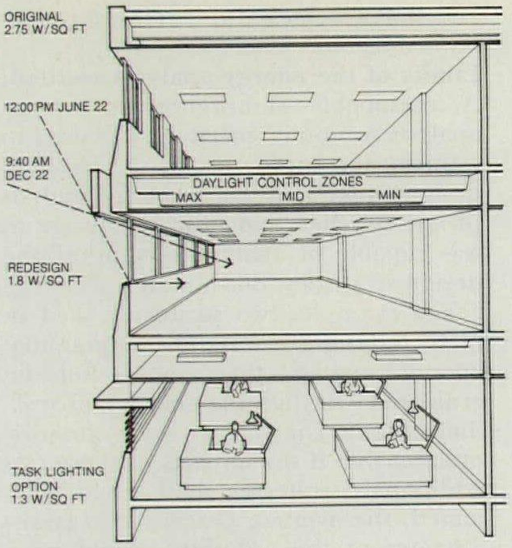
The research concentrated on the energy behavior of the sample building designs. In retrospect, the redesign experiment also provided an opportunity for examining how the attitudes, skills, experience, and design procedures of the designers impacted energy results. However, very little of this was done. Thus, the following comments about the design teams are qualitative and are derived from observations by the authors and by reviewers of the redesign.

The design teams "came along" with the buildings, which were selected to represent statistically new buildings of each type throughout the nation. As a result, the designers participating in the redesign exercise had a wide spectrum of energy skills and experience. A few of them had solid energy analysis experience. There were also a number of energy novices in the group.

The effort put into the redesigns also varied considerably. Some design teams made only minor modifications to their original buildings. Others developed sophisticated and completely new solutions using a full spectrum of design strategies.

Not all of the redesign attempts succeeded. According to reviewers of the completed redesigns, many designers did not take advantage of obvious conservation opportunities. Nine redesigned buildings (6 percent of the total) "failed" in the sense that the redesigns used more energy than the original buildings. In a number of cases, designers either used strategies that were inappropriate or used potentially effective strategies but misapplied them.

The "failure rate" experienced, however, does not seem to be an isolated consequence of this research experiment. In a recent DOE survey of retrofits of over 220 existing commercial buildings, a similar failure rate was discovered. About 10 percent of the retrofits for over 220 buildings "failed" because the actual metered consumption went up instead of down after the retrofit. In that survey, the major problem seemed to be the misapplication of building operation practices.



OFFICE DAYLIGHTING STRATEGIES

ORIGINAL (Power Density: 2.75 W/sq ft): Single glazed, non-continuous fenestration finish facade—4 lamp wide recessed troffers with flat prismatic lens.

REDESIGN (Power Density: 1.8 W/sq ft): Double glazed continuous windows with heat strengthened tinted glass with thermal-break frame; overhangs and/or fins, depending on exposure; moderate textures and medium dark tones to increase absorbence; 2 lamp parabolic troffers, vented; photocell controlled dimmers.

TASK LIGHTING/LIGHT SHELF OPTION (Power Density: 1.3 W/sq ft): Window band below light shelf—double glazed with thermal break frame; Window band above light shelf-insulating low glare panels of translucent fiberglass; light shelf/overhang; bidirectional venetian blinds control glare and direct light further into space—furniture mounted task lighting; twin-beam parabolic fixtures for general lighting.

The authors feel that the redesign energy results do not necessarily reflect the energy conservation technical potentials that are achievable for each building type. Rather, the results indicate what a cross section of designers can achieve at a point in time, given incentive and a small amount of information, training, and feedback.

The coming series

In the coming months, this series of articles will analyze the design strategies, energy results, and building characteristics for specific building types such as large and small offices, elementary and secondary schools, high- and low-rise residences, and warehouses. The articles will also describe changing patterns in many physical characteristics from the original buildings to the redesigns.

The series will concentrate on those building types with the largest projected construction volumes in coming years. The intent is to present from the research practical information and concepts that might be used by building designers as guidelines to help enrich their energy-conscious design vocabularies.

Throughout the series, feedback is invited and encouraged, including examples of recent energy-conscious design efforts and experiences with applying specific strategies. Observations about including energy considerations early in a building's design stages are particularly sought. It is hoped that sufficient interest will merit presentation of this material in conjunction with one of the articles in the series. □

Design strategies

We present here a few illustrative examples of redesigned buildings and design strategies.

***Example 1:** Office building in Farmington, Ct. Architects, Russell Gibson von Dohlen; engineers, Quinlan & Giannoni. This redesign reflects the substantial savings possible from a series of relatively standard energy-conscious design strategies. The three-story, 47,000-sq-ft building on a suburban site is for a speculative client. The original building faced the main road and caused the long elevations of the building to face almost east and west. The redesign was reoriented so that the long elevations faced north and south.*

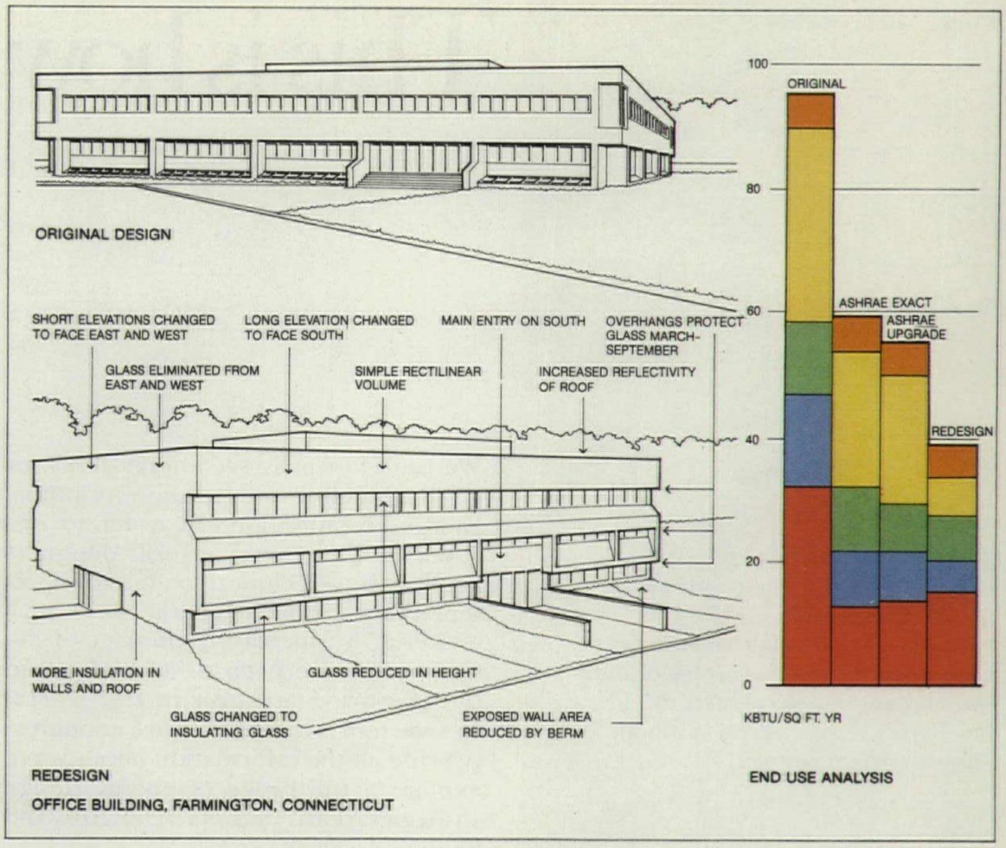
The building was made slightly longer and narrower. Glazing was totally eliminated on the east and west short elevations for better solar control as well as reduced cost. Double glazing replaced single glazing, and external shading on the south was provided to control summer sun, but include winter solar gain.

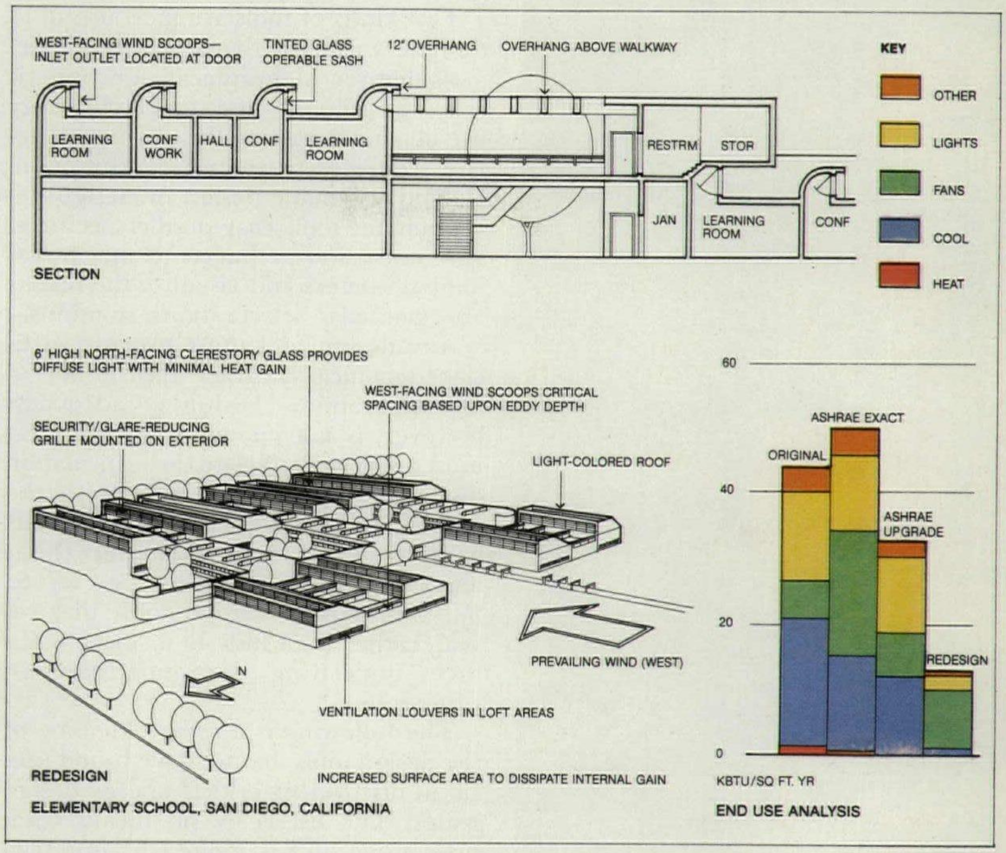
The four-lamp lighting system was converted to three-lamp fixtures, with switching for one- or two-lamp operation. Lighting energy dropped from 33,000 Btu/sq ft/yr to 16,500 Btu/sq ft/yr. The redesigned HVAC system increased the use of water-cooled heat pumps and decreased the use of all-air single-duct systems. Total energy use decreased from 95,100 Btu/sq ft/yr to 48,600 Btu/sq ft/yr, a 48 percent reduction.

***Example 2:** Elementary school in San Diego, Ca. Architects, Deems/Lewis & Partners; engineers, LSWB Engineers. This is a typical 45,000-sq-ft, one-story elementary school located in a very mild climate, where moderate seasonal temperatures and ocean breezes prevail.*

The redesign used available daylight and natural ventilation. North-facing clerestories allow soft, uniform light while minimizing solar heat gain and potential glare. Brightness was controlled at the clerestories with antiglare louvers. The artificial lighting system used photocell controls for further reductions. Overall lighting energy use dropped by 77 percent from 12,700 Btu/sq ft/yr to 2900 Btu/sq ft/yr. Natural air movement provided the main cooling source. The original cooling system was totally eliminated. Instead, ventilation louvers in loft areas were used. The redesign effort resulted in a 70 percent reduction from 44,100 Btu/sq ft/yr to 13,100 Btu/sq ft/yr.

***Example 3:** Daylighting. In this example, we do not present a specific building, but rather typical applications of a design strategy that was used in over 75 percent of the redesigns in a wide variety of forms. Daylighting is a strategy with significant energy conservation potential. The attached graphic depicts possible solutions for an original office building. The items below the graphic list typical changes that occurred as the design was made progressively more energy efficient.*





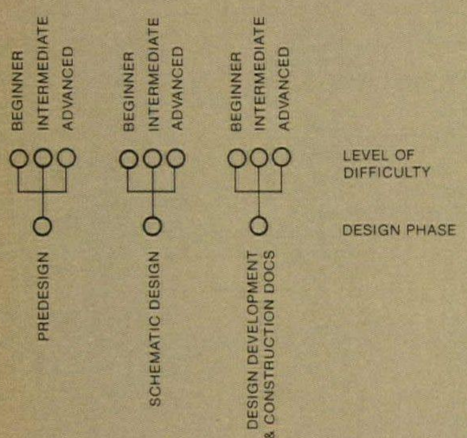
Acknowledgments

Key contributors to the original research program have included: Many individuals within DOE and HUD; the redesign team firms and individuals; the AIA Research Corporation; the National Institute of Building Sciences; Pacific Northwest Laboratories; members of the Technical Advisory Group from a number of professional associations; Syska & Hennessy; The Ehrenkrantz Group; Heery & Heery; Hanscomb Associates, Inc.; Brown Associates.

This is how

Harrison Fraker & Lawrence Lindsey

The flourishing field of applied energy research has produced a multitude of tools for the practitioner. The article that follows reviews prominent examples of both manual and mechanical aids. The key below explains the symbols shown with every entry.



Harrison Fraker is a founding partner in Harrison Fraker, Architects, and has taught architecture for 14 years at four major universities. He and coauthor Lawrence Lindsey formed Princeton Energy Group, a leading research firm in energy and buildings. Their work has received 17 solar research grants and energy-conservation design awards.

We can't normally see energy flows, or go to a building and perceive its annual energy consumption. In order to discover critical energy issues, designers need abstract technical models to represent the anticipated energy flows in a building. An increasing number of design tools have been developed to aid the practicing architect in this search. No one tool is comprehensive enough to provide all the information necessary to explore a full range of energy design strategies. Each has its strengths and limitations.

Two kinds of tools are most useful to designers. During the predesign phase, tools that reveal, graphically or numerically, the amounts and causes of energy use in a building enable designers to devise strategies to reduce consumption. During schematic design or design development, tools that predict performance and allow architects to vary building parameters and visualize the results are essential to select rational solutions.

Any design tool must provide sufficient technical accuracy appropriate to its application. Technical adequacy, however, is not enough. The architect must also learn to relate the information discovered in abstract models to the formal and spatial potential of concepts being analyzed. In our experience this is an exciting learning process, best served by "transparent" design tools that reveal, rather than hide in a "black box," their underlying derivation and assumptions.

The following is a review of some of the design tools that we have found useful in discovering critical energy design issues. The list is by no means comprehensive and is limited by our own practical experience. The review tries to point out, however, the value of these tools in revealing the positive role of energy concerns in the creation of architectural form.

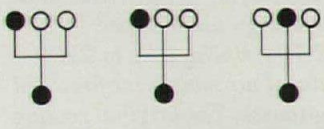
Small buildings

RALEIGH-DURHAM NORTH CAROLINA		SSF =	.1	.2	.3	.4	.5	.6	.7	.8	.9
		WW	155	73	45	31	23	17	12	8	-
35.9 N	L	WWNI	244	117	75	53	40	31	25	20	14
3514 DD	C	TW	151	69	42	28	19	13	9	6	3
T(JAN)=40	R	TWNI	230	110	69	49	37	29	22	16	11
		DG	153	65	36	19	-	-	-	-	-
		DGNI	254	120	75	53	39	29	22	15	9
		WW	14.4	12.8	10.6	9.3	7.6	5.8	3.4	1.4	-
		WWNI	23.4	21.8	19.3	17.2	15.8	13.6	11.2	7.2	3.0
	D	TW	13.9	11.9	9.7	7.3	5.4	3.6	2.2	1.1	.3
		TWNI	21.8	20.1	17.8	16.1	13.9	11.2	7.9	4.8	1.9
		DG	13.3	9.8	5.9	2.5	-	-	-	-	-
		DGNI	23.9	21.4	19.0	16.5	13.7	10.2	6.9	4.0	1.4

Passive Solar Design Handbook

Passive Solar Design Handbook, Volume 1,
prepared by: TEA, Bruce Anderson;
prepared for: U.S. DOE;
available from: National Technical Information Service (NTIS), U.S. Dept. of Commerce, 5285 Port Royal Rd., Springfield, Va 22161;
price: printed copy $27;
NTIS publication No.: DOE/CS-0127/1; 291 pages.

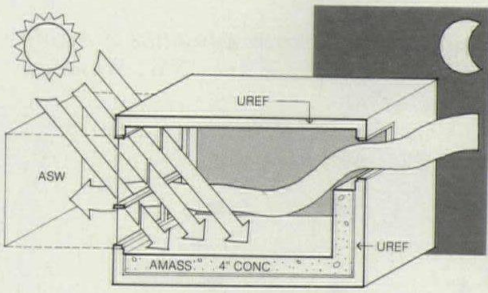
Passive Solar Design Handbook, Volume 2,
prepared by: Los Alamos Scientific Laboratory, J. Douglas Balcomb;
prepared for: U.S. DOE;
available from: NTIS (address above);
price: printed copy $31.50;
NTIS publication No.: DOE/CS-0127/2; 270 pages.



This 2-volume handbook is the single most valuable reference and design manual on passive solar heating, and a must for any serious energy-conscious architect. Volume 1 clearly describes the fundamental concepts of passive solar heating and principles of passive cooling. Volume 2 is a design manual based on computer simulations and performance testing conducted at Los Alamos Scientific Laboratory.

Three techniques for estimating the performance of passive heating systems throughout the U.S. are presented. The complexity and accuracy of the techniques are matched to phases in the design process. "Rules of thumb" are provided for Schematic Design. The now famous "Load Collector Ratio" (LCR) and "Solar Load Ratio" (SLR) techniques are presented for design development and construction documents phases respectively. These three methods give the designer a quantitative basis for making design decisions. With the LCR, annual performance is estimated from tables based on the ratio of building loss to passive collector area. With the SLR method, monthly performance is estimated based on a broader range of variables including shading, reflectors, night insulation, amount of thermal mass, as well as collector area and heat loss rate.

All three estimating methods have been developed for residential construction. But since the SLR method takes internal gains into account, it can be used for estimating the performance of small commercial buildings. Caution should be used in situations where internal gains dominate, because the data on which SLR is based were not developed to account for high internal gains.



Passive Solar Handbook for California

Passive Solar Handbook for California,
prepared by: Philip W.B. Niles & Kenneth Haggard;
prepared for: California Energy Resources Conservation and Development Commission;
available from: California Energy Commission Accounting Office MS 53, 1111 Howe Ave., Sacramento, Ca 95825;
price: $7.42;
item code: P500-80-032; 333 pages.

This handbook presents definitions and fundamentals, performance charts, and selected architectural details for specific passive systems in typical California climates. It also contains background material, derivations, and assumptions used in generating the performance charts. The writing and explanations are among the clearest and most concise in the field. The graphic material is outstanding even if the format is a bit crowded.

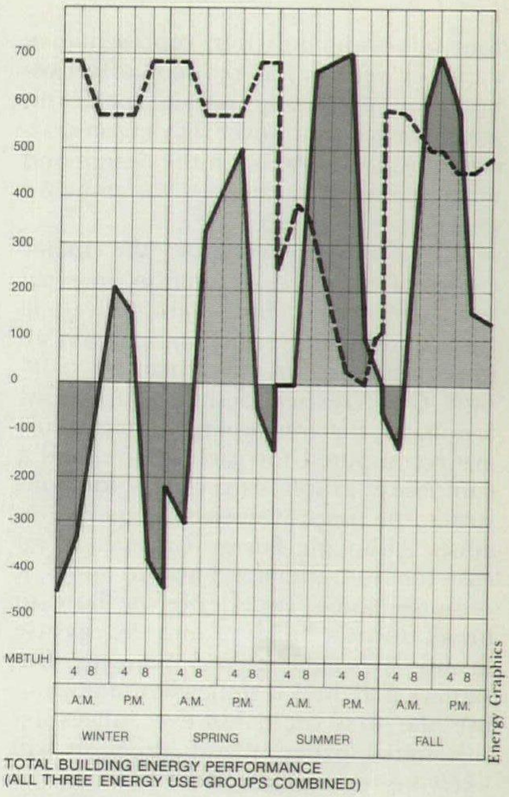
The unique contribution of the handbook is that estimating performance requires almost no "number crunching." Performance is plotted on simple, easy-to-read charts. The designer needs to calculate only such simple building parameters as area of south windows, heat-loss coefficient, and area or storage mass in order to read annual energy performance from the charts. Because the charts are so easy to use, designers can revise estimates of building performance at every stage of the design process. The selected design details for each system are excellent aids for the preparation of construction documents. This publication combines the best features of the *Passive Design Handbook* and the *Passive Solar Construction Handbook.* Its only drawback is that performance analysis is limited to California or similar climatic conditions.

Passive Solar Construction Handbook,
prepared by: Steven Winter Associates;
sponsored by: NCMA, BIA, PCA, NFC;
prepared for: Southern Solar Energy Center; U.S. DOE;
available from: National Concrete Masonry Association, P.O. Box 781, Herndon, Va 22070;
price: $27; 616 pages.

Documentation of effective construction details for passive solar design has been one of the most neglected yet important technical areas of the field. Although passive systems use familiar materials, in many cases they are applied in unusual situations or experience greater thermal stresses than in normal detailing. Inappropriate details can greatly impair performance. The *Passive Solar Construction Handbook* is a practical design aid which is intended to help an architect or designer avoid these pitfalls (P/A, Jan. 1982, p. 168).

The handbook builds on the basic definition of concepts, systems, and design guidelines contained in other important texts. It is organized into sections by system type: Direct Gain, Thermal Storage Wall, and Attached Sunspace systems. Before presenting construction details for each system type, general construction issues for each are discussed. Case studies are included at the end of the handbook illustrating designed and built examples. It also provides an important section on the materials that are appropriate for the components of passive systems, outlining their physical characteristics and explaining many important but little-known problems that may be encountered in detailing. The Construction Handbook is an indispensable aid for anyone who has never detailed a passive system. It is a large first step in what should be an ongoing process of evaluating passive construction details.

Large buildings



Energy Graphics

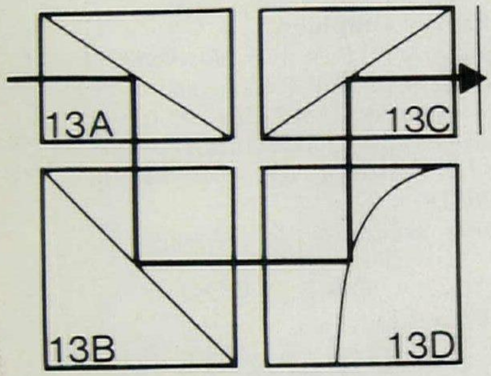
Energy Graphics,
prepared by: Booz Allen Hamilton; John Kurtz, William Whiddon, authors
prepared for: U.S. DOE;
available from: Booz Allen Hamilton, Inc., 4330 East West Hwy., Bethesda, Md 20814;
price: printed copy $8; 81 pages.

The book is designed to provide a graphically descriptive method for determining the energy implications of building program requirements in early design stages and assessing the impact of possible design decisions. The method looks at a typical day during each season and plots the thermal gains and losses in each four-hour increment in the day. This gives a far better picture of representative energy use than summer and winter design day calculations. It is also extremely useful in showing the energy needs over the course of the day and how losses and gains can be balanced against one another. The graphs can visually demonstrate the range of allowable heat gains, periods of excessive heat gain/loss and their magnitude, and seasonal changes in energy use. Because of the relatively large time increment of

Energy design aids

four hours and only four representative days per year, it has reduced effectiveness for predicting annual performance. It excels, however, in demonstrating typical energy use in the design and in suggesting strategies to improve energy performance.

Being able to visualize the major causes of energy consumption (internal heat gain, solar heat gain, envelope gains and losses, ventilation loads) is an important asset in directing the redesign. Once revised design assumptions are made, the four energy components are recomputed for each season, and a composite graph can clearly demonstrate the improvements in performance. Although *Energy Graphics* is an easy tool to understand and to apply, it requires some experience in how to break down a building into energy use groups of similar energy patterns. Designers may find it somewhat tedious to use the first time; however, investing this initial patience and attention will likely be repaid many time over.



Energy in Architecture: Level 2: Techniques (Catalog #4N911); Level 3a: Process (#4N912); Level 3b: Practice;
prepared by: AIA Energy Professional Development Program;
prepared for: American Institute of Architects;
available from: American Institute of Architects, 1735 New York Ave., NW, Washington, DC 20001;
price: $150 per set.

The American Institute of Architects has prepared three excellent workbooks as a part of their comprehensive Energy in Architecture Professional Development Program. They are intended for the practicing architect and concentrate on commercial buildings. The structure and format of the material are designed to accompany a series of two-day workshops for various levels of expertise. Although the workbooks can be purchased separately through the AIA, the full impact of the design methods is learned best through the workshops.

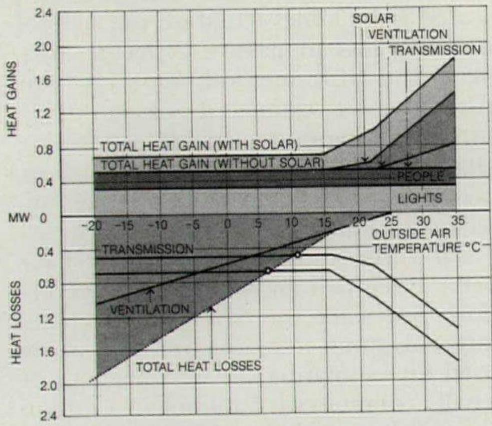
Level 2, Energy in Design: Techniques, gives the practitioner fundamental concepts of energy-conscious design. After reviewing basic concepts, the workbook is organized by chapter into: Program Factors, Climate Factors, Internal Loads, Form and Envelope, and Mechanical Systems. The innovative and most important contribution of the workbook is contained in the final chapter on energy analysis. Synthesizing techniques originally developed by ASHRAE and Hubert Buehruer, an energy balance graph and degree hour method are provided for calculating total annual energy consumption in a commercial building, taking into account the significant effects of internal gains. What makes this a truly powerful design tool is that it lets the architect "see" the relative size of the energy flows in a building and what causes them. Thus the architect is able to develop design strategies that go right to the heart of the energy design problem.

Level 3a, Energy in Design: Process, also breaks important new ground. It explains specific design techniques for Climate Analysis, Concept Analysis, Design Strategies, Daylighting, Energy Analysis, and Economic Analysis. The most important new method of analysis (developed by Tishman Corporation and presented here for the first time) is a system of nomographs used for estimating annual energy consumption. It is an extremely graphic design tool that shows how various components of a building use energy and how changing the design of components can alter energy consumption. This tool is a real breakthrough for simplified analysis of energy consumption in big buildings at early stages in the design process.

The workbook also makes an important contribution to daylighting design because it explains in one place both "Lumen" and "Daylight Factor" methods for estimating daylighting performance, and shows how these techniques relate to daylight model testing.

Level 3b, Energy in Design: Practice, applies all the methods learned in the previous workshops to the design of an actual building.

The Energy in Architectural Professional Development Program is the largest education effort ever undertaken by the AIA. Not only do the tools designed for the program represent the most current developments in the field, they are a major step in making energy analysis a clear and relevant concern to the designer's imagination.



MODEL HEAT LOAD ANALYSIS OF A BUILDING

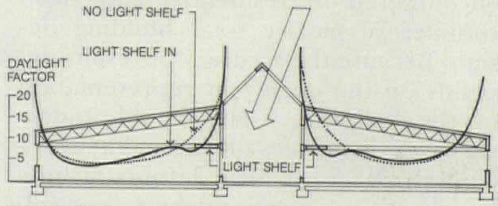
Energy Conservation Design Resource Handbook

Energy Conservation Design Resource Handbook,
prepared by: Enermedia International;
prepared for: Royal Architectural Institute of Canada (RAIC);
available from: American Institute of Architects, 1735 New York Ave., NW, Washington, DC 20006;
(AIA Catalog #M 428);
price: $75; 696 pages.

The handbook is a handy reference for designers of commercial buildings who are presumed to have some facility in synthesizing information to "develop their own solutions to particular and specific problems." Written primarily for a Canadian audience, this publication's 34 contributors cover numerous topics including climatological studies of Canada, design criteria for new construction, urban planning and development criteria, and life-cycle costing. The core of the handbook addresses environmental and energy systems and includes a valuable discussion of the heat balance concept for internal-load dominated buildings and useful descriptions of often employed HVAC system designs and operating characteristics.

The designer who wants a good sense of the many issues involved in energy-conscious design will benefit from this handbook. However, detailed numerical application of design factors (in metric units), which is tabularly or graphically presented, is lacking in the publication. Greatest benefit will be derived by designers who are comfortable with metric units, although the presentation of concepts is thorough and clearly valuable regardless of whether the user undertakes serious numerical analysis. Since this is a reference publication, no attempt is made to synthesize the various topics of discussion under a common methodology that will elucidate design issues of greatest importance. Thus the publication is most valuable when used in conjunction with other workbooks and resources that present ordered design procedures. Extensive references are provided for those who may wish to penetrate any of the handbook's many topics in greater depth.

Daylighting design tools



DAYLIGHTING MODEL TEST RESULTS

Princeton Energy Group

Techniques for predicting daylighting in buildings include numerical/graphic analysis and scale-model testing. Simple numerical and graphic design tools provide daylight factor estimates or footcandle levels in rooms with simple geometry and vertical or horizontal glazing. Scale-model tests can be used to examine lighting levels in more complex building configurations. No single reference covers all the quantitative and qualitative issues involved in daylighting design. *Daylight in Architecture,* by Benjamin Evans, and *Perception and Lighting as Formgivers for Architecture,* by William Lam, are two authoritative works reviewed in this issue of P/A (see p. 204). *The Daylighting Resource-Book,* available from the American Collegiate Schools of Architecture, is an excellent work that describes most of the numerical/graphic methods useful to designers. There is a large body of research and literature on daylighting; much of it, however, is difficult to obtain and highly technical. For purposes of architectural design, the following publication is an excellent introduction:

Recommended Practice of Daylighting,
prepared by: Office Lighting Committee of Illuminating Engineering Society of North America;
available from: Illuminating Engineering Society of North America, 345 E. 47 St., New York, NY 10017;
price: $12.; 48 pages.

A valuable first reference to the designer interested in natural lighting, it identifies basic visual performance criteria and potential glare problems that must be addressed in any lighting application. The sun and sky as sources of beamed and diffuse daylight are treated in detail. Included are valuable illumination curves for clear and cloudy skies for each season of the year as a function of solar altitude. The curves are extremely useful for estimating annual daylighting performance when combined with commonly used calculation methods and scale-model test results. *Recommended Practice of Daylighting* borrows the Lumen Methodology for predicting interim illumination levels in sidelighting and toplighting applications. This method relies on empirically determined utilization coefficients to assess the effects of room geometry, ground reflections, window shading devices, or interior illumination levels. Although the step-by-step methodology is easily executed, it is useful only for vertical and horizontal glazing surfaces and does not present a simple method by which the designer can estimate annual lighting performance.

Hand calculator programs

Card-programmable calculator programs serve many discrete energy calculation tasks. "Discrete" means that these design tools are generally limited by the relatively small memory capacity of hand calculators to specific tasks within a broader energy analysis problem, or to fairly simple building designs. A skilled analyst can sometimes adjust inputs to greatly expand the appropriate use of these simple tools; however, inexperienced designers should be careful to stay within the range of assumptions embodied in these programs and their intent. The special advantages of hand calculator programs are low cost (both in the programs and in required equipment), simplicity of input, and user control. The best of the genre make excellent learning tools for designers just beginning to use machine-aided calculation techniques. Here are some representative examples:

TEANET,
prepared by: Total Environmental Action, Inc.;
available from: Total Environmental Action, Inc., Church Hill, Harrisville, NH 03450;
price: $90. plus $40 for automatrix option.

TEANET, the first card-programmable calculator program published for use in solar design, is an excellent general thermal network simulation program. With it, one designs a mathematical model (the thermal network) to represent heat transfer rates, paths, and relationships in an active or passive solar system. TEANET then simulates performance on an hourly basis, outputting temperatures and heat flows. It is best used for hour-by-hour performance analysis of selected day conditions for fine-tuning various aspects of the design. It is also a good, flexible tool for "learning the ropes" of thermal network analysis, while sophisticated enough, in the hands of a skilled user, to model complicated or innovative systems. If the limits of TEANET's capability are to be pressed, the automatrix option is advised to reduce the time required for data input.

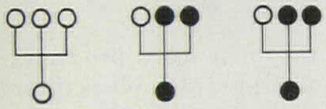
PEGFIX/PEGFLOAT,
prepared by: Princeton Energy Group;
available from: Princeton Energy Group, 575 Ewing Street, Princeton, NJ 08540;
price: $75.

A pair of simplified thermal network programs for day-long hourly simulation of direct gain passive solar heating, these are among the fastest and easiest to use of solar design programs for hand calculators. PEGFIX and PEGFLOAT analyze sunspaces with and without thermostat control settings. They output hourly temperatures and several other useful figures. Written by Bill Glennie assisted by PEG staff, they embody the characteristics that we consider most important in any calculator program. They are excellent learning tools. Appropriately limited to the direct gain systems for which they were written, PEGFIX and PEGFLOAT are among the most effective tools available for evaluating storage, potential overheating, excess heat available, and other issues of interest based on hourly analysis of representative days.

Energy design aids

Solar Energy Programs,

prepared by: Sanford A. Klein and William A. Beckman;
available from: F-CHART, P.O. Box 5562, Madison, Wi 53705.
price: $50; book.



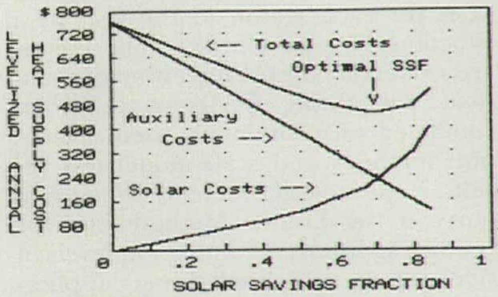
This is a superior inexpensive collection of 13 useful programs, nicely documented, consistent with well-established solar analysis techniques. Useful in both active and passive solar design, they can be used as component routines to speed a hand-calculation process or to develop inputs to be used with other design tools. The programs include solar radiation calculations, solar performance analysis using the F-Chart method, determination of average daily utilizability, an economic evaluation program, and others. The theory and assumptions in each analysis are briefly and clearly explained. Program listings are given for both TI-59 and Hewlett-Packard card-programmable calculators, to be keyed into the calculator by the user.

Other software
Many other good calculator programs are available. Most publishers are listed in *Analysis Methods for Solar Heating and Cooling Applications,* a booklet available free of charge (publication No. SERI/SP-35-232R) from: Solar Energy Research Institute, 1617 Cole Blvd., Golden, Co 80401.

Software for microcomputers
Microcomputer programs are now used by many designers for building energy analysis. Most small buildings can be examined in detail, and many programs permit simplified calculations useful in commercial building design. Capabilities vary with memory size and other characteristics of particular machines; good programs have been published, however, for most of the popular desktop computers.

The range of program applications is already broad and is rapidly growing. Microcomputers and currently available software can handle most energy calculations desired by architects during the design process. Microcomputer programs tend to be easier to use than most hand calculator programs and are capable of much more complicated analyses. The machines operate at amazing speed, and many programs incorporate excellent report-writing capabilities. Some of the best include modest graphic outputs.

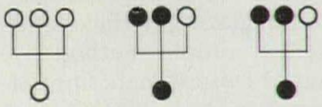
Limited memory places sophisticated computer-aided drafting beyond the ability of most microcomputer systems; extended hour-by-hour simulations and performance estimates for large and complicated buildings are better left to large computers. But for the purposes of energy design analyses commonly undertaken by architects, currently available microcomputer software can be remarkably fast and effective. Costs for both machines and software are within reach for most designers, including small architectural firms. Here are some examples:



Solarsoft

SUNMAT and SUNOP,

available from Solarsoft, Box 124, Snowmass, Co 81654;
price: SUNMAT $250; SUNOP $250; $400 together.

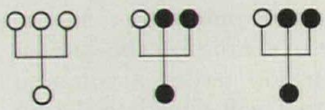


Programs require APPLE II+™ with 2 disk drives and printer.

These programs use the latest Solar Load Ratio method to estimate performance and evaluate cost/benefit prospects for the common passive solar system types. SUNMAT (thermal performance estimates) and SUNOP (economic assessment) greatly increase the speed with which alternatives can be investigated using the *Passive Solar Design Handbook* procedures. Like all the programs published by Solarsoft, these are especially strong in output presentation, which includes graphing of results.

NEATWORK,

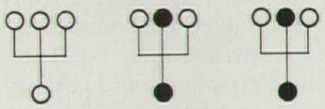
available from: Princeton Energy Group, 575 Ewing Street, Princeton, NJ 08540; price: $250; for TRS-80, APPLE, or Commodore PET/CBM microcomputers, any model 16K or larger.



This is a thermal network analysis program by Bill Glennie of PEG. NEATWORK is a completely general network modeling tool for hour-by-hour simulations of up to 20 days duration. The complexity of systems which can be studied depends on machine memory (RAM) capacity; most popular microcomputers, however, are powerful enough to model the situations often encountered in residential and small commercial passive solar building design. Because the accuracy of results depends on the quality of representation of the building, users should understand the principles of thermal network analysis. NEATWORK outputs include hourly temperature and heat flow values chosen by the user, plus daily summary of heat loss and auxiliary or excess heat at the end of each run.

OVERHANG,

available from: Lone-Parker-Michels, Inc., 7438 Forsyth, Suite 202, St. Louis, Mo 63105;
price: $195 license; for Northstar, APPLE II, Alpha Micro, and S-100 microcomputer systems, 16K RAM models.



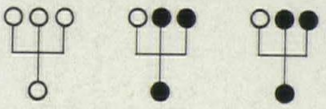
OVERHANG is a tool for design evaluation of window overhangs and side fins. It calculates the average insolation received by glazing or the fraction of unshaded total for windows in any location and orientation. It is thus useful in design for solar heating and for cooling load reduction by means of external shade devices.

Other software
Many firms have published microcomputer programs for building energy calculations. Some are experienced software houses, others architects or engineers who have developed programs in response to the needs of their own practice. Most suppliers, and many of the currently available programs (the list is rapidly growing), are described in *Microcomputer Methods for Solar Design and Analysis,* a booklet available free of charge (publication No. SERI/SP-722-1127) from: Solar Energy Reseach Institute, 1617 Cole Blvd., Golden, Co 80401.

Intermediate computer tools

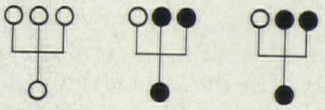
Several fine programs are available for energy design and calculations of intermediate size and complexity. They are capable of handling most residential and small commercial building passive solar designs, but lack the sophisticated mechanical systems modeling capabilities of the large, main-frame computer programs. Written specifically for use by designers, they tend to be easier to understand and use than most main-frame programs. Here are a few examples:

SUNCODE,
available from: Ecotope, Inc., 2328 East Madison, Seattle, Wa 98112;
price: license fee around $1700 (contact Larry Palmiter at Ecotope); requires Data General Eclipse C/330 or similar equipment.



Originally developed by the National Center for Appropriate Technology as SUNCAT, this program emphasizes the performance of passive solar systems in buildings with multiple zones. SUNCODE provides a great deal of flexibility, with rockbeds possible in every zone and thermostatically controlled fans between any. Output is monthly and annual loads by zone. Ecotope has anticipated publishing a version of SUNCODE for TRS-80 or similar microcomputers.

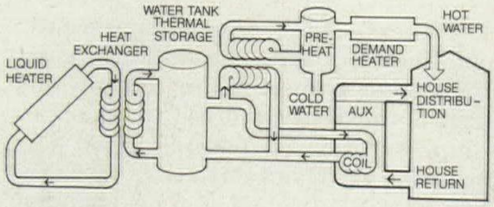
CALPAS3,
available from: Berkeley Solar Group, 3140 Grove, Berkeley, Ca 94703;
price: timesharing service; contact Sara Bennett at BSG.



Initially developed for the *California Passive Solar Handbook,* the program version now available through Berkeley Solar Group allows users to represent a single zone with any passive heating system, as well as natural and forced ventilation or evaporative cooling. Output from CALPAS3 can be monthly, daily, or hourly reports of energy flows and temperatures. An inexpensive terminal or microcomputer with modem is required in user's office. Use is charged on a time basis following a modest initial fee.

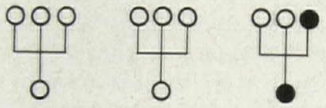
Large-scale computer tools

Finally, there are several large "main-frame" computer programs. Most are products of many years of research and development. They typically excel in the analysis of large and complex multizone mechanical systems. Big building projects, and particularly those involving innovative energy management techniques, can benefit from study using these tools during the design process. Some of the large programs have been recently updated to include passive solar and other alternative energy applications, although this process is in many cases far from complete. If a detailed analysis is needed using these tools, it would be best to seek expert advice on, and probably consulting assistance in, their use. Here are some representative large programs:



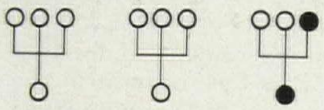
TRNSYS

TRNSYS,
for information contact: Solar Energy Laboratory, att: James E. Brown, University of Wisconsin, 1500 Johnson Dr., Madison, Wi 53706.



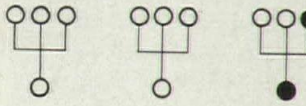
This sophisticated solar analysis program was developed by the University of Wisconsin Solar Energy Laboratory. It incorporates all major types of active and passive solar systems. It handles only a single zone and models fewer standard mechanical systems than some other large computer programs. But users can easily add their own component subroutines, which are linked to others in the same manner that the physical devices would be connected. Outputs from TRNSYS include heating and cooling loads, as well as energy used by various components. It is available through several timeshare services and the University of Wisconsin.

DOE 2.1,
for information contact: 90-3147, Lawrence Berkeley Laboratories, att: Richard Curtis, Berkeley, Ca 94720.



Developed for the analysis of multizone buildings with standard mechanical systems, DOE 2.1 now includes active and direct-gain passive solar system options. The effects of building mass on the loads are represented by weighting factors, similar to those in *ASHRAE Handbook of Fundamentals,* but specific to each zone defined. Indoor temperatures are constant during the load calculation, but can fluctuate when the HVAC system is simulated. This allows the interaction between system and space to be represented with a relatively fast overall run time. DOE-2 was to be the calculative method for BEPS, and it has been the major calculation tool used in P/A's "Energy Analysis" series (see following article by Vladimir Bazjanac).

BLAST,
for information contact: U.S. Army Construction Engineering Research Lab, att: Dale Herron, P.O. Box 4005, Champaign, Il 61820.



The Army developed this program to evaluate energy conservation and solar options for buildings. Either annual or design day hourly simulations of multiple commercial or residential buildings can be made, with consideration of building shading and room heat balances. Interior temperatures are allowed to vary during load calculations and are fixed during the mechanical system simulation. In addition to a large library or system types, BLAST can calculate life-cycle costs for each option chosen. Outputs include monthly and daily loads, with energy for different end uses, as well as peak and average daily profiles. BLAST is available through several major time-share services.

Many other intermediate and large-scale energy analysis programs have been developed by university researchers and major manufacturers of building mechanical equipment. Other resources, including computer manufacturers and service bureaus, are available to assist designers in finding and selecting appropriate software. A good representative selection is presented in *Analysis Methods for Solar Heating and Cooling Applications,* a booklet available free of charge (publication # SERI/SP-35-232R) from: Solar Energy Research Institute, 1617 Cole Blvd., Golden, Co 80401. □

This is where and what

Vladimir Bazjanac

The following article attempts to put the role of energy analysis in the perspective of the total design process and explain the specific use of DOE-2 in design. The author draws from the base of the two-year energy analysis program published in P/A and funded by the U.S. Department of Energy.

The Energy Analyses program recently published in *Progressive Architecture* examined energy performance at only one stage of the design process. It did not attempt to provide comparison of performance at different stages of design. Nearly all of the 14 buildings analyzed so far have been analyzed approximately at the stage of *design development,* even though most of the buildings were under construction or completed at the time of analysis.

Architectural energy analysis can be and should be used, as well, during the entire design process. In fact, the earlier it is used, the more effective it is in helping design a truly energy-efficient building. Energy analysis is most effective when it is treated as an integral part of the design process, rather than a consideration to which attention is paid at intervals. The consideration of the building's energy performance must be a conscious design issue from the beginning to the end of the design.

Design is a learning process

Learning about the problem is the most essential activity in design. As one learns more and more about the problem, one also learns more and more about possible solutions.

The process of learning stops only when one or more resources needed in the process are exhausted: no more time is left, the allocated budget has been spent, everything relevant has been learned, or the learner has reached personal limits and is for the moment incapable of further learning. According to this theoretical model of design, it is obvious that any improvement in design is directly related to the increase in the rate of learning and the amount of accumulated knowledge. Any strategy attempting to improve the design process must therefore be concerned first with improving the learning.

Energy analysis can play a very important role in increasing the rate and accelerating the learning during the design process (Fig. 1). As the designer learns more about the energy performance of the design, the learning curve representing the design process can become steeper and can reach a higher level. This means that the entire learning process can proceed faster and that more comprehensive knowledge can be developed about the problem and the solution.

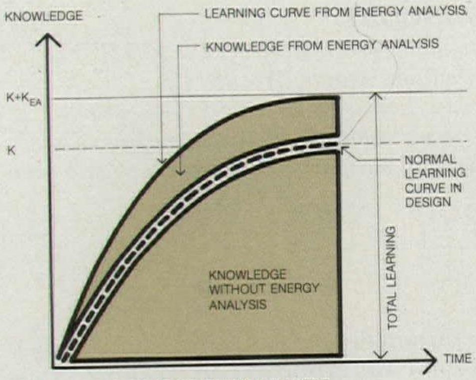


FIGURE 1: DESIGN AS LEARNING PROCESS

The "contractual" model of design

The architectural design process can also be viewed as a function of the architect's contract. A contract primarily defines the type of work the architect will perform during the design, the type of information (i.e., documents) the architect will generate, and specific times at which the architect will submit the information.

The process so defined is strictly linear in time (Fig. 2). It may start with architectural programming, or with schematic design, or even later; it may continue as long as the supervision of construction or it may terminate at the end of design development or even earlier. Design terminates when the resources considered in the contract are exhausted: time or funding. Characteristically, the designers' personal abilities or the limits to the understanding of the problem are not accounted for in this model. Also, the described process is not continuous; it is interrupted by periods of review, over which the designers have little control.

In the "contractual" model, energy analysis is useful only if it helps design buildings more energy efficient than they would otherwise be. Implications of this are clear: energy analysis must take place *during* the design process—information must be available *at the time*

Dr. Vladimir Bazjanac teaches in the Department of Architecture at the University of California in Berkeley. He is project director in the Center for Planning and Development Research and is also guest scientist at the Lawrence Berkeley Lab.

design decisions that are critical to the energy performance are made. Energy analysis which *follows* such design decisions and treats them as *faits accompli* is not a positive contribution to design.

The energy performance of a building is being determined from the very beginning of design. The earliest design decisions (those that formulate the design concept, the configuration and the orientation of the building, and its placement on the site) are usually the most critical. (The architect often does not have an opportunity to participate in programming, and determining the energy performance then does not start until the beginning of schematics.) After that, each new design decision has a progressively smaller impact on the energy performance of the building. By the time design development is coming to conclusion, design decisions have the effect of fine-tuning the performance.

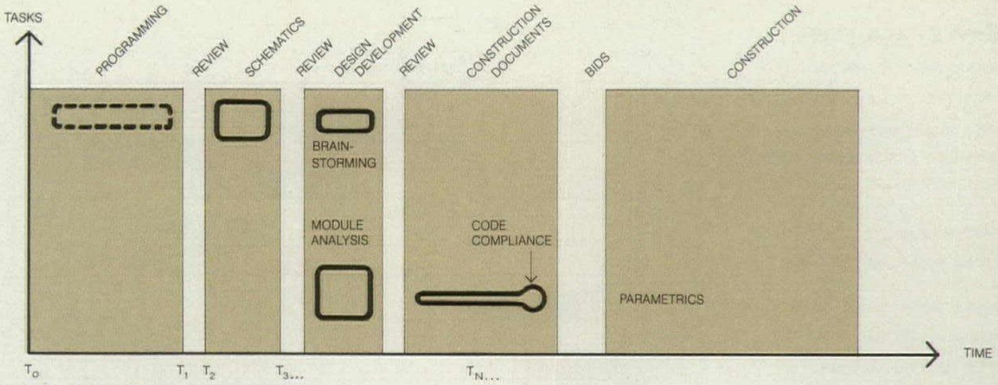


FIGURE 2: DESIGN AND ARCHITECTURAL ENERGY ANALYSIS AS SEQUENCES OF TASKS

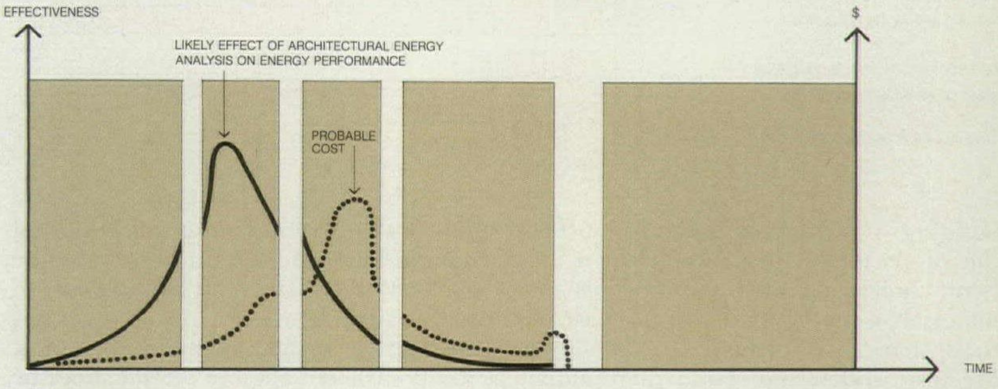


FIGURE 3: EFFECTIVENESS AND COST OF ARCHITECTURAL ENERGY ANALYSIS IN THE DESIGN PROCESS

In support of architectural design

Architectural energy analysis is thus most effective at the beginning of design. All too often, unfortunately, it does not start until much later and after severe limitations to the building's energy performance have already been set by uninformed designers. The actual tools employed in energy analysis during the design process vary according to the stage in development of the process (Fig. 3).

Brainstorming: At the beginning, "brainstorming" is most effective. By the time the strongest design solution is beginning to crystallize and the designers need more quantitative information, brainstorming will partially give way to "module analysis." After the final design development and during the development of construction documents, full-scale "parametric analysis" of the entire building is needed.

During "brainstorming," energy analysis focuses on the generation of many energy-conserving concepts that may be appropriate for the particular design, and on the assessments of the merits of each of them. The essential part of brainstorming is *speculation:* opportunities to employ various energy-conserving features in the building and the effectiveness of the proposed concepts are judged mostly on the basis of previous experience or the analysis of other buildings.

Quantitative analysis at this stage is limited to the manipulation of only the most obvious design parameters. Early quantitative analysis is always based on a large number of assumptions, since the detailed information about the design necessary for such analysis simply has not been developed yet.

One of the most important activities during the "brainstorming" phase is the "energy education" of *all parties* involved in the design. Education may pertain to the state of the art in energy-efficient design, the goals of energy-efficient design, and about the ways and strategies to reach energy efficiency in a building. If this education is successful, all parties (the building's owners, the designers, the building management) develop a "common language"—future decisions related to the energy performance of the design are then reached more swiftly. Also, the goals of energy performance for the particular building and the strategies in design to reach those goals are easier to determine. The latter are perhaps the most important results of "brainstorming analysis."

As a particular scheme is formulated more clearly, more specific questions about its energy performance need to be answered. Typically, this takes place in the latter part of schematic design. While the design solution is beginning to take specific shape, it is still defined rather unevenly: parts of the solution are worked upon in more detail than others. Typically, these parts are most representative of the performance of the future building.

Module analysis: Using this type of analysis, the typical, critical parts of the building are isolated from the remainder of the building. Sections of the building (a few floors, a few bays, or a few rooms) are defined and analyzed quite carefully under the assumption that their energy performance will characterize the energy performance of the entire building. "Module analysis" provides the first opportuity to perform fairly detailed quantitative analysis, including simple parametric analysis. As a result, the designers can decide which are the most promising specific, detailed solutions among those that they are considering. They can also be alerted to favorable solutions they may have missed. These decisions are no longer based on speculation—they are based on results from reliable analysis, which has taken into account characteristic design factors. The most important result of "module analysis" is the discovery of those elements in the design that can be changed in the next stage and result in the greatest improvement of energy performance.

The energy performance of a building cannot be fully understood until the *entire* building has been analyzed in detail. In such analysis, the design is typically modeled by one or more sophisticated simulation models (P/A, April 1980, pp. 98–101). When all the information about the design required by these models has been developed (typically later in design development), one can start "parametric analysis."

Parametric analysis: During this stage, different design decisions are examined in detail by simulating their effect on the performance of the entire building over an extended period of time. From the results of "parametric analysis," one can access the specific benefits from different decisions, compare them, and also determine quite precisely the role they play in the overall performance of the

Energy analysis

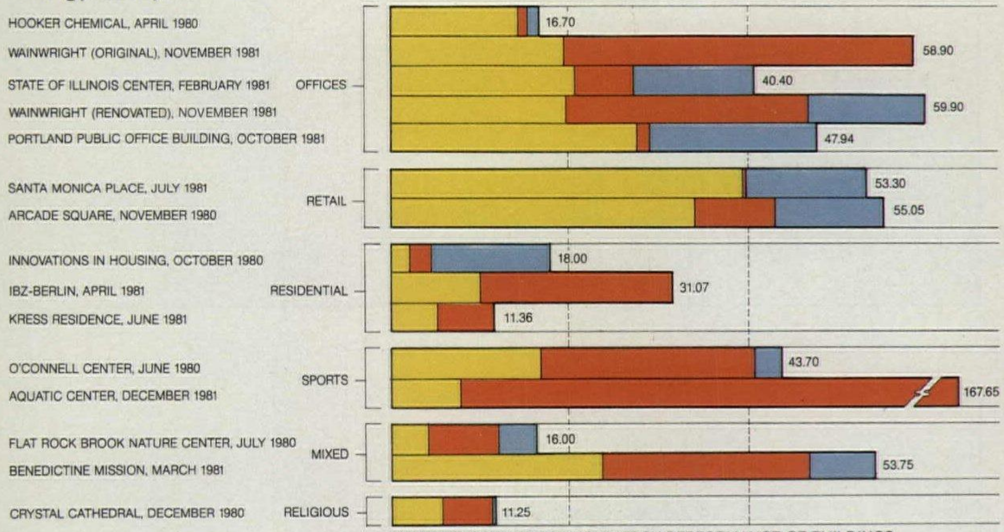


FIGURE 4: COMPARISON OF ENERGY PERFORMANCE OF BUILDINGS ANALYZED IN P/A

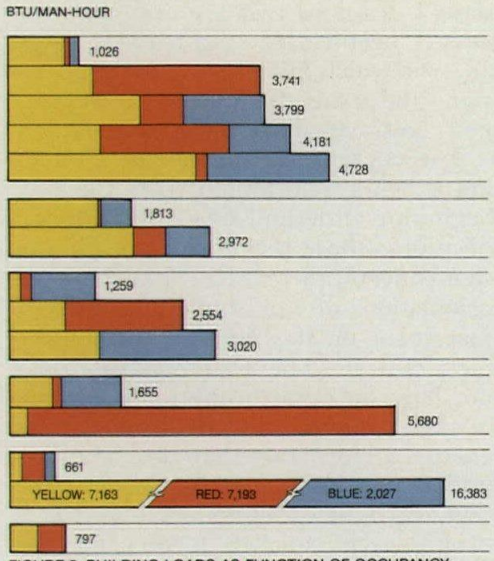


FIGURE 5: BUILDING LOADS AS FUNCTION OF OCCUPANCY

building. "Parametric analysis" offers the single means of decision when difficult choices in construction details and materials must be made on the basis of their energy performance.

Meeting codes: Full-scale quantitative energy analysis of the entire building also provides the necessary data for the demonstration of performance in compliance with energy codes. This demonstration typically takes place at the end of preparation of construction documents of compliance with codes, when all necessary details have been resolved and the demonstration represents the final analysis. More important, full-scale quantitative analysis with sophisticated simulation models during design development can clearly indicate whether the building is going to meet the code when code compliance analysis is performed much later. Correspondingly, "parametric analysis" can tell the designers which design modifications may be needed to meet the energy code.

Costs: There is a discrepancy between the effectiveness of architectural energy analysis and its cost (Fig. 3). Energy analysis is clearly most effective early in the design process. At that time it is relatively inexpensive, mostly because "brainstorming" is neither labor nor equipment intensive. While the effectiveness of energy analysis inevitably drops during design development, its cost rises very significantly. This is because detailed quantitative analysis with sophisticated simulation models requires a lot of work and the use of expensive equipment in the modeling of the building. The cost of "parametric analysis" drops significantly because the detailed modeling of the building has been finished by then. Attempts to "save" money by delaying architectural energy analysis are obviously counterproductive. Designers who think that "right" design decisions early in the design process can be made entirely without the benefits of energy analysis (i.e., "brainstorming analysis") later often find that they were wrong; the resulting changes in the design often prove to be much more expensive. The high cost of analysis during design development is difficult to avoid, because the most energy-efficient choices often cannot be made without "parametric analysis."

Comparison of energy performance

Most information about energy performance of buildings is expressed as annual consumption per sq ft, as peak hour consumption, or as total annual consumption. Comparison of energy performance in the demonstration of compliance with energy codes is given as total annual load per sq ft. Comparisons relevant to architectural design are typically given as heating and cooling loads for the building. Such comparisons seldom reveal much about the effect of occupancy or the climate on the energy performance without detailed study of parameters in the simulation, even when electrical loads from lighting and occupant-operated equipment are included in the analysis.

The comparison of the simulated energy performance of buildings as individually reported in *Progressive Architecture* (Fig. 4) demonstrates the point clearly; the most energy-efficient building appears to be the Flat Rock Brook Nature Center in Englewood, NJ, a building with no air conditioning. The Aquatic Center in Corvallis, Or, appears to be the least efficient; the plot fails to communicate anything about the extraordinary requirements for heating required in the use of the building.

The notion of energy efficiency changes somewhat when the intensity of occupancy is considered. If the demand for energy is plotted for the same buildings against man-hours of their use, the results of comparison are a little different (Fig. 5): they favor more the heavily occupied buildings.

The best way to measure the success of the design in dealing with the climate in which it is located may be in the establishment of its heating and/or cooling effectiveness. This is accomplished by determining the heating load per sq ft per heating degree day and the cooling load per sq ft per cooling degree day. Figs. 6 and 7 show the heating and cooling effectiveness respectively for the buildings analyzed in *Progressive Architecture.* (The comparison of cooling effectiveness includes a smaller number of buildings because some of the buildings in Fig. 6 have no cooling system.)

One may be tempted to plot energy performance against cost of construction. This is potentially misleading. Cost of construction is a function of many different factors: the type of building, its location, its owner's aspiration for status, the type of use, etc. It is often impossible to fully isolate the cost of energy-conserving features. Construction cost is hardly ever representative of the effort put into making the building energy efficient. Crystal Cathedral is a case in point: its total load is relatively small, mostly because the volume above the ground is unconditioned and because the building is used only a few hours per week. Yet the cost of construction per sq ft exceeded several times the cost of the next most expensive building in the Energy Analyses. Crystal Cathedral's high cost of construction certainly does not reflect much upon its energy performance.

DOE-2 in design

When architectural energy analysis involves the manipulation of numbers, the use of one or more quantitative models

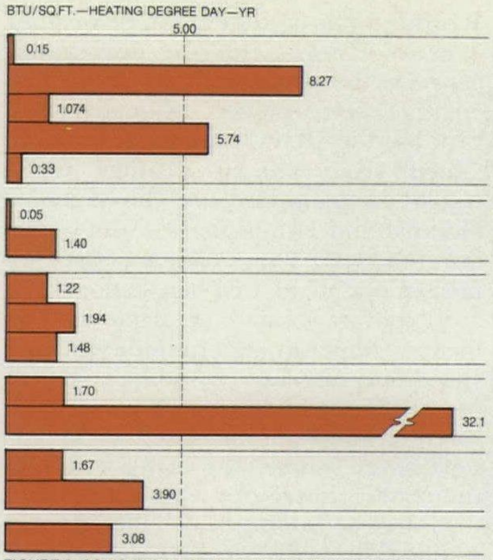


FIGURE 6: COMPARISON OF EFFECTIVENESS IN DEALING WITH HEATING LOAD

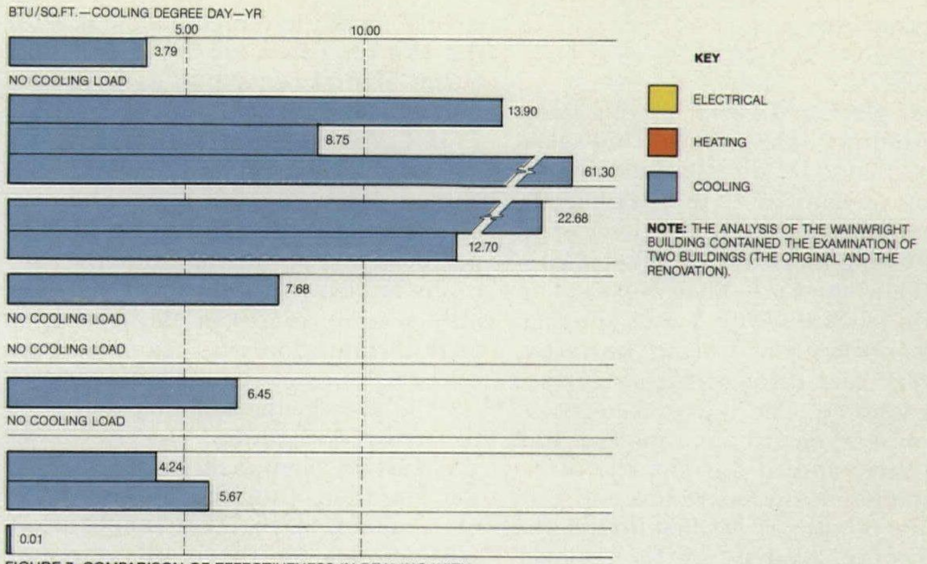


FIGURE 7: COMPARISON OF EFFECTIVENESS IN DEALING WITH COOLING LOAD

is inevitable. These models may be very simple and may not even require the use of a calculator; or they may be very complex and capable of execution only with the help of large computers.

As a rule of thumb, the more complex a model of the energy performance of buildings, the more architectural design variables can be considered. This is not to say that simple models are not useful in the design process (see previous article). However, some of the very important parameters of energy performance of buildings (e.g., external shading, managed windows, patterns of use, the annual variation of climate, etc.) can be considered only with the more sophisticated models.

Several models qualify as "sophisticated." Of those, DOE-2 is perhaps the most powerful for architectural energy analysis. This is because DOE-2 can consider the greatest number and variety of *architectural* design parameters that determine the energy performance of buildings (P/A, July 1980, p. 63). Models that are excellent in the simulation of the performance of mechanical systems (e.g., ACCESS or TRACE) are less sophisticated in the calculation of the building's heating and cooling loads and often cannot consider the appropriate detail of architectural design nor credit the building for some of its special energy-conserving features.

DOE-2 can be used virtually at any time in the design process. It can be useful in "brainstorming," in "module analysis," and in full-scale "parametric analysis." The scope and strategy of simulation will vary with the time DOE-2 is used. During "brainstorming," it is likely to be limited to some generalized, hypothetical descriptions of the design; DOE-2 analysis will consist of the comparison of generalized performance of different configurations, given different orientations, climates, and other general considerations. The sophistication of the analysis at that stage of design matches the level of sophistication of the examined design solution.

During "module analysis," the capabilities of DOE-2 are utilized much more. The design of the typical modules includes enough detail: DOE-2 description of the modules' features that are important to the energy performance is based on actual design decisions, not on assumptions. The impact of various design decisions can be examined in as much detail as is defined by that stage of development of design.

DOE-2 is best utilized in "parametric analysis." While it cannot generate reliable, exact predictions of the actual energy consumption (P/A, April 1980, p. 100), DOE-2 is at its best when all parameters of energy performance are controlled. When all parameters are defined, the variation of one parameter causes a change in results from simulation which is a *clear and reliable indication of the effect* of the variation.

One of DOE-2's characteristics most important in architectural energy analysis is its ability to examine hourly performance for a full year. Peak loads are sometimes poor indications of a building's energy efficiency: one building can have higher winter or summer peak loads than another, yet consume less energy in a 365-day period. The building's *annual* performance provides a much better measure of energy efficiency. Energy efficiency during peak demand hours is becoming an increasingly important consideration of energy performance. Peak demand hour analysis can also be accomplished with DOE-2.

Sometimes buildings do not have cooling and/or heating systems. This is particularly true of some building types (e.g., in most other countries housing is not expected to be air conditioned) and of buildings located in extreme climates. If a design does not include a heating and/or a cooling system, no heating and/or cooling loads are evident. Then the critical measurement of the building's performance is the interior temperature. DOE-2 can simulate the hourly fluctuation of interior temperatures for any space in the building and for any length of time.

Of course, no model is ever even close to being perfect. The problems encountered in architectural energy analysis with DOE-2 result from the conceptual shortcomings of the model or from the limitations in its size. When such problems are encountered, one has to resort to "tricks" in the description of the design or to modifications of the DOE-2 program. Occasionally, features characteristic of the design simply cannot be modeled by DOE-2 in any way.

Tricks

"Tricks" are definitions of design properties described as some other properties with very similar performance characteristics. One may not be modeled by DOE-2, the other can. The use of "tricks" in DOE-2 simulation is limited only by the resourcefulness of the user. Many "tricks" are used in Energy Analyses that are published in *Progressive Architecture.* When no "tricks" are appropriate, one may be able to modify some of the algorithms in DOE-2 or add new ones. This implies access to DOE-2 code, which is seldom available in the commercial use of DOE-2. Some problems are encountered repetitively.

Interior glazing: Interior glazing (interior windows, glass walls, and glass doors) cannot be directly modeled by present versions of DOE-2. Conceptually, a window in the DOE-2 description of a building is *always* part of an *exterior* wall. If a window is defined as part of an interior surface, DOE-2 will simulate only its *thermal* performance correctly; any solar gain through such a surface will be ignored. The appropriate "trick" solution is to describe the internal wall as external, and to discount the direct solar gain and conductive loss and gain from the outside. It was first used in the P/A Energy Analysis of the Hooker Chemical Office Building (P/A, April 1980), and was reused in many other Energy Analyses.

Air stratification: Many buildings include very tall spaces. Because of the height of such spaces, and because of convection, the air will move vertically and the temperature at the top of the space will be considerably higher than at the bottom. This process is called air stratification. DOE-2 cannot model "air stratification." The best strategy is to divide the tall space vertically into two or more thermal zones and simulate thermal transfer between them. It was used in the Energy Analysis of the O'Connell Center (P/A, June 1980), the Crystal Cathedral (P/A, Dec. 1980), the State of Illinois Center (P/A, Feb. 1981), the Santa Monica Place (P/A, June 1981), and the renovation of the Wainwright Building (P/A, Nov. 1981).

Curves: No model accepts curved surfaces. All irregular surfaces are modeled as flat segments. The number of segments will depend upon the characteristics of expected performance. If the surface is only subject to conductive loss or gain one segment with the same area as the curved surface may suffice. If the curved surface is exposed to sun, even the division into many segments may not be enough.

Natural ventilation: DOE-2 cannot directly simulate natural ventilation. The effect of air flow inside the building can be simulated only through controlled infiltration, as was done in the Energy Analysis of the Crystal Cathedral. Under certain circumstances, one can write natural ventilation algorithms and add them to DOE-2 code; such algorithms are designed only for a particular building, as was the case in the simulation of the vented double skin for the Hooker Chemical Office Building. When natural ventilation is the critical performance characteristic of a design, DOE-2 analysis must be coupled with wind tunnel and comfort analysis.

Natural light: The consideration of the effects of natural lighting on thermal performance is difficult with the currently available versions of DOE-2. The only way to represent daylighting in DOE-2 simulation is to manipulate artificial lighting: electrical load is reduced for the area in the building that is affected by daylighting. One has to be very careful when determining such reductions in lighting load, as this method of credit for daylighting cannot properly account for the hourly variation in the effectiveness of daylighting.

It is not possible to correlate automatically the conditions of the sky or the position of the sun with lighting schedules in DOE-2. Since daylighting starts and ends at different times throughout the year, one must resort to the definition of several lighting schedules to adequately represent the beginning and the end of daylighting periods and the variation of the depth of zones affected by natural light. This is a very laborious process which results in very large DOE-2 descriptions of the use of the building.

The real issue in the simulation of lighting is the simulation of the performance of lighting control systems. The commercially available version of DOE-2 assumes essentially only a discrete switching system, whereby the intensity of light in the space can change only once an hour and according to some defined plan. Dimmable lighting, flexible control systems for multiband lights, or occupant response according to conditions cannot be adequately simulated. Fortunately, a daylighting version of DOE-2 is well along in development at the Lawrence Berkeley National Laboratory.

Patterns of use: A building's energy performance is very strongly influenced by the patterns of its use. Data for the simulation of occupancy are typically provided by the client or building management. As much as such information is often founded in experience or in observation of the use of similar buildings, a large portion is based on speculation. This is one of the major reasons why the prediction of the actual consumption of energy for the building still in design will inevitably be different from the actual consumption of the building when occupied. If one wants to compare the performance of one design with another, one must use the same occupancy characteristics for both, or the comparison will be meaningless.

Weather: The consideration of weather is another reason for the discrepancy between the simulated and the actual energy performance. Climatological data used in DOE-2 simulations are obtained from annual weather tapes, which are compiled by the National Oceanic and Atmospheric Administration (NOAA). Those data are based on measurements at weather stations that are typically located at airports. Ambient temperature, humidity, wind speed and direction, cloudiness, etc., at the site of the building may be very different from those measured at the airport. Even worse, for many buildings the closest source of measured weather data may be hundreds of miles away.

Though hourly weather data can be simulated for a particular location from a general set of weather characteristics for that location, very little can be done to account for the actual differences in microclimate between the building site and the site of the source of data. One possible recourse is to take the critical measurements at the building site and adjust the weather tape before simulation. This is a costly and time-consuming project, often not at all feasible. The problem may be partially alleviated by the development of models (now in progress) that will adjust the information on wind speed and direction as a function of the distance and the topological characteristics of the area between the building site and the site of measurement.

Conclusion

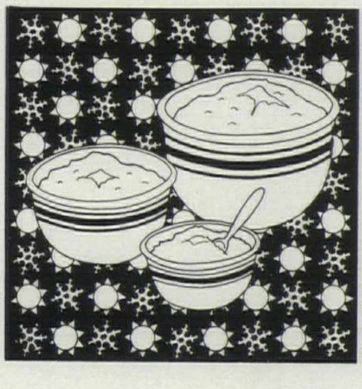
Despite some shortcomings, tools for energy analysis throughout the design process are available and are continuously being improved. There is no longer any excuse for not considering energy conservation from the very beginning of design.

This article points out some questions about energy efficiency of buildings. Two standard procedures of comparison of energy efficiency failed to agree. What is "true" energy efficiency? Is the present demonstration of compliance with energy codes misleading? The answers to these questions will depend on one's point of view and the circumstances under which they are raised. The architect must try to understand the relevance of such questions to his or her design. After all, the most important thing is to learn more. □

Introduction Part II

Goldilocks and the 13 buildings

For the first time since these April issues were devoted to energy, we have had a problem of too many buildings fit to publish. We could have published 20, but some thought that was too many; 16 seemed appropriate to a few people here; but 13 . . . that was just right.



Elizabeth Golz Rush

The other evening, I was reading Goldilocks and the Three Bears *to my young son. The story was proceeding smoothly until I got to the part where Goldilocks tastes the porridge. The largest bowl of porridge was too hot, the middle-sized bowl was too cold, and the littlest bowl contained porridge that was just right! I stopped reading. How could this be? Assuming they were all served together, the smallest bowl would contain the coldest porridge. If lukewarm porridge was what Goldilocks was after, why not take the middle-sized bowl?*

The truth is, Goldilocks had a formal hang-up. She liked small things: little chairs, little bowls, little beds, and little bears. Her choice was only partially based on thermodynamics. The other part was pure form.

Style-conscious owners and designers alike would prefer a specific look, something you could sell as "solar" or "energy efficient." All the buildings would have that look in some form. Over the four years P/A has been doing these energy issues, we have proven, beyond a doubt, that there is no specific aesthetic to energy design.

In fact there are big buildings and complex mechanical methods of conservation and small extremely simple solutions. There are houses, schools, office buildings . . . and they are spread throughout the country. An energy building can be socially conscious, built by its inhabitants, built for the wealthy or the poor. It can be funded by a government grant or not. Of course even the age of a building does not keep it from being energy conscious.

The buildings in this issue have been chosen for many reasons. Individually, they can be judged on their own merits. If energy does not dominate the design, it does not necessarily dominate our discussion of it. When looking at the examples and reading about them, one will inevitably compare them as buildings, concepts, and attitudes. What influence do the building type, program, and complexity play? Does the architect innovate? How dominant is energy as a form determinant? Is the space internal-load dominated or external-load dominated? What is the schedule or use? How much control does the occupant personally have over energy use in the spaces? What role does the climate, the planting, or the site play?

Many of the buildings have chosen earth berming, some are massive, some are lightweight. Color is a factor in some designs, as is energy economy of shape. Thermodynamics control many decisions, while lighting determines others. The proximities of uses can also be an energy issue, as well as the three-dimension disposition of space. Ventilation can be a reason for placing windows, doors, or openings.

One task already discussed in Part I is to know enough about the expected energy performance of the ensemble that constitutes your building so that every possible energy contribution towards the success of a building can be made by it. An energy-conscious design is literally one in which the designer has consciously sought to balance the energy-consuming characteristics of the building with all of the other social, physical, and climatic influences in the design. It is not necessarily petroleum-independent. It is not necessarily energy-minimizing. A good energy-conscious design is "architecture-optimizing" in the broadest and deepest sense.

After years of effort, architects are now achieving a proper perspective about energy. Engineering determinism has given way to a softer, more humane kind of building. Design offices that scurried to catch up on energy and filled up with engineering are now casting about for better designers. The most difficult task is to stay in balance: neither the form nor the technology dominates the building. The building must dominate the building.

Time has been a crucial element all along: the speed at which the information is generated, the speed at which it is consumed, the speed with which it can be used. It could take five years to find out whether or not the analytical procedure used, the design, and the building performance actually correspond. There will never be enough time for the quality; the only hope is to achieve enough quality for the time.

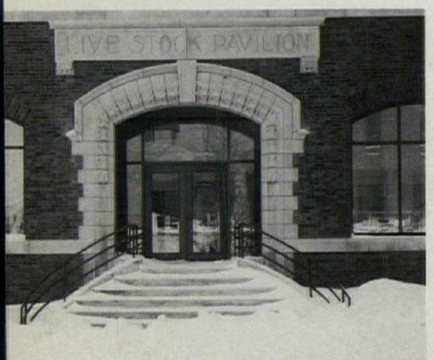
With each design, the confidence grows. The energy and comfort qualities of building are better understood; the balance of importance within the design is more nearly perfect; more time can be devoted to understanding more of the problem.
[Richard Rush]

Vocational Technical Education Facility, University of Minnesota, St. Paul

A north star

A new facility by the Architectural Alliance at University of Minnesota combines aspects of energy efficiency, contextualism, and reuse in one building.

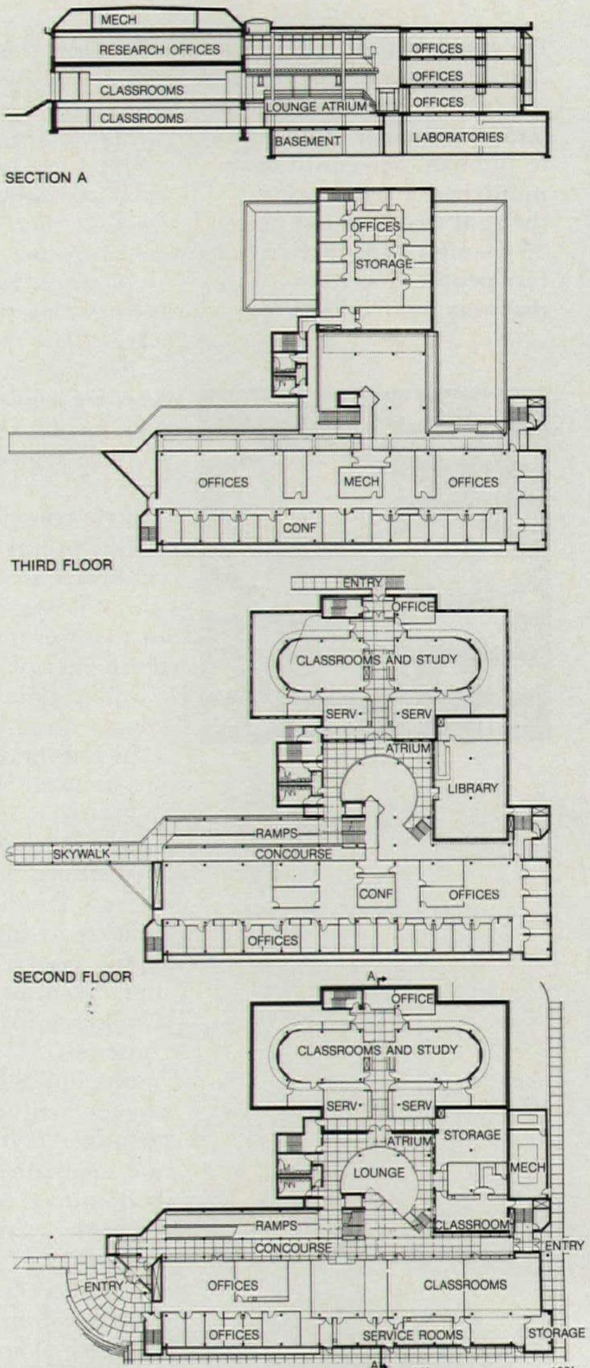
An old livestock pavilion converted to classroom use (bottom) is joined to a new office addition via a transitional atrium (below and far right) that becomes a campus lounge and part of the campus pedestrian skywalk system.

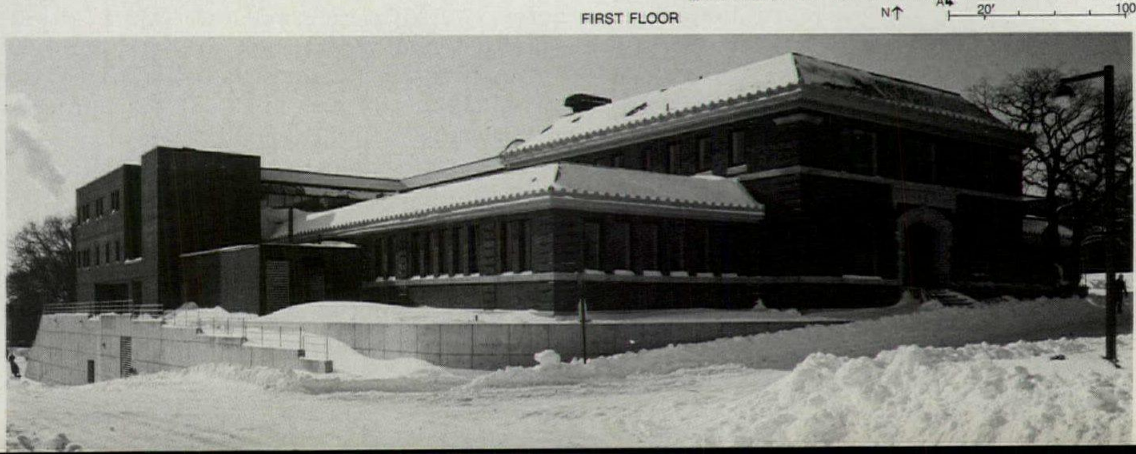


The St. Paul campus of the University of Minnesota is not unlike many other older campuses across the country. What had once been a fairly cohesive collection of attractive buildings, related to each other in terms of scale and materials, has been seriously eroded over the past few decades by the addition of new and generally unsympathetic structures. Part of the Architectural Alliance's intention, when asked to provide a new Vocational Technical Education Facility for the school, was to counter that trend.

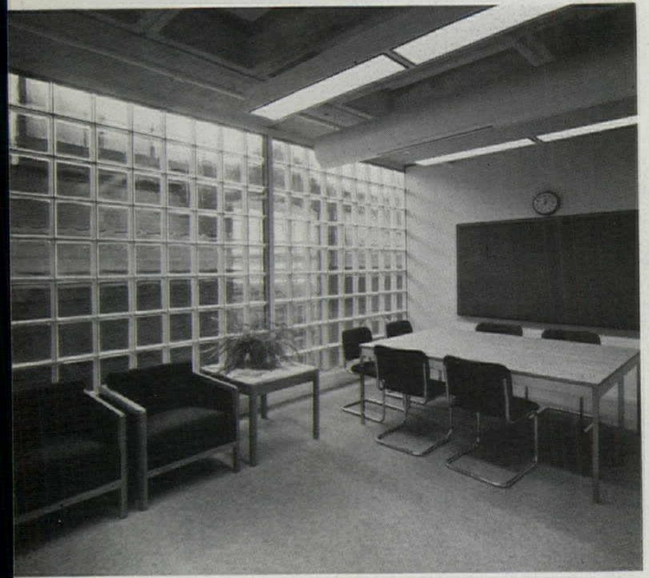
At this former agriculture college, the architects were asked to convert a handsome red brick livestock pavilion of 1904 into the faculty offices, classrooms, and a library for five related but previously separated divisions that teach students how to teach vocational and technical subjects. It became immediately apparent, however, that even with the excavation of the pavilion's dirt floor and the addition of a new subterranean floor, the resulting 30,000-sq-ft structure would still not adequately house the functions planned for it. Consequently, a new 100,000-sq-ft addition of four stories was designed to be added to the rear of the renovated three-story pavilion, where the sloping site would allow roof lines to be maintained at a similar height.

The new facility, which accepts its first students this spring, shows a number of significant attributes. In addition to reusing the older structure, which accounts for a considerable energy saving in itself, the new building is also highly energy efficient. It has been carefully related to the pavilion through the use of a similar type of red brick and red-stained mortar, and where it corresponds to the older building, it has been brought down to scale for compatability. At the rear south façade, which incorporates a Trombe wall, the building has been detailed essentially as a light, glass structure that forms a welcome foil to the somewhat ponderous recent buildings up the hill to the north.





Vocational Technical Education Facility, University of Minnesota, St. Paul



Another attractive feature of the new building is that the architects did not simply attach it to the old building, but added it in a sensitive way that allowed them to maintain the integrity of the former livestock pavilion and its handsome details. The new building also adds an important new amenity to the campus. The addition, which houses laboratories and shops on its lowest level and faculty offices on its upper levels, is attached to the classroom pavilion by means of a high, light atrium. This transitional space uses clerestory glazing and skylights for daytime lighting. That light is then passed through glass-block walls to illuminate the north offices in the new faculty building, which is attached to the south side of the atrium.

The atrium, in addition, interconnects the various levels of the old and new structures by its stairs and elevator, and it connects to another building by a ramp to the west to become part of the campus skywalk system. A future bridge will form a connection over a road to the east campus. As part of the enclosed pedestrian system needed in the harsh winter climate, the atrium, which is also a lounge, becomes a gathering place not only for students in the new facility, but for all others as well.

Energy considerations

Besides its circulation and lighting functions, the atrium has one additional attribute. It and the connecting ramp system were designed to be heated and cooled by the tempered air discharged from the structures at its side. The resulting cascading airflows minimize heating and cooling and also allow the atrium to be used as a return air plenum.

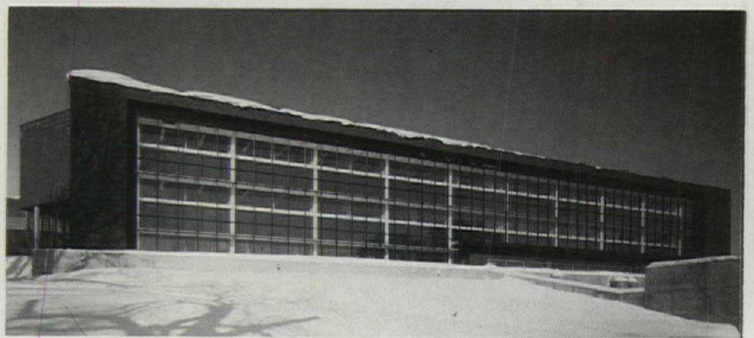
The most important energy-saving feature of the building, however, is the unvented Trombe wall that forms most of the south wall of the faculty building. This wall is composed of an interior "thermal" wall and an exterior, single-glazed "moisture" wall. These are separated by a 3-ft-wide greenhouse space in which horizontal sunshades of metal deck (walkable for maintenance) are placed above ribbon windows in the interior wall to screen summer sun, while allowing winter sun in for lighting and passive heating.

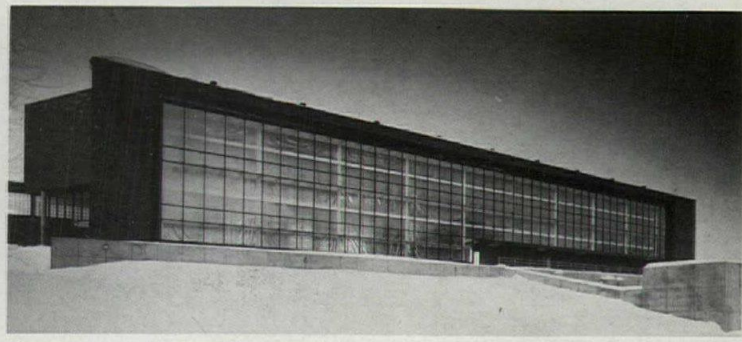
The inner wall is composed of 8-in.-thick spandrels of filled concrete block between the floor line and the window sill, and a structural spandrel beam between the window head and the post-tensioned concrete floor slab. The outer side of this interior wall is equipped with a motorized, thermostatically controlled movable insulation system that can be either lowered or raised over the glazing or thermal mass areas of the wall depending upon the requirements for heating and cooling during the various periods of summer and winter day and night (as shown in detail in the diagram at right). [David Morton]

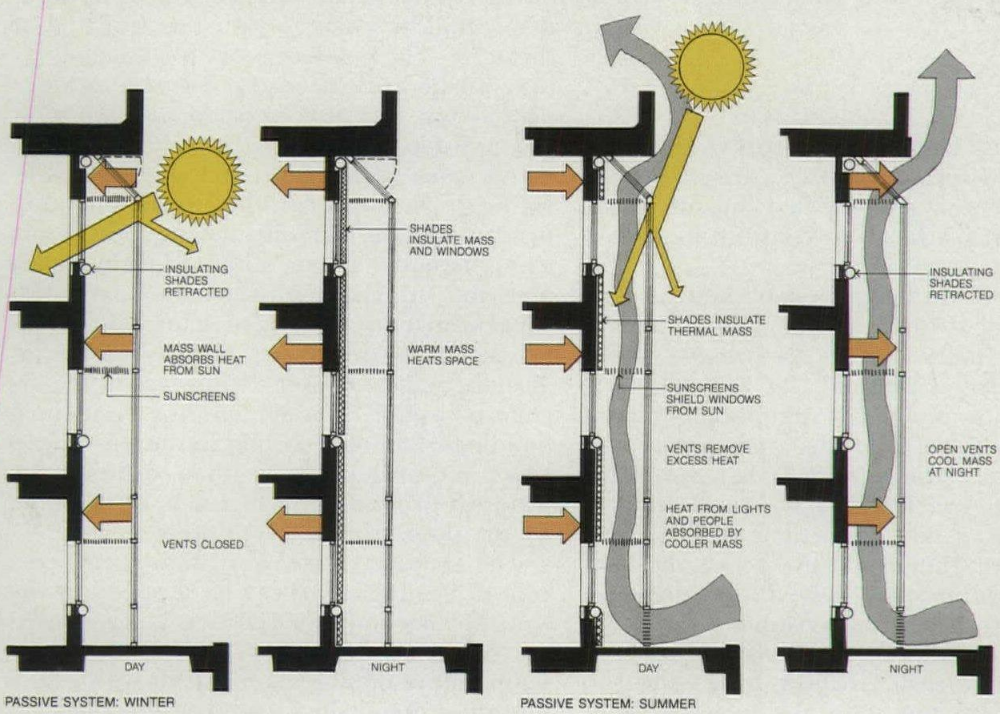
Data

Project: *Vocational Technical Facility, University of Minnesota, St. Paul.*
Architects: *Architectural Alliance, Minneapolis, Mn, Herbert A. Ketcham, principal in charge; Thomas J. deAngelo, principal designer; Art Yellin, Chris Johnson, Linda McCracken-Hunt, George Stevens, Peter Pfister, project team.*
Client: *University of Minnesota.*
Site: *a sloping 1 ½-acre infill lot with dedicated open space to the south.*
Program: *classrooms, laboratories, and offices of 100,000 sq ft, plus 30,000-sq-ft reused livestock pavilion for classrooms.*
Structural system: *cast-in-place concrete footings, columns, and slabs; steel decking and beams over interior courtyard; new steel joist floors in remodeled pavilion.*
Mechanical system: *central high-pressure steam with low-pressure distribution; interior courtyard used as return air plenum; passive solar Trombe wall with movable insulation system for south offices.*
Major materials: *cast-in-place concrete walls; masonry interior and exterior with 2-in. rigid insulation and concrete block. Aluminum windows in new and existing structure; sloped glazing; 12-in. clear glass block; single-glazed curtain wall at Trombe wall (see Building materials, p. 224).*
General contractor: *Knutson Construction Co.*
Costs: *$5,194,350 ($52 per sq ft), including site work.*
Photography: *Franz C. Hall.*

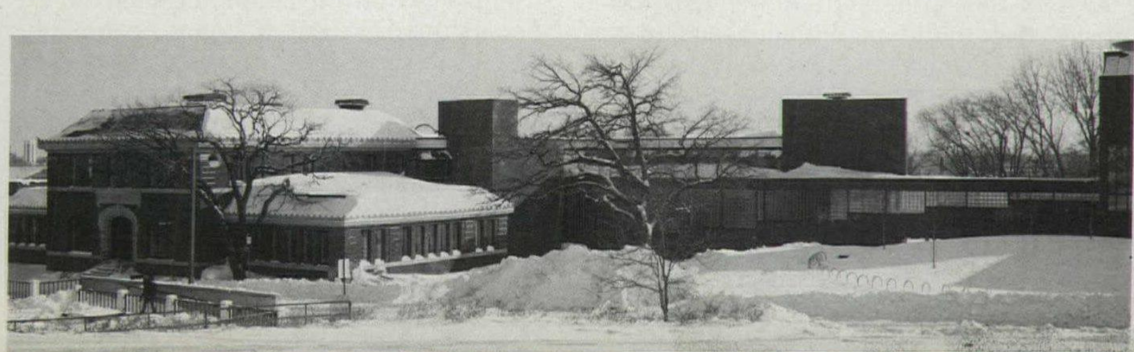
Although seen during a winter day, the new addition at the south of the old pavilion is shown as its insulating shades of the Trombe wall would be used during a summer day (facing page, top), a winter day (middle left), and a winter night (middle right). Inside the new addition (left) ribbon windows in the Trombe wall illuminate south-facing spaces (top); areas in the north of new addition (middle) borrow daylight from atrium and skywalk system (bottom), which is also seen from exterior (facing page bottom).







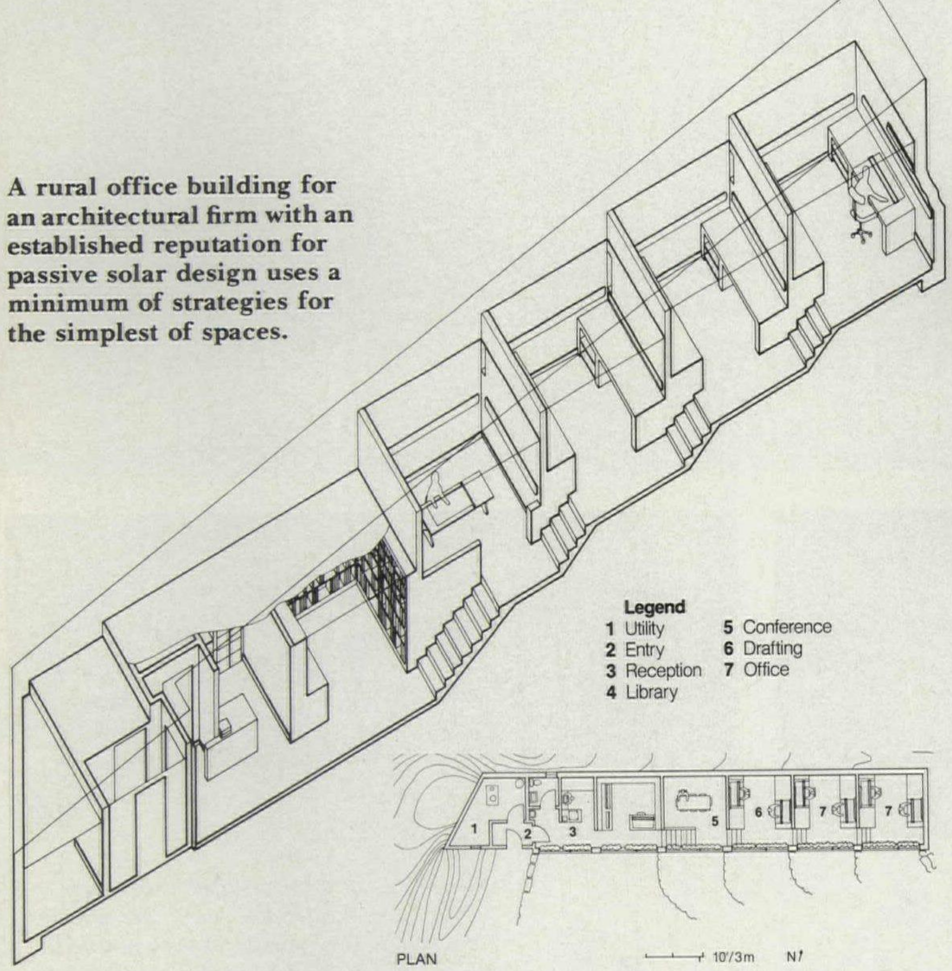
Trombe wall passive system. Winter day: low-angle winter sun is not blocked by sunshades and heats and lights office interiors; insulation is automatically raised to allow sunlight to heat masonry and concrete mass wall; on cloudy days, insulation is lowered over mass walls to keep heat in. Winter night: insulation is lowered over glazing and thermal mass areas to reduce heat loss. Summer day: horizontal sunshades screen high-angled sun from interior; insulation is lowered over mass wall to minimize solar gain. Summer night: insulation is fully retracted; greenhouse space between exterior moisture wall and interior thermal wall is vented directly to outside to provide convective cooling of interior thermal wall.

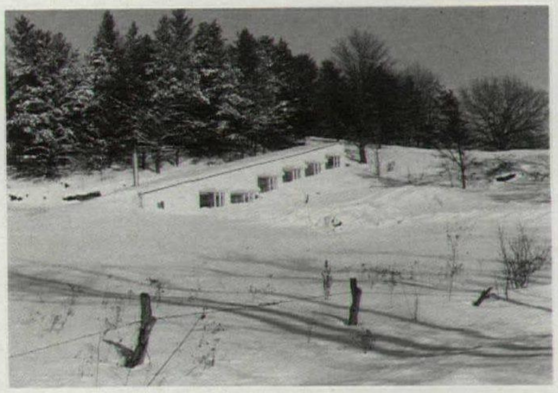


Hawkweed Offices, Osseo, Wi

Basic white

A rural office building for an architectural firm with an established reputation for passive solar design uses a minimum of strategies for the simplest of spaces.





Data

Project: *Hawkweed Group Office Building, Osseo, Wi.*
Architects: *Hawkweed Group (Rodney Wright, president, Robert Selby and Sydney Wright, vice-presidents).*
Site: *south-facing slope on 160-acre tract.*
Program: *1000-sq-ft office for architecture/planning.*
Structural system: *wood frame, including walls below grade; concrete slab floors; stone walls to south.*
Major materials: *flush pine exterior walls; wood windows; gypsum board interior, hardwood trim (see Building materials, p. 224).*
Mechanical system: *backup wood furnace; underfloor duct.*
Contractors: *owners, except for some skilled trades.*
Costs: *estimated $50,000, including furnishings, allowing for owner labor.*
Photos: *Robert Selby.*

It's small and simple, but it works. This little building comfortably houses a six-person architectural firm. And nestled into its farmland site in Northern Wisconsin it looks just right.

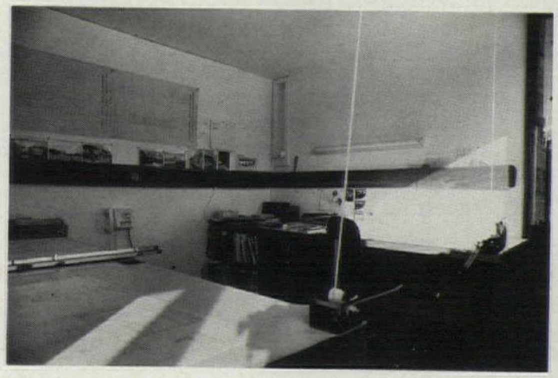
The Hawkweed firm, established in Chicago back in 1973, moved in 1980 to this site about 300 miles to the northwest—an old farm purchased originally as a country retreat. As their practice in the specialized area of solar buildings expanded and spread over several states, they decided that any place within reach of telephone, airplane, and parcel service would suit their professional needs. Here, they could live across the field and work within sight of the flowers that gave the firm its name and its sunlike logo—the red and gold hawkweed (known elsewhere as "devil's paintbrush"), which tracks the sun and closes at night.

One of their program requirements was a design that would permit members of the firm, with some able-bodied offspring, to do most of the construction themselves. Another objective—part practical, part philosophical—was to use local and natural materials so far as possible.

In contrast to most passive solar architecture, this little office is a remarkably uncomplicated volume. The firm's previous work, well documented in *The Hawkweed Passive Solar House Book* (Rand McNally, 1980), displays the angular planes, jagged silhouettes, and complex fenestration pattern we have come to expect. The serenity of the form here, however, is clearly not based on any change of formal preference, but on the relative simplicity possible with this function at this scale. The building is occupied mainly by day, has no great needs for privacy, includes no cooking, has little need for hot water. It was possible to stretch out a volume of consistent cross section and notch it into a south-facing slope so that both heating and lighting needs could be met with the simplest direct gain methods. By carefully adjusting glass area and sun shades to sufficient mass, with superinsulation and sealed joints, there was no need for even such passive devices as Trombe walls or water drums, which the architects would typically use for residential buildings. Summer cooling in this 14-ft-deep space requires no more than opening the windows—casements that catch air running up the slope from the southwest.

The architects have calculated that 80 percent of heating needs can be supplied by the sun. The back-up wood stove is typically used on cold mornings only—when an indoor temperature of 50 F may coincide with −20 F outside—often using office trash as fuel.

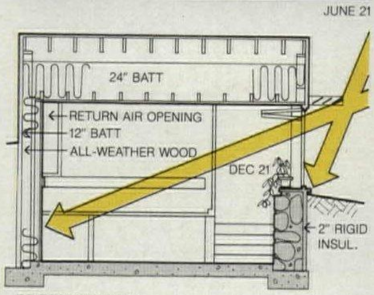
Simplicity of form and predictability of use allowed the architects to count on building contents to carry a 10 percent share of thermal storage—including the 80 flowerpots that nurture ivy along the stone windowsills. Color counts, too: white on the exposed walls fends off unwanted summer heat, slows down winter radiation losses; white on sunshade louvers and interior walls assures good light



distribution for drafting tables. Other seemingly small decisions count: full-height partitions between work spaces help with light distribution, quiet sound sufficiently, and add a little mass; flat ceiling planes—instead of the continuous sloping plane that would look more dramatic—hold down the volume to be heated, simplify installation of the 24-in. insulation, and also help distribute light.

The look of the resulting building is reminiscent of small early Modern buildings influenced by the American vernacular—the New England houses of Gropius and Breuer, for instance. The simple volumes, the flush white wood above fieldstone foundations, the cantilevered (and accurately proportioned) sun visors, and the accommodation to American carpentry practices all lie behind this apparent connection. So does the direct confrontation with a romantic, abandoned-farm landscape.

Under certain circumstances then—not for just any program or site—it is possible for passive solar design to take on a visible kinship with the American Modernism of the 1930s and 1940s—an innocent, optimistic Modernism that, at its best, reconciled technical and aesthetic goals. [John Morris Dixon]



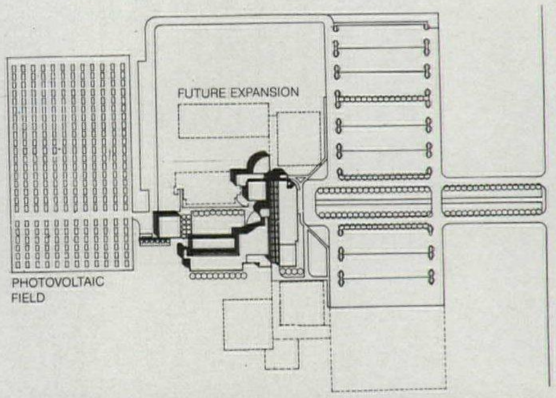
CROSS SECTION

Offices ascend hillside (top photos) which has been sown with wildflowers and grasses. Interiors (above) have backup fluorescent task lighting, insulated night blinds rigged like sails, hardwood trim and furniture—some from trees on site. Visors (right) control heat gain on stone wall and floor slab.

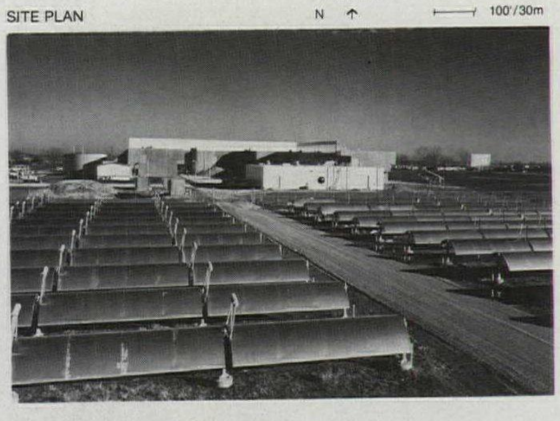
Mississippi County Community College, Blytheville, Ar

PV one

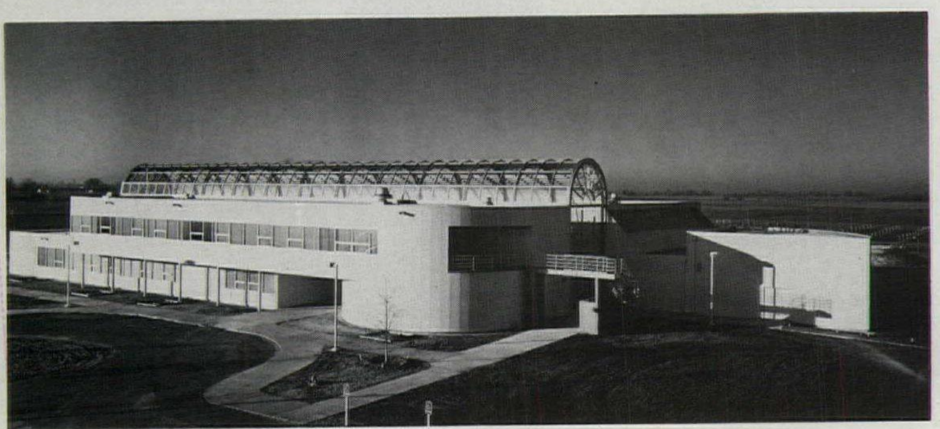
A community college is born complete with state-of-the-art passive solar and a photovoltaic/active solar hybrid collecting system of the future. The first PV system of this scale and use, it is also the first photovoltaic-powered building ever featured in P/A. (See P/A, April 1981, pp. 182–183.)



SITE PLAN



(At right) The field of concentrating collectors exists to the west of the building. (Below) View from the northeast. (Bottom) View from the southeast.



The pioneering effort in solar photovoltaic research and design is only part of the intricate built organism that contributes profoundly to the ultimate educational goal of this small Arkansas community college. What lifts this building into the realm of wonder and awe is that when Dr. Harry V. Smith was named president of Mississippi County Community College on February 17, 1975, he was the sole college employee, and there was no existing physical college at all. He saw his $2.5 million building budget as only the beginning and initiated a dogged crusade to Washington, which two years later landed a $6.5 million government grant from the Department of Energy. Once the new money was obtained, the task was just beginning. Photovoltaic technology, which was hardly out of the laboratory, had to be transformed from possibility to practicality. The simple flat experimental solar panel with a cluster of cells became a field of 270 concentrating collectors using nearly 60,000 wafer-thin PV cells and converting solar energy to 320 kW electrical power in addition to the thermal energy withdrawn in liquid from the warming cells. Added to all of this budget bending and solar pioneering, six months after he was sworn in as president, Smith began classes for 800 students with faculty in hand and a temporary classroom facility in a high school. Today, the field of collectors tracking the sun plugs into a building chugging away to educate 1200 students. Smith provides the single most valuable element any school can contain: a good example. He is proof that one man's fetters are another man's foundations, proof of the power of hard work, vision, and just plain guts.

From its inception and original concept of a cluster of low, individual buildings to its present state of completion, the project has had the same architect—Cromwell, Neyland, Truemper, Levy & Gatchell, Inc., of Little Rock, Ar. The insertion of energy-conscious design midstream into the college design meant no small effort in education for the firm itself. The complexity of the energy strategy, however, cannot be fully understood without an appreciation of the ornate programmatic demands of the institution.

The program

In the mid-1960s, the State of Arkansas recognized the gravity of the low educational level of its population. Mississippi County was targeted specifically for aid. Because of the unequal academic achievement levels, such a community college demands a high degree of individualized instruction. The faculty-student ratio is about 17 to 1. In a given term, 50 to 100 different courses can be taught.

About 50 percent of the student population is employed full time. Few classes are conducted from 1:00 to 4:30 in the afternoon, and a full slate of courses is offered in the evening until 9:30. No classes are held on Fridays to allow time for staff meetings.

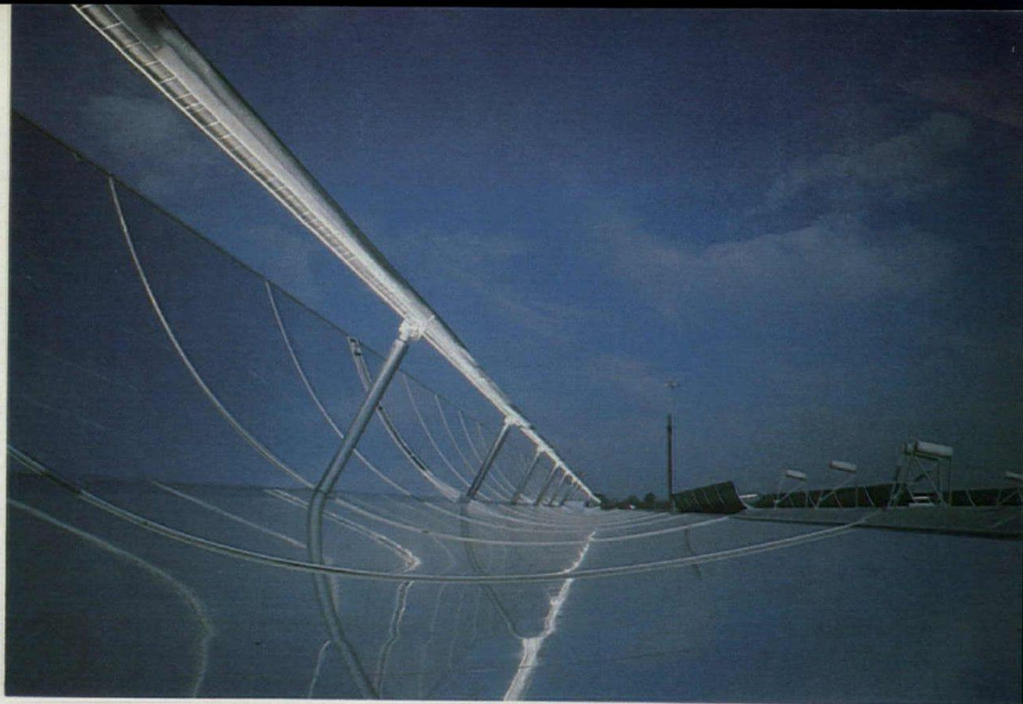
In programming the building, the emphasis was upon the necessary. The teaching spaces with costly complex requirements—scientific laboratories, art, and music spaces—were given first preference over a gym or a theater. A vocational school 18 miles away helped to pick up the slack need for workshops. Administrative offices were provided to offer a fixed base of space for the staff, and local industries have contributed a building off campus for a gym. The First Baptist Church is used for a theater; there are five temporary classroom locations off campus. Even some of the staff offices are in a trailer on the campus.

Fortunately, the climate in Blytheville is not a harsh one: 3600 heating degree days and 820 cooling degree days. There are approximately two months of summer, two months of winter, four months of fall weather and four months of spring. Cooling was determined to be the primary mechanical load problem.

The built solution

The interface of programmatic use and energy conservation had some very specific formal results for the building. Although the architects recognized the importance of reducing the energy load on the building before the PV system is plugged in, the experimental nature of the collectors caused them to be placed in a field behind the building instead of integrated onto it. In case of failure, the collectors can be unplugged, disassembled, and carted away.

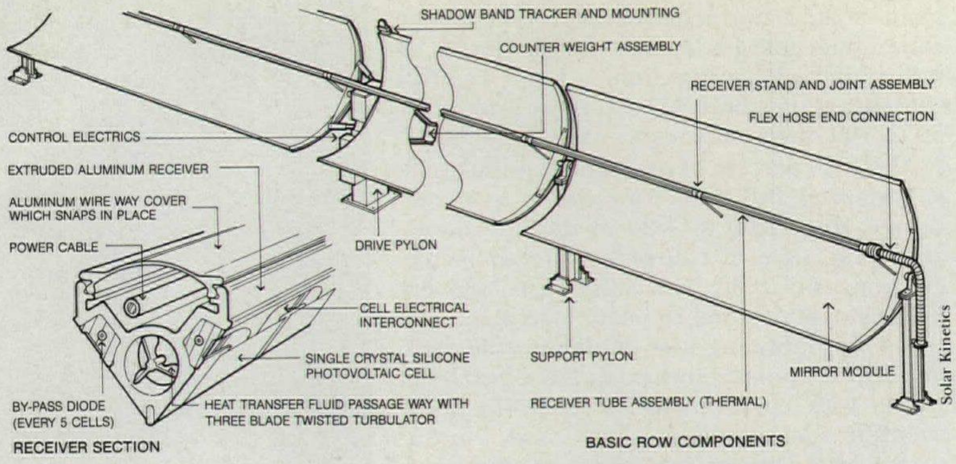
The main concourse, which serves as the focal space of the school and a buffer between administrative offices and teaching spaces, is unconditioned and left to fluctuate seasonally with the outdoor temperature. In the winter, the space is passively heated in the morning through its vaulted skylight. In the summer, the ridge vent and operable louvers at each end of the space provide natural ventilation, which can be augmented by fans. Outdoor temperatures as high as 105 F have produced recorded temperatures of 110 F on the second level and 140 F at the uninhabited top of the vaulted space. The corridors in the academic wings, which feed into the concourse, are also unconditioned and rely upon spillage from the air-conditioned spaces they serve. An economizer cycle is used for the mechanically conditioned spaces to make use of outside air whenever possible. Classroom lighting is controlled by photocells. The entire mechanical system, including the active solar input, is managed and monitored by a computerized energy management system.



Richard Rush

(Top) The photovoltaic cells are mounted on the focal line facing the dished collector. (Above) The upper atrium.

Mississippi County Community College



A borosilicate cover-glass is bonded to the front of each cell. The cells are mounted in two one-cell-wide, 10-ft-long strings to a hollow extrusion to form the receiver. Each cell string produces approximately 7.2 kW.

Although by no means dominated by energy considerations, the overall form of the building and distribution of spaces also reflect the energy demands of spatial types. Administrative offices are aligned facing east. Classrooms are generally oriented for north light. Faculty offices are on the south, seasonally heated or sheltered from the sun by overhangs. The west façade of the building is minimized to avoid afternoon sun.

Insulated metal panels are used for exterior walls with the exception of west-facing cast-in-place concrete walls. Walls are light in color to reflect heat. By use of the concourse (or atrium) space, daylight penetration into the administrative spaces is increased, while the exposed exterior envelope of the building is minimized.

The heavy use of the classrooms at night meant diminished first cost advantages in using natural daylight. If there is a flaw in the building design, it is the overreliance upon operable vertical blinds in the majority of the large interior and exterior windows in the building. The occupants of the spaces use the blinds to control sunlight, privacy, view, glare, and mean radiant temperature (MRT). The blinds in many of the space are often closed. One secretary keeps her blinds closed because the window surface in winter is too cold (MRT). People in offices that face the concourse on the ground level close the blinds to keep the students from feeling as if they are being watched. The morning sun is kept out of east-facing upper-level offices with closed blinds. Even the president, whose office and meeting room overlooks the concourse and has a spectacular view, keeps them closed. From a purely solar control point of view, blinds for the south should be horizontal. In any case with blinds closed, of course, the lights are on, adding to the electrical and cooling load.

The main attraction

The energy stars of the building are out back roosting like a silver flock of trained birds. The cupped concentrating collectors are aligned north to south, tracking the sun from east to west. The polished "airplane wing" aluminum construction is roughly parabolic, focusing the parallel sun rays to a point or, in this case, a line at the focal point. The 12-mil-thick single crystalline silicon PV cells line two sides of a V facing the concentrating surface. Each flat cell has an active area of 2.5 x 5 cm. The dished reflecting surfaces effectively magnify the sunlight falling upon the PV cells by 30 times. While increasing the amount of light on the cells multiplies the amount of electrons that are generated, the cells lose efficiency as they heat up. To cool the cells, a glycol and water solution is piped in back of the cells. A 30 percent glycol solution keeps the water from freezing and inhibits corrosion. The tracking devices themselves are hydraulic and computer-controlled.

The glycol solution is pumped through a heat exchanger where the solar heat is transferred into two 40,000-gallon hot water storage tanks. The stored water is piped on demand to the fan coil system where it contributes to the space heating of the building.

The electricity coming from the PV field is d.c. and has to pass through an inverter before the a.c. current can be used by the building. When more electricity is produced than demanded by the building, the excess a.c. current is sold to the local utility at the same rate that the school must pay for utility-supplied power. If insufficient electricity is produced by the system, the school buys its electricity direct from the Arkansas-Missouri Power Company. A stand-by boiler supplies hot water to supplement the collector heat. The chiller for cooling is electric. The peak electrical output for the project is estimated at 320 kW with a solar cell efficiency greater than 11.5 percent.

About $1 million was consumed in developmental research for the PV system. Another $500,000 was spent on a fruitless effort to perfect a battery storage system. The PV collectors themselves cost about $3 million (about the same as the whole building). During the design process, another $40,000 was spent on computer analysis of the design, a process that delayed building the project for one year. The college was successful in raising its grant to $6.8 million before Reagan's door closed on DOE funding. It was also able to obtain $1 million to cover the first two years of a projected five-year post-occupancy project they have dubbed "S.O.E.E. (Simulate Operate Evaluate Educate).

If you believe in Reagonomics, the sight of all that money sitting in the middle of an Arkansas wheat field must produce a sense of regret that the monetary floodgates were not closed sooner. If you believe in the future of photovoltaics, there is also a sense of regret, but only that another couple of years will pass before government-sponsored research at this scale can continue (if voted into office). If there are any doubters out there, they are not in Blytheville, Ar. More specifically, the interior walls of the Mississippi County Community College are as white as snow, and no graffiti! [Richard Rush]

Data

Project: *Mississippi County Community College, Blytheville, Ar.*

Architects: *Cromwell, Neyland, Truemper, Levy & Gatchell, Inc., Little Rock, Ar.*

Client: *Mississippi County Community College, Dr. Harry V. Smith, president.*

Site: *80 acres of Mississippi Delta farmland. Building and parking area raised above flood level.*

Program: *a community college including classrooms, laboratories, faculty offices, administrative offices, student activity, and central energy plant. Total building area 53,440 sq ft.*

Structural system: *reinforced concrete foundations, structural steel frame, composite steel/lightweight concrete deck, bar joists, and metal roof deck.*

Major materials: *aluminum/expanded polystyrene sandwich panels, fiberglass built-up roofing (see Building materials, p. 224).*

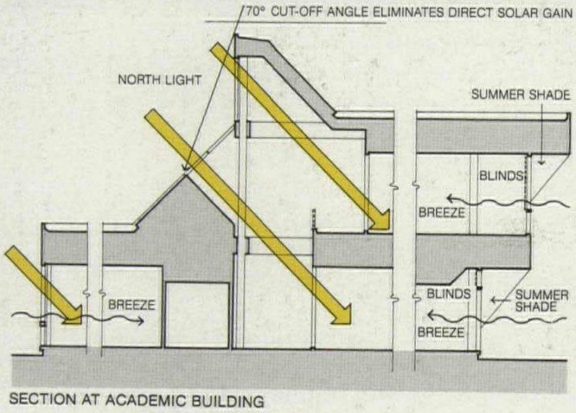
Mechanical system: *photovoltaic-powered electrical system and thermal resource, electrical liquid chiller, back-up 240 kW 8-stage boiler.*

General contractor: *Huffman Engineering.*

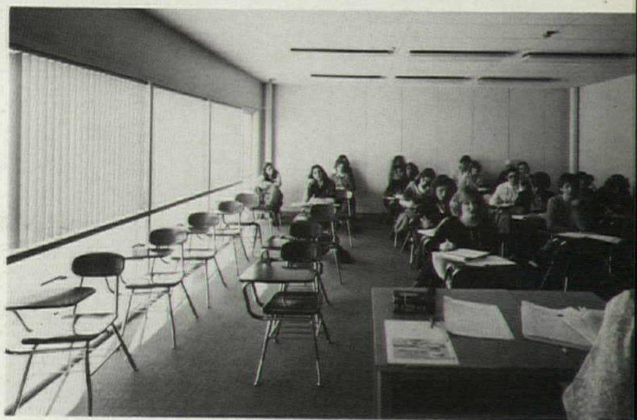
Costs: *$3 million for the building and $3 million for the solar system; $53.22 per sq ft of building, and $9.70 per peak watt.*

Photography: *Hursley, Lark & Hursley, except as noted.*

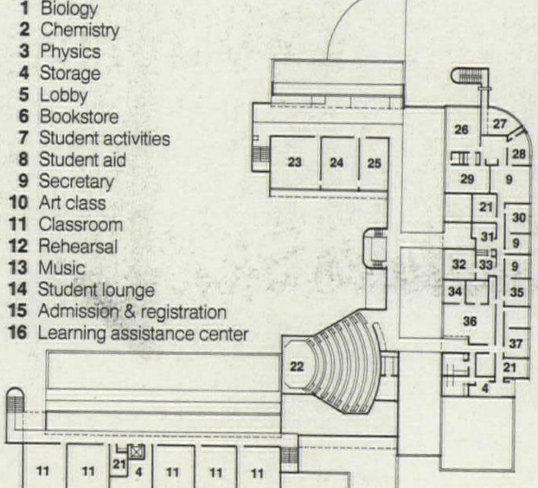
(Above) The administrative offices look out onto the concourse and borrow light. (Top right) The lecture hall relies completely upon artificial lighting. (At far right) Classrooms combine natural and artificial light. (Bottom right) Since cooling load is the main consideration, north light penetrates the building while blocking the direct sun. The hall is conditioned only by spillage from the spaces that face it.

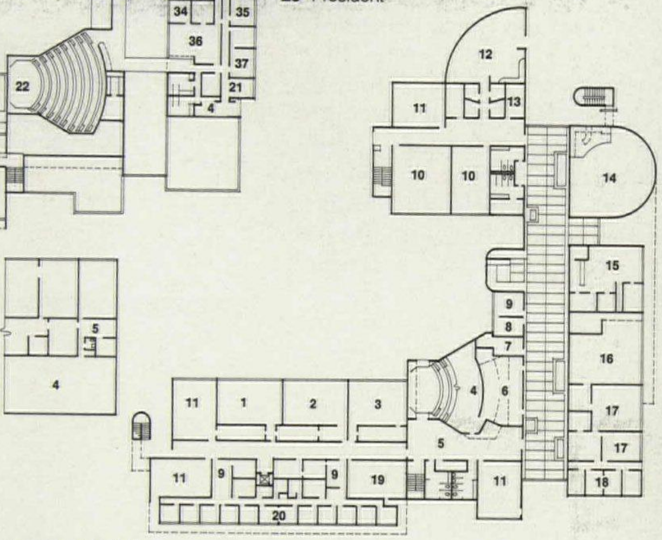


SECTION AT ACADEMIC BUILDING



Legend
- **1** Biology
- **2** Chemistry
- **3** Physics
- **4** Storage
- **5** Lobby
- **6** Bookstore
- **7** Student activities
- **8** Student aid
- **9** Secretary
- **10** Art class
- **11** Classroom
- **12** Rehearsal
- **13** Music
- **14** Student lounge
- **15** Admission & registration
- **16** Learning assistance center
- **17** Developmental education
- **18** Counselors
- **19** Nursing
- **20** Faculty offices
- **21** Conference room
- **22** Lecture hall
- **23** Typing/Shorthand
- **24** Office applications
- **25** Business machines
- **26** Boardroom
- **27** Terrace
- **28** Assistant to president
- **29** President
- **30** VP academic student service
- **31** Waiting room
- **32** Mail room
- **33** Receptionist
- **34** Accounting
- **35** Dean of business & administrative services
- **36** Business office
- **37** Purchasing
- **38** Personnel


SECOND FLOOR PLAN



FIRST FLOOR PLAN

Under and above

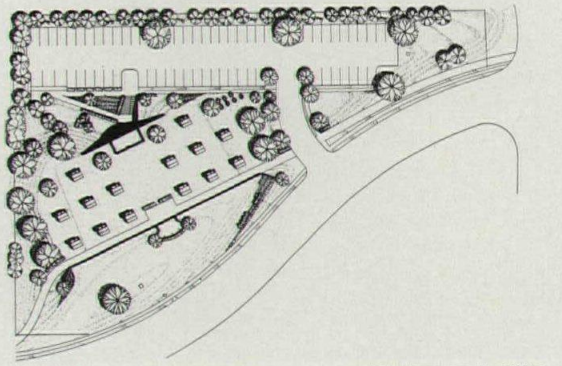
An underground office building and a house by Walter Roberts demonstrate a range of passive solar design techniques.

Data
Project: *One University Plaza, Fairfax, Va.*
Architect: *Alternative Design, Walter F. Roberts, architect, Reston, Va.*
Client: *Fairfax County Redevelopment and Housing Authority, Fairfax, Va.*
Site: *2 acres, sloping to the west, bounded on north and west by residential community and on south and east by a road and university campus.*
Program: *an 18,000-sq-ft office building, including central meeting room, storage, and space for planned expansion. Earth sheltering was desired to conserve energy and to minimize the building's visual impact on adjacent residential areas.*
Structural system: *composite steel frame on poured concrete perimeter walls and steel columns on concrete spread footings.*
Mechanical system: *heat pump, air duct distribution divided into four separate systems with the two main systems capable of 100 percent outside makeup air.*
Major materials: *poured concrete, redwood, brick pavers, studs, gypsum board (see Building materials, p. 224).*
Consultants: *structural, Tadjer-Cohen Associates; mechanical, Leland D. Eisenhower Ltd.; landscape, Design Resource Associates; lighting, Peter Barna Lighting Design.*
Costs: *$1,186,000; $65 per sq ft.*
Photography: *Walter F. Roberts.*

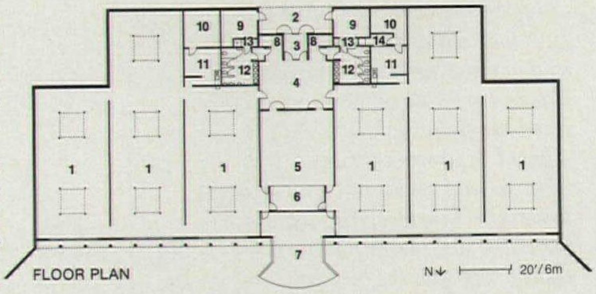
One University Plaza

When the Fairfax County (Va) Redevelopment and Housing Authority decided to build new headquarters for its 100 employees, it went underground. Architect Walter F. Roberts of Alternative Design in Reston, Va, was asked to create a "buried" passive solar structure not just to save energy, but so that the building would also disappear into its site, a triangular 2-acre lot in Fairfax that adjoins a 7-acre public-housing development and a small university campus. The building's south side, necessarily exposed to the sun (and protected from summer heat gain by a redwood sunscreen), became its public façade. On the east, the structure cuts directly into the earth, while on the north and west (facing the housing development), it is earth-bermed, with 18 in. of dirt and rigid insulation over a composite roof. The roof doubles as a recreation area for employees and even boasts its own bicycle path. The berm serves to moderate yearly temperature changes in the building by absorbing heat. The temperature of the berm will stabilize by next winter (a year after the building's completion) to the point where the winter temperature inside should settle at approximately 60 F—warmer than it was last winter, and thereby resulting in lower heating costs.

Punctuating the grassy expanse of the roof are 16 light monitors—the building's strategy for energy-efficient illumination. In plan, the 10′ x 10′ monitors are centered over the 30-ft square bays of the building, which are divided, by acoustical walls with integrated mechanical space, into offices for the authority's six departments. A clear aisle under the monitors insures that even the northernmost offices receive their fair share of daylight and outdoor views (six private offices share light through clerestory panels). The monitors capture and reflect natural light, while photoelectric dimmers located within them control the use of artificial light (from perimeter boxes), when necessary, to maintain constant, even levels of illumination across the bays. On lighting grounds alone, the monitors have been successful, demonstrating interior illumination levels of 300 footcandles on sunny days, and 160 footcandles on cloudy ones—resulting in a 50 percent reduction in lighting costs.

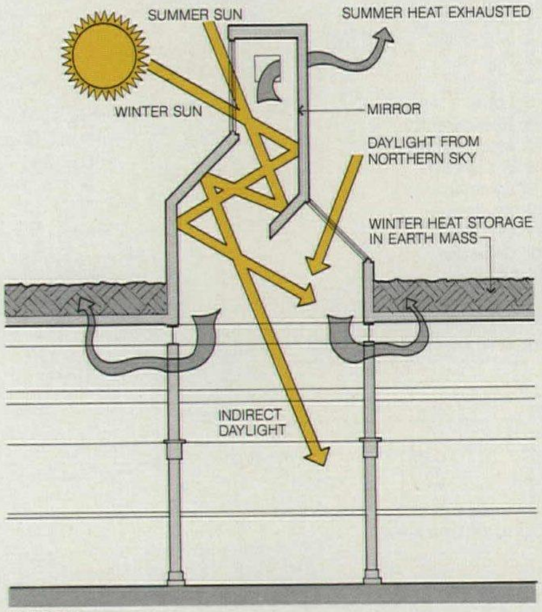


SITE PLAN N 40′/12m

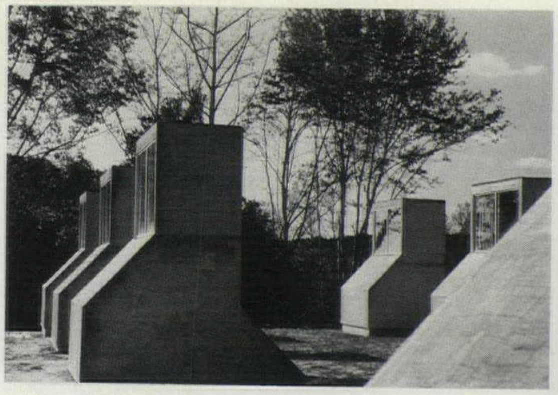


FLOOR PLAN N 20′/6m

Legend
1 Office area
2 Portal
3 Vestibule
4 Entrance lobby
5 Conference room
6 Platform
7 South plaza
8 Coat room
9 Mechanical
10 Filing
11 Duplication
12 Toilets
13 Shower
14 Janitors closet



SECTION

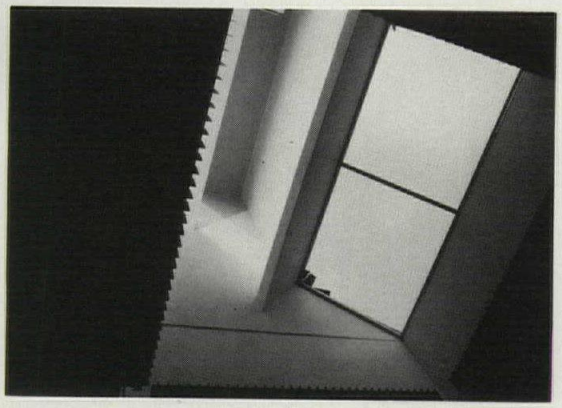


The monitors also assist in heating and cooling the building, by acting either as exhaust chimneys or heat collectors, as needed. In the heating process, warm air generated by solar radiation collects at the highest level of the monitors, thereby warming the earth mass, which then acts as a flywheel to return that warmth back to the interior at night. In the cooling process, the building's 14-ft ceilings help to stratify warm air, which rises into the monitors (which are 28 ft high), and is exhausted through louvers that are set to open automatically when the temperature inside the monitor reaches 85 F.

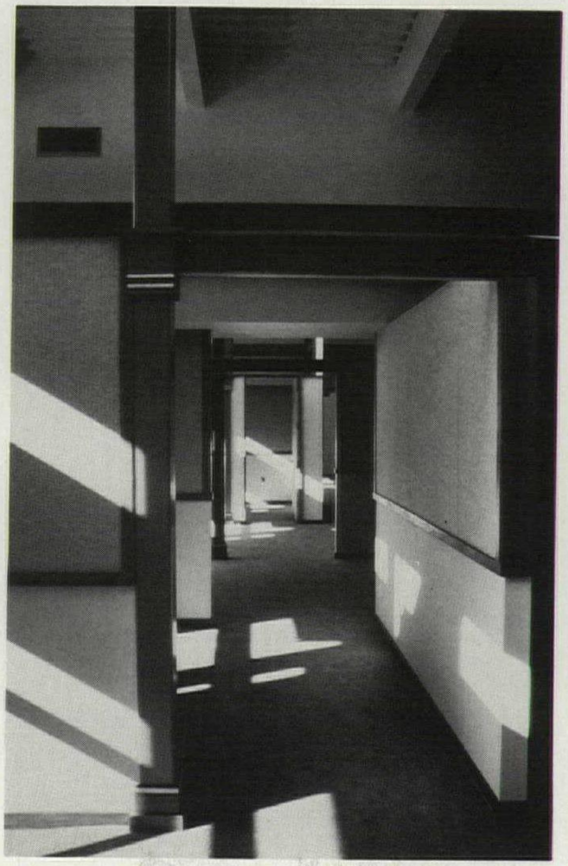
A zoned heating/cooling system employs separate heat pumps (which are also used to draw cool outside air into the building), in addition to the central system, to heat or cool the conference rooms for night or weekend use without heating or cooling the rest of the building.

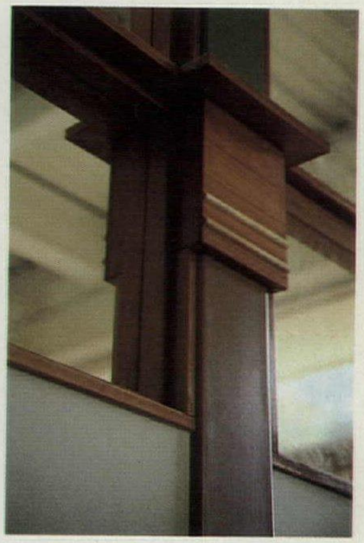
The structure was financed by the sale of tax-exempt notes and bonds and cost about $90,000 more than a conventional one-story structure with the equivalent floor space. Costs for heating, lighting, and cooling together are expected to be one-third of those for a building of similar size, thus allowing the recovery of investment in lighting and heating equipment within four-and-a-half years (assuming an annual inflation rate for energy costs of 15 percent).

Architect Roberts credits the authority's director, Walter Webdale, with being "an ideal client," who wanted the building to demonstrate a range of passive solar techniques. But it was Roberts who integrated program and design to such pleasing ends. When the juniper plantings on the berm are fully grown, all that the neighbors will see of this building is a double row of sentinel-like monitors—a rather poetic transformation of technological imagery. [Pilar Viladas]

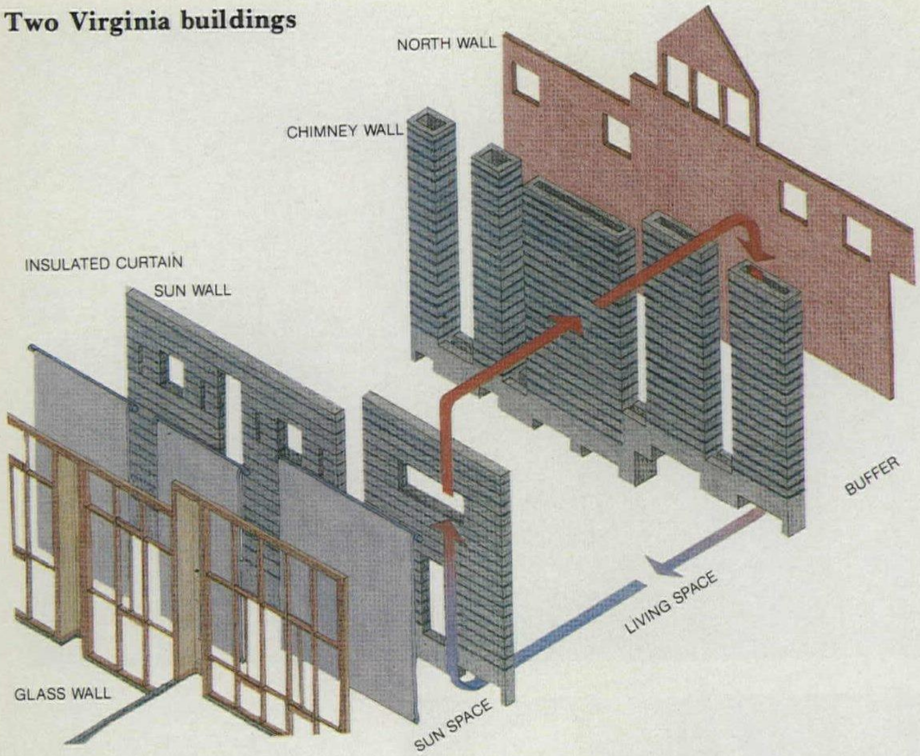


Facing page: Floor plan (center) divides office into departmental areas, with light monitors centered over each bay. Diagram (bottom) illustrates monitors' role in daylighting, heating, and cooling. This page: Redwood sunscreen shields south-facing windows from summer sun. Rows of monitors (top left) punctuate the surface of the earth-covered roof. North façade (second from top) disappears from view. Light monitor (left) creates plays of light and shadow. Bay system of interior (bottom center and below) is finished with careful attention to detail.

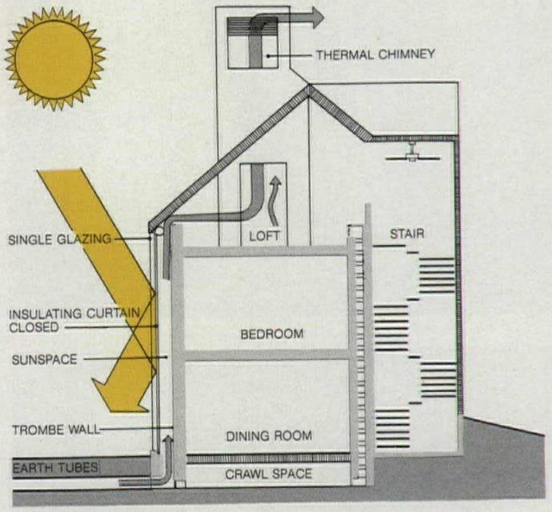




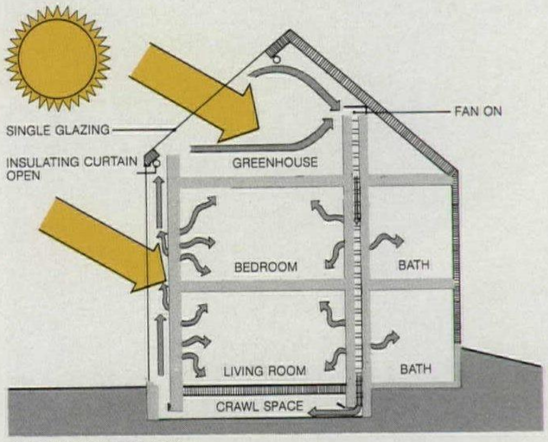
Two Virginia buildings



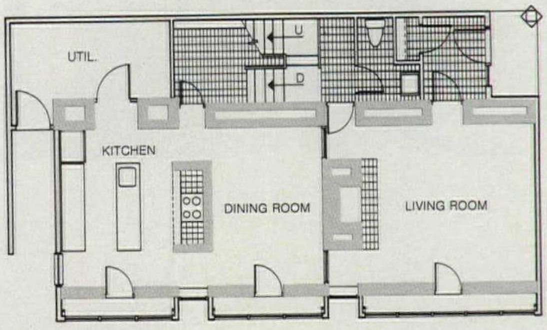
Drawing (above) illustrates the layering of walls, with living areas sandwiched between the masonry mass walls of the Trombe wall and "chimney" wall that separates the living spaces from the buffer zone of service areas and stairwell, to protect the former from temperature extremes. Sections (right) illustrate passive heating and cooling by day. South elevation (facing page, top) is shown at night, with Trombe wall exposed to direct gain. Alternating block courses enrich interior walls (facing page, center), while wood beams are part of a program of handcrafted details, as is the staircase (facing page, lower right).



SECTION: SUMMER DAY



SECTION: WINTER DAY



FIRST FLOOR PLAN

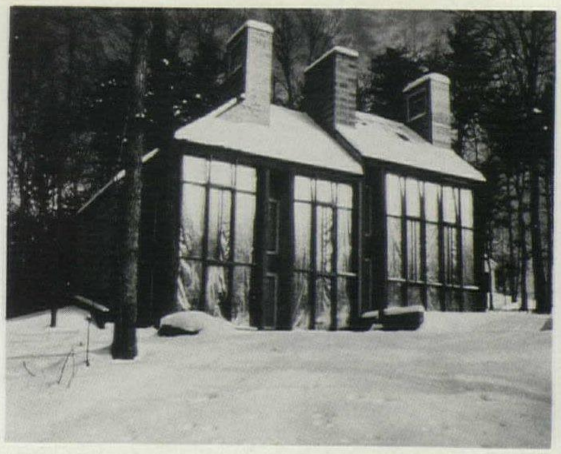
Sundance

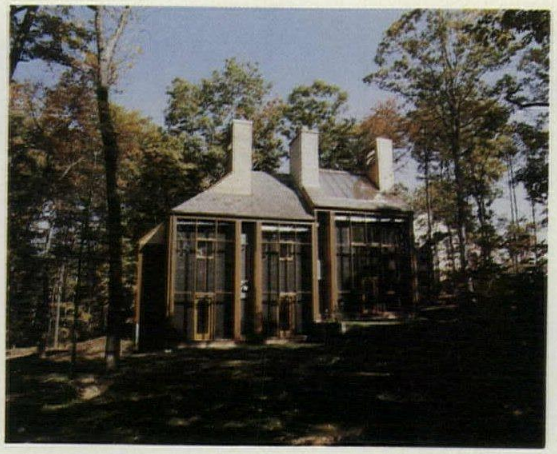
With its cedar siding and redwood trim, Sundance, Walter Roberts's own house in Reston, Va, bears little resemblance to its developer-Colonial neighbors. But while its materials look laid-back contemporary, its form is far more authentically Colonial than that of the other houses on the street. Roberts drew on 18th-Century building forms based on principles of natural convection before adding current passive solar knowhow to the design of the house. "I wanted to integrate the mechanics of environmental systems with form," he explained. "That's how I became interested in passive solar design."

The three-bedroom, 2300-sq-ft house is organized into two zones, with all living areas on the south side and all service areas (stairway, closets, bathrooms, etc.) on the north, to act as a "buffer zone" to prevent winter winds from direct contact with the living-area walls. Roberts then developed the idea of the house within a house: a Trombe wall on the south; and a sandwich of two 8-in. masonry walls with an 8-in. air space between on the north, to store heat collected from the sun and radiate it into living areas. The wood outer house is a cocoon to shelter the inner house.

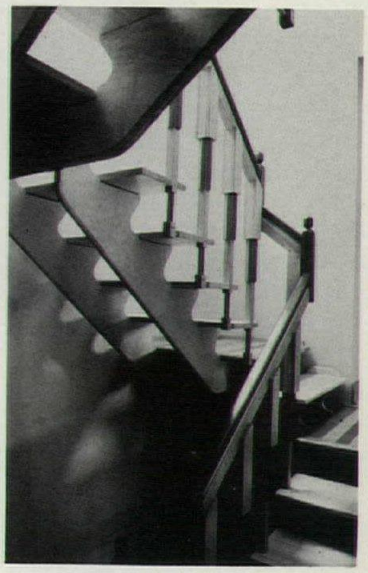
To heat the house, solar radiation warms the masonry mass of the Trombe wall as well as the air in the 18-in. space between the wall's windows and masonry mass. This air rises within the "sunspace" to the attic and solar greenhouse, where it is circulated down through the shafts in the north "sandwich" masonry wall. As the air cools, it falls into the crawl space, where it is circulated back to reenter the sunspace at the base of the Trombe wall, thus completing the convective loop. To conserve heat collected by day, an automatically operated, self-inflating insulating curtain is lowered over the south windows at night.

Summer cooling is aided by the buffer zone. Warm air rises through the stairwell until it is expelled through two thermal chimneys—inspired by Colonial architecture—located in the loft and greenhouse. At night, windows are opened and cool air flows through the house up through the chimneys, a process that cools the mass of the house. The thermal curtain procedure is reversed, with the curtain lowered during the day to block direct solar gain. Earth tubes buried in the south lawn conduct air that is pulled up by the chimneys, cooling it as it moves to the space between the thermal curtain and the Trombe wall (this air is too damp to be circulated through the house), creating yet an-





Data
Project: *Sundance, Reston, Va.*
Architects: *Alternative Design, Walter F. Roberts, architect, Reston, Va.*
Client: *Walter and Patricia Roberts.*
Site: *one-half acre, heavily wooded, sloping gently toward the west.*
Program: *a three-bedroom, 2300-sq-ft house, to include greenhouse and service spaces.*
Structural system: *concrete spread footings; concrete masonry inner structure; wood stud frame exterior structure; wood frame floors and roof.*
Mechanical system: *hybrid solar, with Trombe wall, fan-driven convective loop to charge inner masonry structure, and baseboard electric backup system.*
Major materials: *concrete, cedar siding and shingles, redwood trim, plexiglass, gypsum board, exposed fir floor framing and trim, oak flooring, ceramic tile (see Building materials, p. 224).*
Photography: *Walter F. Roberts, Fred Kligman.*



other thermal barrier. This air eventually warms and rises up and out through the thermal chimneys.

Inside the house, the walls' alternating courses of 4″ x 8″ x 16″ and 8″ x 8″ x 16″ concrete block create a surprisingly warm and rather elegant visual texture, while they absorb humidity in summer and release it in winter, thereby increasing thermal comfort in both seasons. Roberts solved the problem of installing electrical wiring in masonry walls by running the wires along the wall surfaces, concealing them in wood stripping and baseboards that seem a perfectly logical part of the interior's handcrafted details.

A backup system of electrical baseboard heaters will one day be replaced by heat pumps; even so, the electric bill for auxiliary heat last winter was a slim $150. Fireplaces in the living room and master bedroom draw combustion air from pipes connected to the outside, so that their glass doors do not have to be opened. Roberts also found that three conventional electric hot water heaters, costing $90 each and operated on time clocks, offered an economical alternative to a $3000 active-solar hot water system. Last winter, the house maintained an average interior temperature of 62 F. The National Solar Data Network has recently installed computerized monitoring equipment to record mean radiant temperature, humidity, mass wall temperature, air velocity, and other data every five minutes, 24 hours a day.

Sundance's design received an award at the 1980 Passive Solar Conference, no small honor for an architect's first solar design. [Pilar Viladas]

Bonilla and Sisko houses, New Jersey

Solar domesticated

Two houses by architects Kelbaugh & Lee continue the firm's development of building form out of energy systems, responding as well to the specifics of the place.

Data

Project: *Bonilla house, Cream Ridge, NJ.*
Architects: *Kelbaugh & Lee, Princeton, NJ (Doug Kelbaugh, design and site inspection; Mark Gray and Tom Swartz, contract documents).*
Site: *about five wooded acres; house on flat portion, ravine just to west, trees cleared to south.*
Program: *2460 sq ft inhabited space, plus 506 sq ft garage.*
Structural system: *wood platform frame 2 x 8 floor decking; concrete block foundation and Trombe walls.*
Major materials: *1 x 6 cedar siding over plywood; cellulosic fiber insulation blown into all cavities; wood awning and casement windows; yellow pine board and gypsum board interior walls. Built-up and roll roofing (see Building materials, p. 224).*
Mechanical system: *back-up furnace, burning wood or propane; solar hot water preheater.*
General contractor: *R.M. Sweeten & Son.*
Costs: *$150,000; about $50 per sq ft ($65 per sq ft, living space; $30, garage).*
Photos: *Robert Perron.*

Rural house

Standing in a clearing on a woodlot in horse farm country is the minimal volume of the Bonilla house. Isolated in nature, out of view of nearby buildings, the new house makes no concessions to the traditional built forms of the vicinity, but neither does it flaunt technology. Its solar devices are all contained inconspicuously within its crisp, undeniably Modern form, which is softened somewhat by natural cedar siding and deep green trim (spiked with a bright red on movable sash).

The energy basis of the design is indicated by the twist of its cubic form to face due south; large glass collecting areas facing south contrast with small punctured windows artfully cut through other walls.

Other functional considerations were factored into its form. Views to the west, into an unspoiled ravine, and to the east, toward the horse farm across the road, could be appreciated only from the second level, so a *piano nobile* scheme was worked out, with living areas a story above grade. Bedrooms and a large workroom occupy the lower level; above them, the living spaces have the benefit of the tall volumes that increase the capacity and temperature stability of the passive solar scheme.

The garage is placed against the north side of the house, as a thermal buffer, and its roof deck provides entrance into the *piano nobile* by way of a prominent stair. Part of this deck is roofed and screened, using 3x3 framing that gives the shady mosquito-free retreat the look of a summer camp.

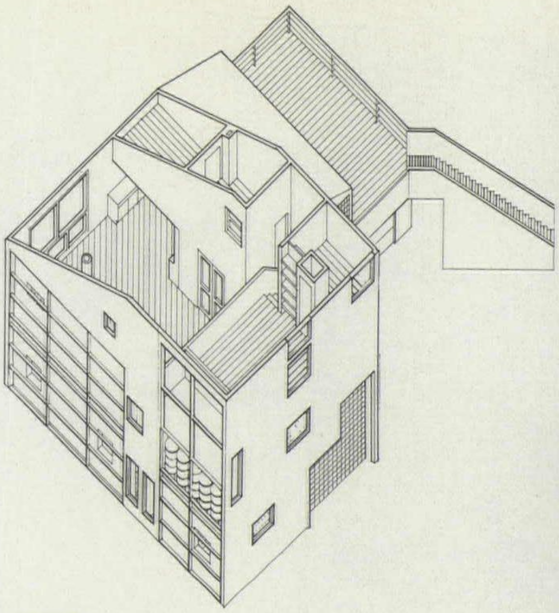
Throughout the house, opportunities are taken to evoke homey images. The airlock main entrance is separated from the living area by a pair of doors with stained glass in a naturalistic pattern of ambery hues that suggests the mission style vestibules of about 1910. Pine decking for the above-grade floors is left exposed for ceilings, and boards are applied to walls. Tiles of a muted blue are used on the slab floor of the lower story. The focus of the living space is a cylindrical black stove, set in front of the Trombe wall against an arched backdrop (the curve made of standard manhole block).

One flourish that comes as something of a surprise in this low-keyed house is the treatment of the main bathroom with an extensive glass-block wall that rises a story and a half above a raised tub. This is undoubtedly an exhilarating space on mornings when the sun floods in through the east-facing block wall, but otherwise hardly contributes to the energy solution. On the exterior, the notched-out area of glass block is pleasing in itself, but gives undue prominence to what is after all only a bathroom.

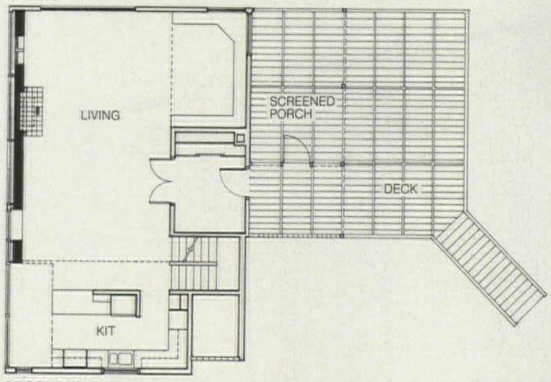
The passive solar scheme is fairly simple. Besides the Trombe walls on the south walls of the lower floor and living room, there is a two-story direct-gain space at the kitchen. The water drums shown in section have been replaced at the loft level by a lighter, more compact balustrade of phase-change salt canisters; the ones below have never been installed and are not missed. Vents in the bedroom Trombe walls have been closed, since daytime gain from that source is not needed. A wood- or propane-fueled furnace, fired up once every cold evening, with the help of the living room stove, keeps the house comfortable through the night. Bathrooms have infrared lamps, which the architects have found very effective for short-term personal comfort. A domestic water preheat tank, just under a skylight with rooftop reflector, also helps warm the guests' sleeping loft. Warm air that collects at the top of the stairwell is recirculated to the lower floor through a 6-in. duct or—in warm weather—exhausted by a 42-in. fan.

Developed three years ago, the house design was a winner in a HUD-sponsored awards program. As a result, it received a grant of $11,695 toward construction and an array of equipment for government energy monitoring, which is installed in a hideaway above the vestibule. Data are not yet sufficient to show whether the solar systems meet their estimated 75 percent of heating needs.

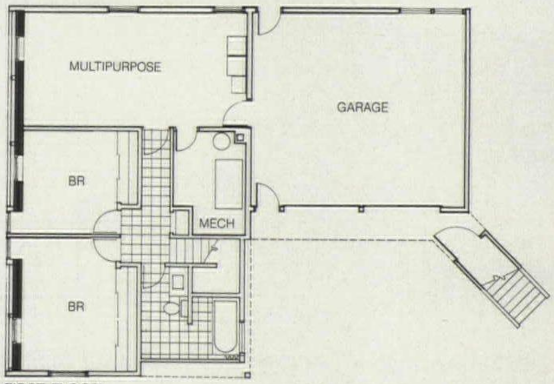
The relatively small number of passive devices used here permit the house its considerable formal unity—free of various projections. The exterior is, for the most part, a single cube, notched and chamfered to interesting effect, with openings and Trombe walls distributed gracefully. Considering this, it may be quibbling to wonder why the lean-to screened porch is allowed to conflict with the overall form at such a conspicuous location or why there are so many shifts in interior finish materials. It is as if the architects must here and there assert the primacy of the particulars over the whole.



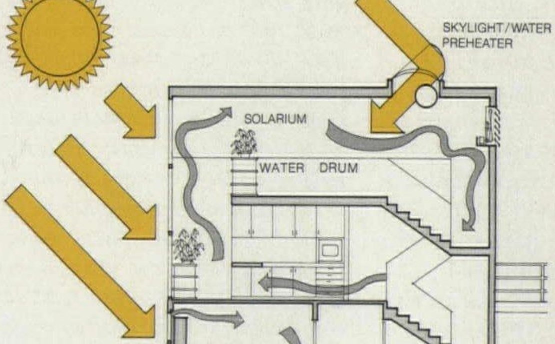
ISOMETRIC



SECOND FLOOR



FIRST FLOOR



PASSIVE SOLAR DIAGRAM—WINTER

Seen from along the approach drive (top) the house shows areas of solar collecting glass to the south, various punctured windows—and a glass block bathroom wall—to the east. A stair angles up from the parking area (above) over the garage to the second-level main entrance. Living space (left) has loft over kitchen, supported by parapet-truss clad in pine boards; Danish stove is set against a Trombe wall that is vented at the top through a cornice.

Sisko house, Metuchen, NJ

Suburban house

Set on a lot in a built-up neighborhood of richly detailed houses, the Sisko house takes on the more ambitious objective of reconciling the house as an energy system with surrounding traditional dwellings. Designed about a year later than Bonilla, it also shows more willingness to deal with overt imagery of home.

The situation of the deep, narrow plot made the task particularly difficult: the crucial south exposure was to one side, but at a slight angle; the land sloped down several feet from the street on the east, so that the house could seem to be peering up out of a hole—at the neighbors and at the sun. And the client wanted a one-story house.

The solution was to stretch the house along the south side of the lot. Entrance and service spaces were placed to the north—as in all Kelbaugh & Lee houses. A slight podium was built up by cut and fill for the main living portion of the house, and the bedroom wing was allowed to step down the slope to the west.

The extensive roof, with the unusual form of a symmetrical hipped shape sliced off at midpoint, gives the house the scale of a much larger structure. Yet, because the eaves are low and the surface neutral and continuous, the house looks rather recessive, seen from the front.

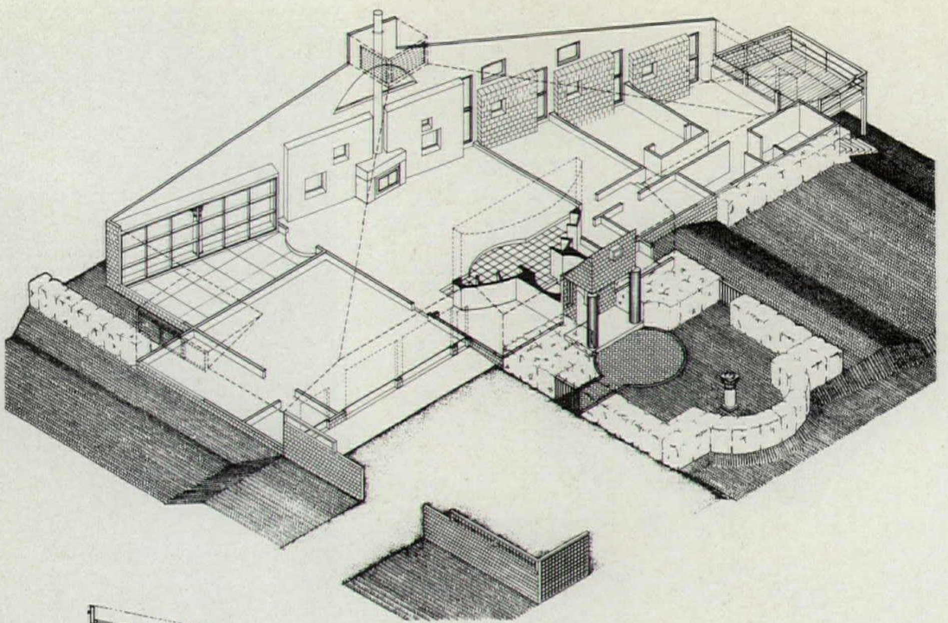
Slicing the hipped-roof volume this way has exposed a tall gabled wall toward the south sun. Lined up along it are the direct-gain glazing of the solarium and the Trombe walls of the principal rooms, but the upper reaches of the wall are little used for solar gain. The crescent window high on the living room wall is a pleasing traditional flourish, but hardly a major heat source. Retractable awnings over the Trombe walls supplement the less efficient shade of the lot-line trees in summer.

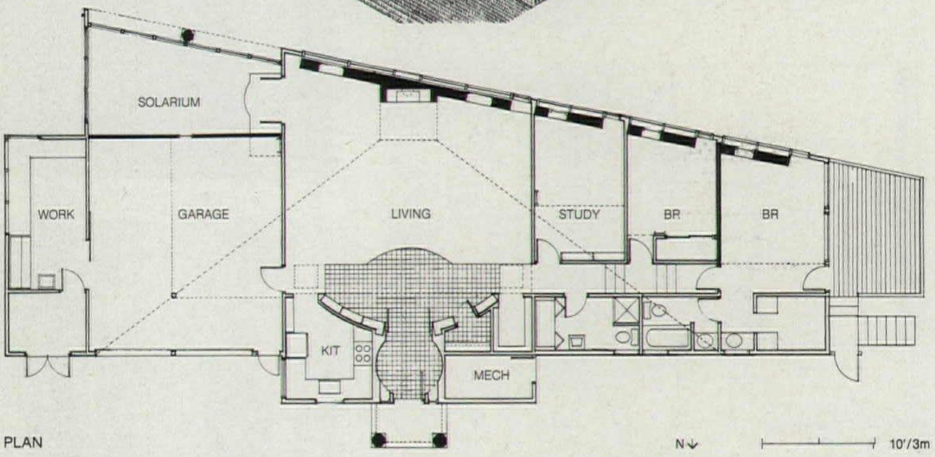
The interior responds to the owners' desire for a single major living-entertainment space, which occupies most of the volume under that tall roof. The main entry leads into this space on axis, facing the fireplace; the entry side of the room is a tile-paved space, embraced by curving walls of books (another special interest of the owners) from which a curved step, on axis, leads up the main space.

With all of this regular, axial organization, it comes as a formal surprise that the focal south wall is cut at an angle and is, in itself, asymmetrically composed. This twist on one's expectations is executed thoughtfully, with carefully balanced asymmetry, but the skill of this formal game is counteracted somewhat by the choice of materials: the smooth earth-colored finish of the masonry wall here seems to belong to a different visual world from the white-painted bookshelf wall opposite. An exposed block Trombe wall—like those in the bedrooms—would, it seems, have been more compatible.

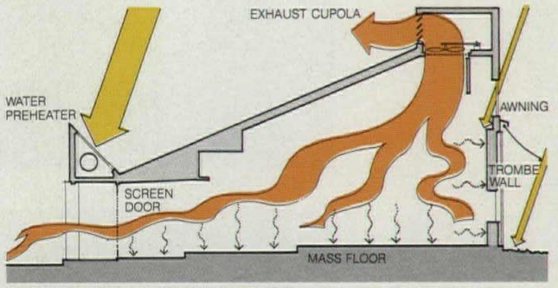
In its passive solar provisions, this house is simpler than the architects' previous ones, relying mainly on the long line of unvented Trombe walls to the south for heating (est. 75 percent solar). The solarium also provides heat, by thermosiphoning, during the day. Warm air accumulating in the upper volume of the living room can be directed by ducts in the heating system to other parts of the house—and exhausted in the summer to cool the entire house. In the service spaces that line the north side of the house, the architects have relied again on infrared lamps for quick heating of occupants. A preheater for domestic water, under the reverse slope above the entrance, catches available sun all year.

Since the major rooms rely little on direct solar gain, floors can be carpeted and interiors disposed with less concern about thermal implications. The result is an interior more conventional than the architects' previous ones. The owners' living patterns, as well, are conventional in that both go out to work,

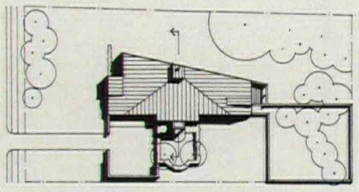




PLAN



PASSIVE SOLAR DIAGRAM—SUMMER

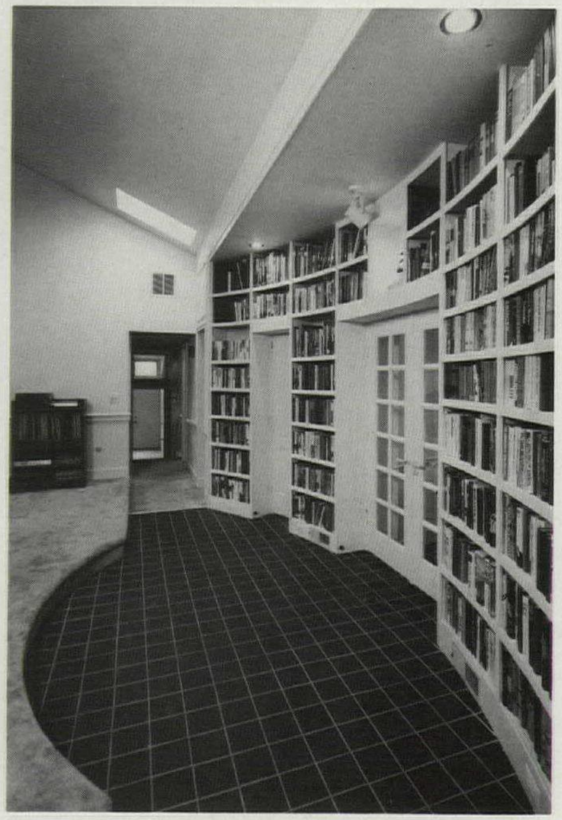


SITE PLAN

The extensive south wall (opposite page, top) includes direct-gain solarium, areas of Trombe wall, and punctured view windows. From the street (upper left photo), the large hipped roof seems to envelop the whole house. The north-facing entry (lower left) is under a canopy whose shed roof houses a solar hot water tank. Main living space, centered under the roof peak, is entered through skylighted vestibule into book-lined circulation area (middle right); glass-doored fireplace (bottom right) is set against Trombe wall, which plays asymmetrical composition against prevailing symmetry.

Data
Project: *Sisko house, Metuchen, NJ.*
Architects: *Kelbaugh & Lee, Princeton, NJ (Doug Kelbaugh, Sang Lee, Paul Froncek, Tom Swartz, design team).*
Site: *suburban lot, 100 ft along street to east, 200 ft deep, sloping 5–10 percent down from street; house on podium raised by cut-and-fill; better trees saved.*
Program: *1875 sq ft inhabited space, 625 workroom and garage; all one floor; major entertaining room, small kitchen, space for book collection.*
Structural system: *wood frame; concrete block foundation and Trombe walls; concrete slab on grade.*
Major materials: *wood shingle exterior over 1 ½ in. Styrofoam over plywood; asphalt shingle over plywood; cellulosic fiber insulation pumped into 3 ½ in. wall cavities, 9 ½ in. in roof (see Building materials, p. 224).*
Mechanical system: *gas-fired hot air, 2 zones; furnace blower can transfer air; 36-in. exhaust fan in cupola; solar preheater for hot water.*
Consultants: *Allan Goodheart, landscape; Jae Woo, structural.*
General contractor: *Dan Rich Construction Co.*
Costs: *$140,000 ($56 per sq ft) including sitework.*
Photos: *Robert Perron, except as noted.*

Ron Ellis



so are not available to deal with manual control systems during the day.

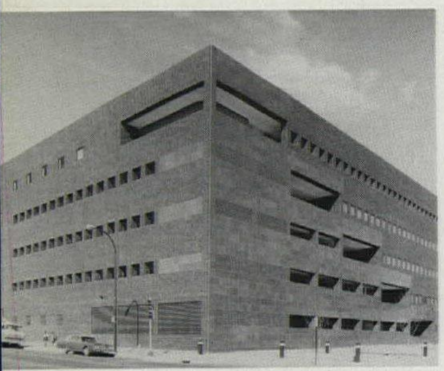
In this house, then, solar considerations determined only a few organizing elements: the long, angled south wall; the living spaces lined up along that wall, with service spaces to the north; the tall volume of the main living space. Much latitude was left for American Shingle Style imagery like that of the firm's earlier Environmental Center in Pennsylvania (P/A, April 1981, pp. 118–121).

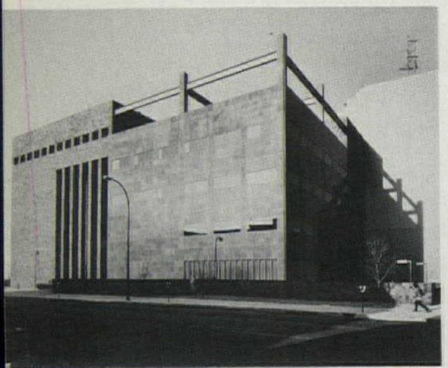
In a departure from their earlier work, Kelbaugh & Lee have not turned this house to face south, but aligned it with the neighborhood geometry, then pointedly cut across that grid with the south-facing solar wall, using this device remarkably well to yield desired room layout. By dramatizing this confrontation between two systems of orientation, they have again demonstrated a relish for upsetting consistency. In its emphasis on incident and juxtaposition, the house is more reminiscent of Queen Anne than of the more self-assured Shingle Style. [John Morris Dixon]

IPS Headquarters, Sioux City, Ia

Ice one

In its new corporate headquarters, a public utility commits itself to energy-saving and to external and internal contributions to both its town and employees.





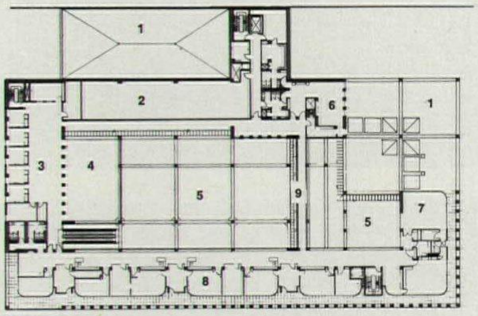
Sioux City, Ia, like many similar cities across the country, is trying to bring renewed life to its downtown. The Iowa Public Services Company, a large utility organization, has added its blessing to the effort, having constructed its new headquarters at the termination of an existing 5-block downtown mall. Joint venture architects Rossetti Associates of Detroit and Foss, Engelstad, Heil Associates of Sioux City have produced a handsome collage of materials and spatial experiences, intent on pleasing observers and employees alike.

On the exterior, the collage comprises dark-brown iron-spot brick, green-glazed terra cotta panels, bronze glass, and orange steel panels and steel framing on the top floor. On the south elevation, the terra cotta traces the stepping of the interior atrium section, while on the east side the green wraps dining and engineering functions. On the fifth—executive—floor, glass block and clear glazed walls are pulled inboard of the 4′ x 4′ openings, and a roof deck on the northeast corner is delineated by orange steel members on terra-cotta-clad columns. These elements and others are intended to indicate the building's ability to change and adapt in the future without sacrificing its basic expression.

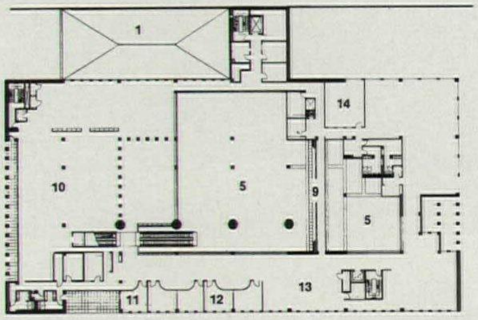
Because it is not really a "public" building in the normal sense, the entry is restrained; even though it is four stories high, it is studded with columns and somewhat ambiguous. For security reasons, the reception foyer is isolated, but visitors can just begin to get a hint of the main event beyond the sloped glass wall behind the receptionist. Once one is past this point, the atrium opens up and away from the entry, escalators soar, and bridges pass overhead, under a huge L-shaped skylight.

On each successive floor, the west edge of the atrium steps one 36-ft bay farther west, while the bridges shift in the same direction by 12 ft. As in the reception area, sloped interior glazing connects each bridge with a beam a floor above, creating transparent canopies. A viewer on a bridge can look down on another or up to the skylight, and the angle creates a periscope effect for viewers farther away to view the reflected sky.

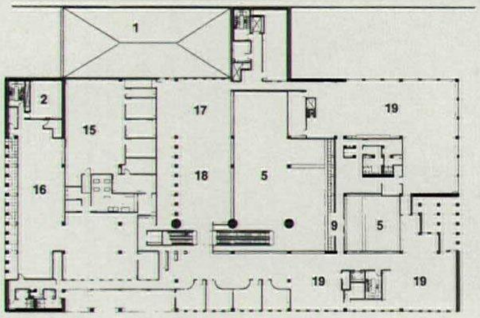
About the only feature of the atrium that might raise questions is the row of four oversized columns toward the south end. Starting



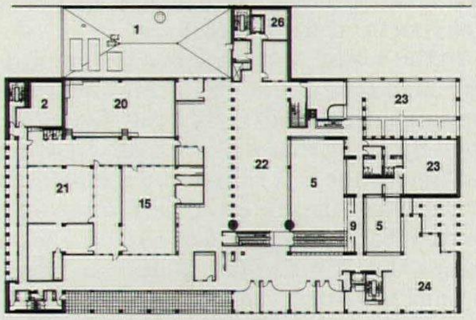
FIFTH FLOOR



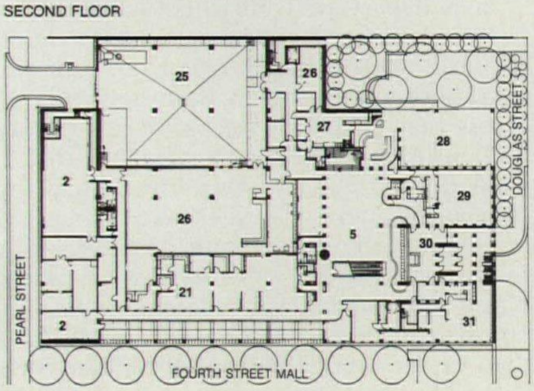
FOURTH FLOOR



THIRD FLOOR



SECOND FLOOR



FIRST FLOOR

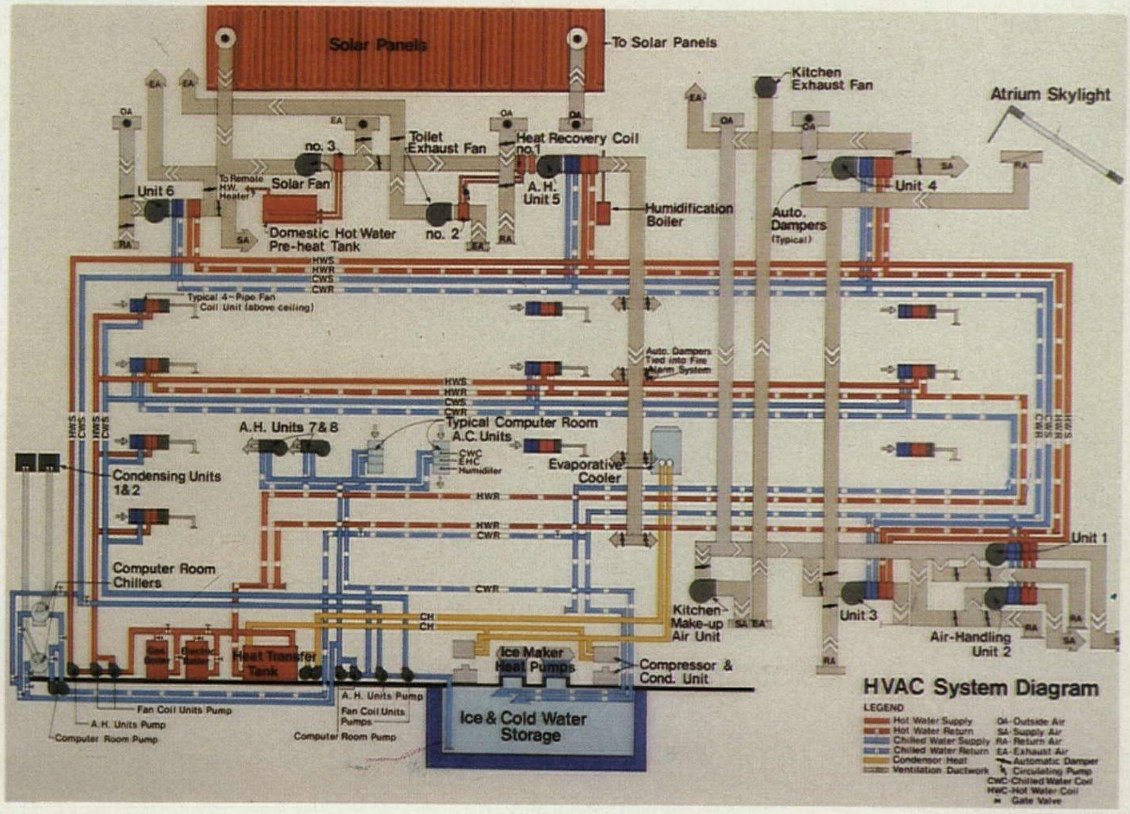
↑N

Legend
1 Roof
2 Mechanical
3 Legal
4 Library
5 Atrium
6 Executive dining
7 Board room
8 Executive offices
9 Bridge
10 Accounting
11 Controller
12 Treasurer
13 Rate and treasury
14 External audit
15 Computer
16 Programmers
17 Customer accounting
18 Consumer services
19 Engineering
20 Control room
21 Communications
22 Major projects
23 Open to below
24 Central drafting
25 Service court
26 Storage
27 Kitchen
28 Dining
29 Meeting
30 Reception
31 Personnel

Each façade of the building is different; tall slots on the entry side (above and opposite page, bottom) give way to stepped horizontal openings on the side, then to punched openings on the back (opposite page, top).

with one on the first floor, two on the second, and so on, all four stop abruptly below the fifth level. At that point it appears that they could carry beams three times the size they actually bear. Although they are interesting items in the space, they strike a somewhat arbitrary note.

On the office floors, natural light is introduced in various ways. The fifth floor has glass block outer walls and clear glass on some corridor offices, while the lower floors have many perimeter office walls of bronze glass on the exterior, glass block facing the circulation (atrium) side. Since these offices are located along the south wall of each floor above the first, light is transmitted through them to the secretarial and circulation spaces. Interior colors range from green and orange to shades of mauve and plum, in some areas perhaps threatening to get a bit out of hand when added to the rich materials palette of wood, metal, and ceramic tile. But in general the spaces are bright, warm, and cheerful, and it is easy for a visitor to feel the friendly interaction of the employees while touring the building.



IPS Headquarters

Spatial effects are to be found everywhere, from the atrium (top) to the double-height dining area (above) to the executive office and secretarial area (right). Bridges span the atrium at all upper levels (opposite page, top), stepping to the west as they cross the area (opposite page, bottom) at successively higher floors.

On the first floor, in addition to the reception, atrium, and dining areas, large spaces house mechanical equipment, storage, and communications functions. A large service court and receiving dock and the personnel office also are located on this level. A large percentage of the second floor is devoted to communications functions, and to computer and system control analyst areas. The two-level control room for IPS systems is another major feature of the second floor, as are the large area and offices for staff working on major projects.

Consumer services and accounting, backed up by major computer and programming areas, occupy the west end of the third floor. The rest of that level holds the engineering disciplines. The fourth floor is currently the home of all the accounting functions and the controller and treasurer, while the fifth floor, in addition to executive offices, contains the legal staff and the library.

At heart

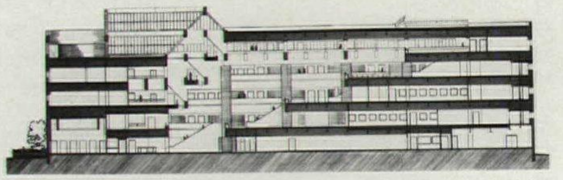
Even though the apparent main attraction of the IPS Building is its atrium, the real performance is playing in the first-floor mechanical room. Instead of the normal array of boilers—there *are* two, small electric and gas-fired supplementary units—there are six large commercial ice-making machines and a 75,000-gallon ice storage pit. The process of making ice releases 1200 Btu per gallon, so a potential exists to recover a total of 90 million Btu by transfer through the heat exchangers. On winter days when the building is occupied, lights are on, and computers are all running, chilled water from the ice pit circulates through appropriate fan-coil units. Warmed, it returns to the storage, melting some of the ice and returning the 1200 Btu per gallon energy to the system. Made back into ice, the Btu's start the cycle again.

In addition to the ice-making heat pumps, the building uses heat recovery from the central toilet exhaust fan system and from returns through light fixtures. On the roof, solar collector panels heat required ventilation air and also contribute to domestic hot water requirements. Heat rejected from the ice makers is used to heat—to 105 F—water for areas not requiring chilled water. Backup chillers are provided for computer room cooling, since those areas are critical, and they often work on summer nights while the ice makers prepare for the next day. If supplementary heat is required, either of the two small boilers may be called in, depending on fuel availability or peak loading conditions.

Other than these sophisticated approaches, the basic mechanical system is a straightforward 4-pipe configuration with the fan-coil units. But the overall building operation is controlled by computer, including heating/cooling, security, and fire alarm functions. In terms of HVAC operations, it constantly monitors conditions, controls and selects the most efficient modes for parts of the system.

Clearly, the Iowa Public Service Company set out to make its new corporate headquarters a contribution to Sioux City on several levels. On the most obvious plane, it has given the downtown a shot in the arm, visually, urbanistically, and in economic terms. Its endeavors toward creating a humane working environment seem—at least to a visitor's eye—to be working well. And its commitment to solving energy problems has produced an impressive intermix of technology, with no small contribution from the utility itself.

In short, IPS seems to be successful in doing what it intended. It has certainly put Sioux City and itself on the energy map and has encouraged some fine architecture along the way. It will be interesting to return a few years hence to see how the ice business has fared. [Jim Murphy]



EAST–WEST SECTION 40'/12m

Data
Project: *Iowa Public Service Company Corporate Headquarters, Sioux City, Ia.*
Architects: *joint venture between Rossetti Associates, Detroit, Mi, and Foss, Englestad, Heil Associates, Sioux City, Ia.*
Client: *Iowa Public Service Company.*
Site: *most of a city block in downtown Sioux City.*
Program: *new corporate headquarters for a utility company, comprising several groups of services with a total area of 167,635 sq ft.*
Structural system: *steel frame with cellular metal deck, concrete foundations and auger cast piles.*
Mechanical system: *ice-maker heat pumps and solar collector panels, backed up by an electric or a gas boiler.*
Major materials: *brick, terra cotta, and metal wall panels, exterior; glass block, ceramic tile, carpet, and gypsum board walls, interior (see Building materials, p. 224).*
Consultants: *Foss, Englestad, Foss, Fargo, ND, mechanical; other work by the architects' offices.*
General contractor: *W.A. Klinger, Inc.*
Costs: *$14,350,000; $82 per sq ft, including interiors and sitework.*
Photography: *Balthazar Korab.*

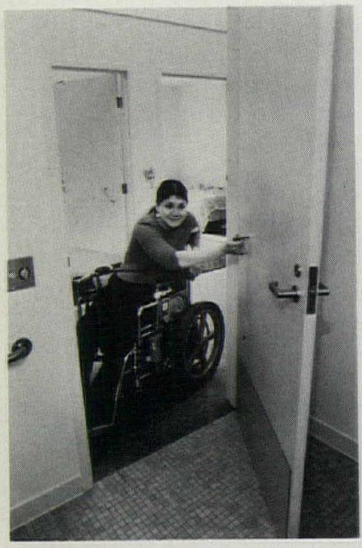
John Nutting Apartments, Amherst, Ma

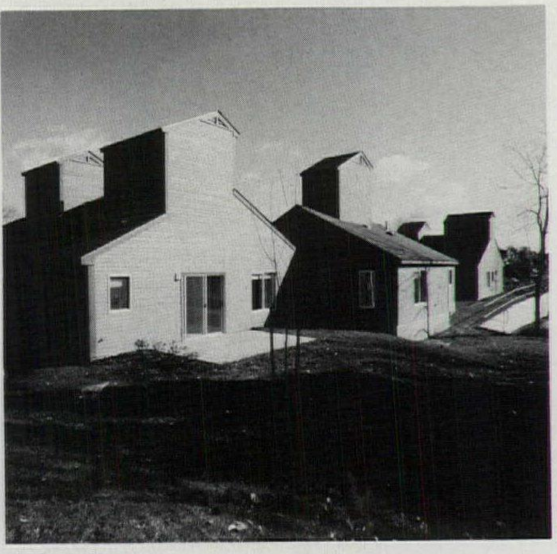
Barrier-free and energy-conscious

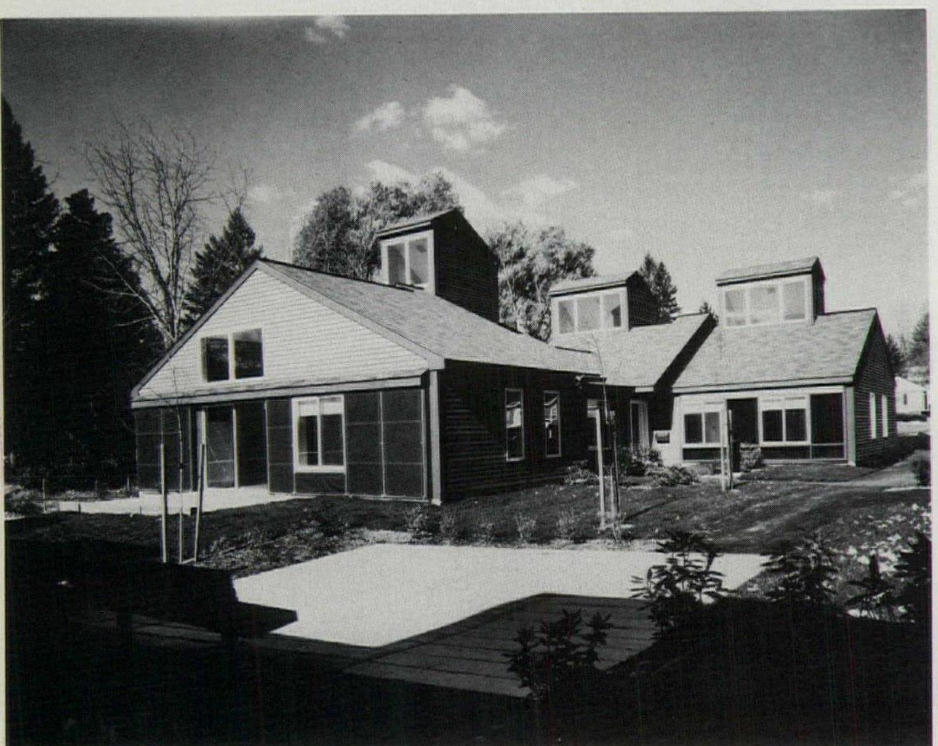
As confidence in energy design principles grows, architects tackle increasingly difficult programmatic situations. Blending energy consciousness and barrier-free design is both demanding and rewarding.

"Amherst sees itself as having a picturesque Colonial New England heritage." Architect Norton Juster is explaining the appearance of his new buildings as we approach them. "We try to find some resonant sense of either form or material to deal with that. We like to do understated, low-key architecture . . . so that people will say, 'Wasn't that building always there?' "

When grant money was approved by the state for additional energy features, one of the results was a series of sun scoops, which poke their heads up through the original roofs and cock to "face" into the sun. How would the overseers of New England heritage respond? Or as Juster put it: "Oh my God, what are they going to say about the sun scoops?"



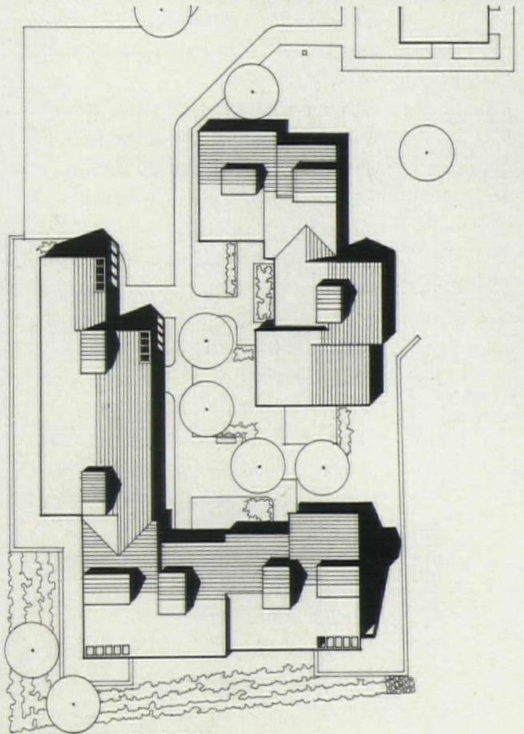




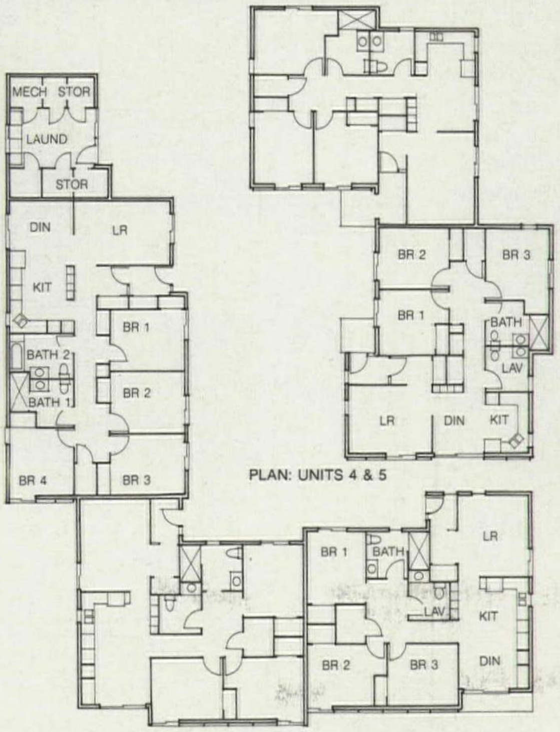
As it happened, the Amherst Housing Authority had no difficulty accepting the scoops. In choosing property close to the center of town for the ease of tenant access, the authority had sacrificed optimal sun orientation for a skewed southwest face. Even the Trombe walls, also added as a benefit of the new grant money, were limited by the amount of solar exposure.

It is in fact the vehicular access, a cluster of specially equipped vans in the parking lot, that provides the visitor with a clue that this tiny solar village is for special people. It is a pilot project of living units designed to serve the rental needs of the physically handicapped. These are people with permanent mobility disabilities, but with proven records of independence from professional care. While living in the company of a nonprofessional attendant, or simply a family environment, the individuals who live here do so without the stigma of an institution, and with the additional benefits of an environment specifically designed to accommodate wheelchairs.

Such a place must ideally contain a minimal number of level changes, and turning radii must be carefully considered. Double handles are placed on all the doors. Massachusetts laws on accessibility are the most stringent in the country, and such concerns are not uncommon. There is still plenty of room, however, for creativity. As architect Juster explains it: "If you limit yourself to the existing standards, you inevitably end up with something that doesn't work very well." Careful programming is essential. Juster continues: "What is barrier free for one person is a barrier for another." Ramp details that benefit wheelchair occupants can be a hazard for a blind person. Bringing tools and surfaces lower into the range of the wheelchair occupant makes them a hazard for the child of that same person.

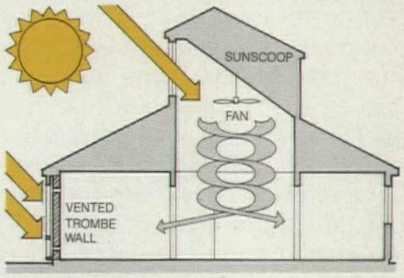


SITE PLAN AND ROOF PLAN (WITH SUNSCOOPS)



PLAN: UNITS 4 & 5

PLAN: UNITS 1, 2 & 3



SECTION: ENERGY STRATEGY

The skewed site orientation, population demands, and level site requirements made optimizing solar advantages difficult. Trombe walls and sun scoops (above) face southwest. Facing page: Temporary fabric shades protect Trombe walls from summer sun. Walls where solar does not penetrate are heavily insulated. The direct-gain sun scoops and windows provide daytime heat while Trombe walls can also store heat for night use.

John Nutting Apartments, Amherst, Ma

Bathroom: The occupants of this project readily emphasize the place to start improving the facilities of a conventional apartment: the bathroom. Just the capability of wheeling (in a special plastic chair) into the shower area directly avoids the danger and inconvenience of a tub or necessary seating transfer. All of the dwellings in the project contain two enlarged bathrooms; only one contains bathing facilities, but the duplication permits longer time intervals in the bath. Each bathroom is equipped with an emergency buzzer.

Kitchen: Outside the bath, the other area of profound influence from barrier-free design is the kitchen. The changes here are not large. But as Juster puts it: "An inch or two difference makes a large difference in comfort." The counter tops and the drawers mounted beneath them are suspended by brackets. Like large shelves, they can be adjusted up or down for each tenant within a range of about 12 in. Other special features include an emphasis on access to storage space low to the floor, plugs located where a seated person can reach them, an oven door that is hinged at the side, and a special pull-out working board with holes in it to keep bowls steady while in use.

Elsewhere in the apartments, details designed to accommodate the special occupants are less obvious. The window sills in the bedrooms are lower to allow an expanded view while bedridden. Circulation space is carefully conceived to bypass furniture or other obstructions difficult for a wheelchair. Windows and doors are designed for ease of operation and maintenance.

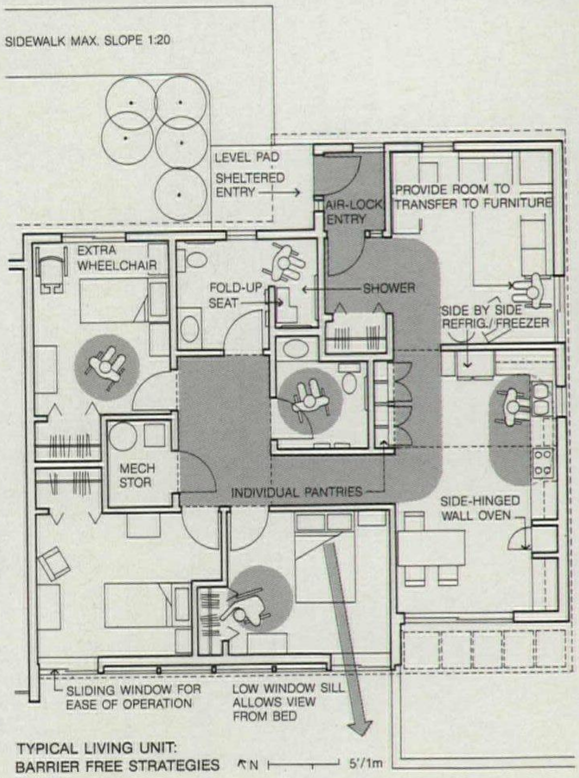
Enter energy

The emphasis is on independence. The immediate living environment becomes a series of tools rather than a collection of obstacles. Energy independence plays a natural role in such an environment. The sun streaming in the south-facing direct-gain windows and sun scoops expands and animates the spaces. The sun scoops occur twice in every unit, once outside the sleeping and bathing rooms and once in the public living space. The tall, colorful scoops are angled to absorb and reflect light and heat down into the space. Propeller fans are positioned to activate automatically to destratify and circulate hot air.

Many energy features are manually operated. The vents from the Trombe walls must be opened and closed by hand. The fabric covers added for summer protection of the Trombe walls are intended to be seasonal. The air-to-air heat exchangers in the kitchens allow the air to be purified at the occupants' demand without the loss of heat.

The buildings are not without energy flaws. There is no night insulation over the large

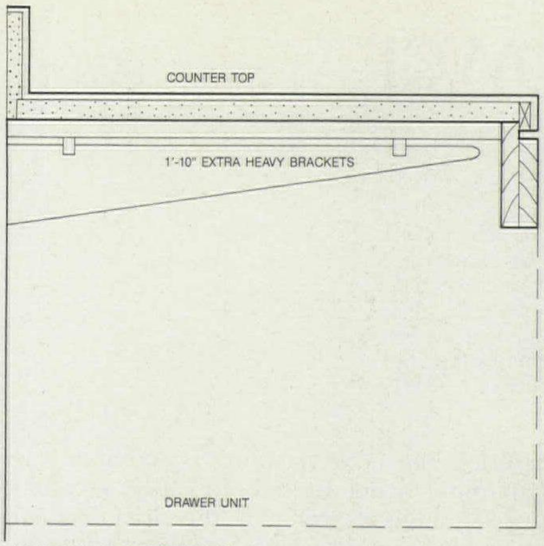
Ample turning and circulation for wheelchairs are central to unit design.



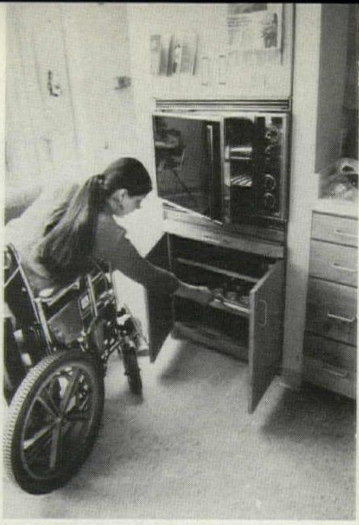
TYPICAL LIVING UNIT:
BARRIER FREE STRATEGIES

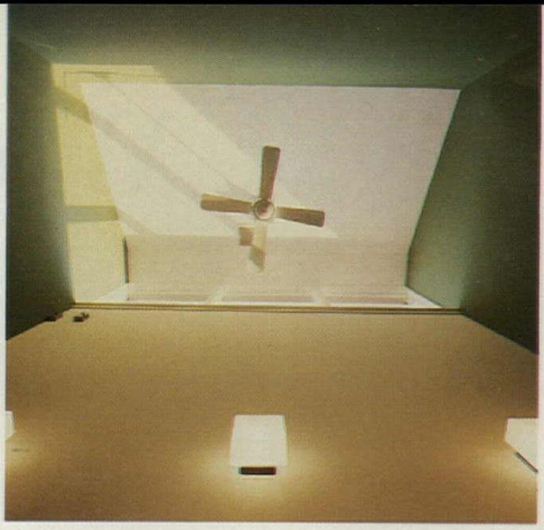
Data

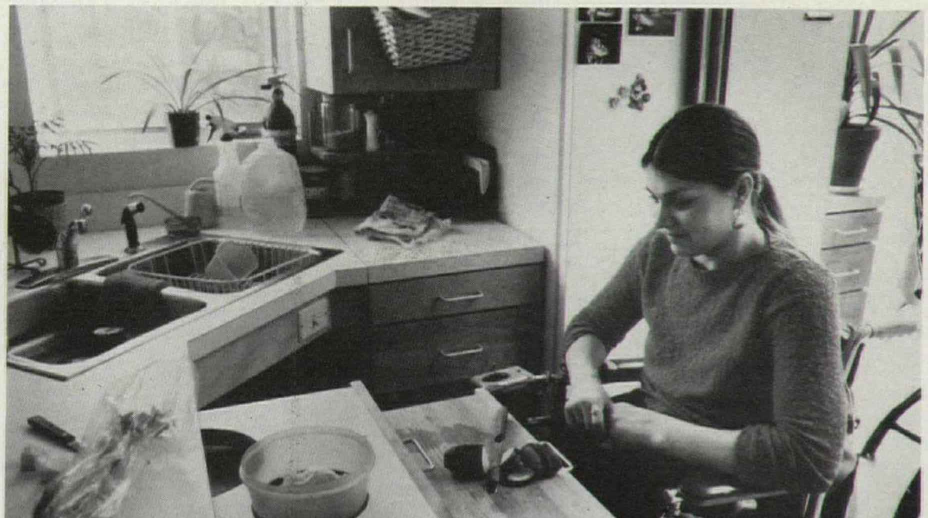
Project: *John Nutting Apartments, Amherst, Ma.*
Architects: *Juster Pope Associates, Shelburne Falls, Ma. Nancy Smith Schwartz, Norton Juster, Jack Frazier, Earl Pope, design team.*
Client: *Amherst Housing Authority, Carole Collins, project director; The Massachusetts Executive Office of Communities and Development, Steve Spinetto, project coordinator; The Massachusetts Executive Office of Energy Resources, Roland E. Rouse, Solar Program Director; Stavros, Inc., Chris Palames, sponsor.*
Program: *four 3-bedroom rental units at 1243 sq ft; one 4-bedroom unit at 1540 sq ft.*
Site: *27,000 sq ft.*
Structural system: *wood frame construction on cast-in-place slab and foundations.*
Major materials: *conventional wood frame construction, with 2" x 6" stud walls filled with 6-in. batt insulation (see Building materials, p. 224).*
Mechanical system: *heat pump and fan coil units for all-weather air conditioning. Air movement augmented by fans.*
Consultants: *V. Michael Weinmayr Associates, landscape; Robert W. Hall Consulting Engineers, Inc., mechanical; Gordon E. Ainsworth & Associates, site engineer.*
General contractor: *Palazzesi Construction Corp.*
Costs: *$463,344.*
Photography: *D. Randolph Foulds.*



ADJUSTABLE COUNTER DETAIL







Tenant Karen O'Neill (and son Todd, opposite) demonstrate barrier-free design features. (Above) Sun scoop and fan are above the kitchen in this unit.

windows as yet, and their direct gain features have not led to appropriate furnishings placement by the occupants. One might also argue that the architects were remiss in not providing exterior shading for the south-facing windows to reduce cooling load. The units will be air conditioned by the same electrical heat pumps that heat them on cold winter nights.

If there is a single force working against the energy efficiency of the units, it is the fact that the residents pay a fixed sum of 25 percent of their monthly income as rent, regardless of energy consumption. The Amherst Housing Authority picks up the tab for the rest.

Enter government

In the context of governmental role in energy conservation or social welfare, these buildings programmatically respond to specific needs in a fashion every bit as dramatic as their physical sun scoops do. The people who live in this place had no direct role in its creation. Project director Carole Collins of the Amherst Housing Authority gained inspiration from a local group, Stavros Foundation, which advocates independent living for the handicapped. Together they were successful at obtaining $525,000 support from the Executive Office of Communities and Development for the State of Massachusetts, as well as a $59,500 grant from the Executive Office of Energy Resources for adding energy amenities in a multifamily project.

The combination of barrier-free design and energy consciousness joins, probably for the first time in a new building, the two most important concerns about building usage in the last decade. Both point to a saner world, one with less waste. It feels good to experience such a sensible place; you regret the architects were so clever at accommodating so many units on the site. There is no room to expand: [Richard Rush]

Vistor center,
Antelope Valley, Ca

Wildflower power

Kathy Goss

An earth-sheltered visitors' center in California's Mojave Desert supplies all its own energy needs.

Data

Project: *Visitor Center (Jane S. Pinheiro Interpretive Center), Antelope Valley California Poppy Reserve, Antelope Valley, Ca.*
Architects: *The Colyer/Freeman Group, San Francisco, Ca. Principals, Robert Colyer, S. Pearl Freeman.*
Client: *State of California, Department of Parks and Recreation, Sacramento, Ca.*
Site: *a 1500-acre state desert wildflower reserve in a valley 2800 ft above sea level.*
Program: *a 2110-sq-ft building, with 1100 sq ft of exhibition space, and administration offices, storage, and utility areas.*
Structural system: *reinforced concrete spread footings supporting reinforced concrete masonry walls and a cast-in-place reinforced concrete roof with a one-way pan joist system.*
Mechanical system: *underground air intake duct, stack ventilator.*
Major materials: *split-face and smooth concrete block, quarry and mosaic tile (see Building materials, p. 224).*
Consultants: *structural, Shapiro, Okino, Hom & Associates; electrical, Marion, Cerbatos & Tomasi.*
General contractor: *Dermody, Inc.*
Costs: *$410,000; $120 per sq ft, including entrance road, parking, and trails.*
Photography: *Tim Street-Porter.*

Kathy Goss is the author of books on health and articles on solar energy, science, and the environment. She lives in San Francisco.

The Antelope Valley California Poppy Reserve was created for visitors to enjoy one of the last great stands of the state flower, the California poppy. Situated some 85 miles northeast of Los Angeles in the western reaches of the high Mojave Desert, the Antelope Valley is an area of dramatic contrasts. The desert is rimmed with mountains to the north and south, its flatness relieved by a series of rolling hills, or buttes. The high-desert climate, at 2800 ft elevation, has marked diurnal temperature fluctuations. Summer temperatures commonly exceed 100 F, while in the winter they may drop below 20 F. Brisk prevailing southwest winds make the area one of the windiest in the state.

At the time that the California Department of Parks and Recreation commissioned San Francisco architects Robert Colyer and S. Pearl Freeman to design a visitor center for the Poppy Reserve, one clear mandate had already been formulated. Because of its remote location in this environmentally sensitive area, the structure had to be autonomous in its energy requirements and unobtrusive in its natural setting. To accomplish these ends, the building was to be earth sheltered.

The architects drew their inspiration for the building's design from the desert architecture of the American Southwest. The formal elements were determined by a combination of energy and aesthetic considerations. The butte designated as the building site has a generally southwestern orientation. In order to balance solar gain seasonally through the window wall, the building had to be swung out of the hill to face due south. The curving wing walls on either side, partially embraced by the surrounding earth, tie the structure back into the hill.

The 2000-sq-ft interior contains exhibit space, office and storage areas, and rest rooms. The cylindrical form of the vestibule, reminiscent of the kivas of the American desert, affords the comfort of shade, while protecting the entry from the southwest winds. A video display and decorative cooling fountain are set in niches to allow for flexibility in the exhibit area. The wall between office and exhibit room is eroded down to permit air circulation and to enhance visibility.

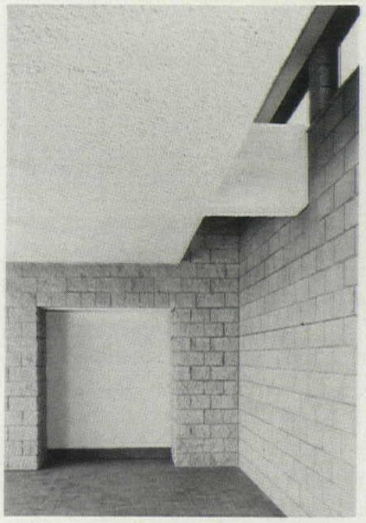
The architects chose split-face concrete block for the building's interior and exterior walls, not only for thermal mass, but for its color and texture that echo the native decomposed granite and further blend the building into the surrounding butte. On the exterior, the split-face block is accented with horizontal bands of smooth block, recalling the sedimentary rock of the area. As the curve of the south façade penetrates the window wall and enters the interior space, the pattern reverses the rear wall and ties the interior and exterior in an uninterrupted flow of form and texture.

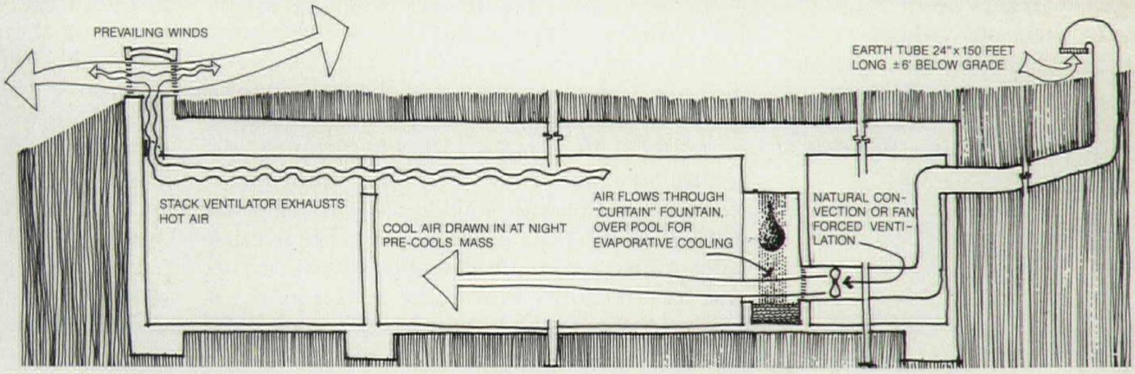
Designed to display the workings of its natural energy systems, the building is heated 100 percent by passive solar features, with direct solar gain through the south window wall and thermal mass in the concrete floor slab and walls. Interior thermal shades at south wall and clerestory prevent nighttime heat loss. A Trombe wall carries through the window pattern of the window wall and provides thermal storage for the rest rooms while at the same time affording privacy.

Marking the site of the visitor center atop the butte, the 8kW wind generator is expected to provide nearly 100 percent of the building's electrical needs for lighting, power, and mechanical systems. Tied in to the power grid, the system will actually sell back electricity to the utility company during peak production periods in this high-wind area.

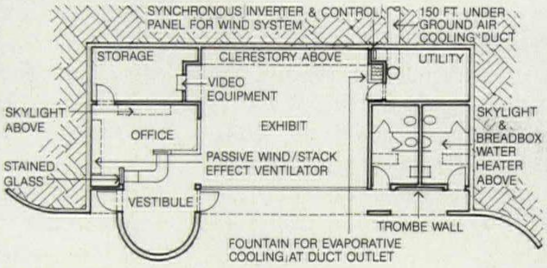
Cooling is accomplished through a combination of passive and mechanically assisted features. The earth sheltering provides conductive cooling and shields the building from direct heat gain. An overhang on the south façade, besides providing a covered exterior walkway, prevents direct gain through the window wall during the hot summer months, while permitting the sun to enter during the winter. Operable sections in the south window wall and clerestory permit seasonal cross-ventilation.

More complex is the nighttime cooling system, derived from the desert architecture of medieval Iran. Cool night air is drawn into the building through a 150-ft "earth tube" and then passed over the fountain in the exhibit area to precool the building mass. Hot air is exhausted mechanically or convectively through a stack ventilator on the opposite side of the building. This innovative cooling system is mechanically assisted by a fan and motor-operated louvers. The building has its own well to supply the fountain. Fan, louvers, and pumps operate on power supplied by the wind generator and are controlled by a timer for ease of operation at night.

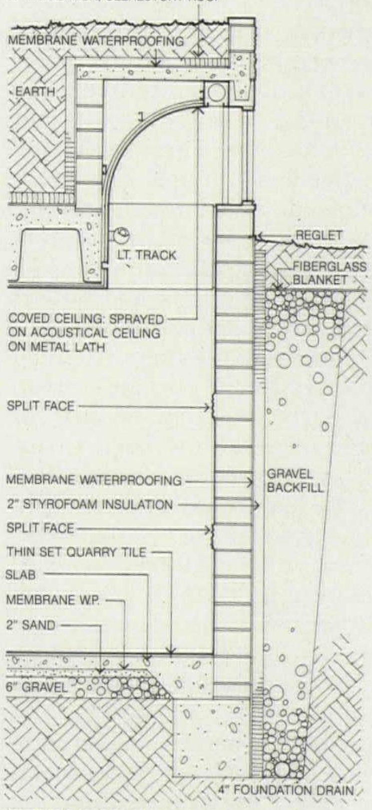




PASSIVE COOLING



FLOOR PLAN



SECTION: NORTH CLERESTORY

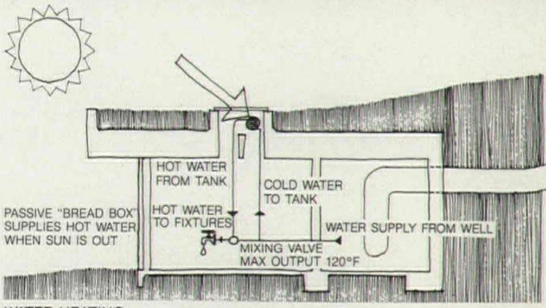
Visitor Center (top) will soon be almost hidden by local vegetation and poppies. Interior (above) shows clerestory, upper right. Sections show cooling, hot water, daylighting.

The building relies on natural daylighting, supplemented only by task lighting for the exhibits. Direct light is introduced through the south window wall and may be diffused by the operable exterior shades to reduce glare and minimize solar gain. The exhibit area is lit by the 30-ft north clerestory, whose curved ceiling distributes the light over the north wall. Glass block skylights provide daylighting in the office and rest room areas. The artificial illumination scheme, for nighttime use, mimics the daylighting effects, with fluorescent tubes in the skylight and clerestory wells.

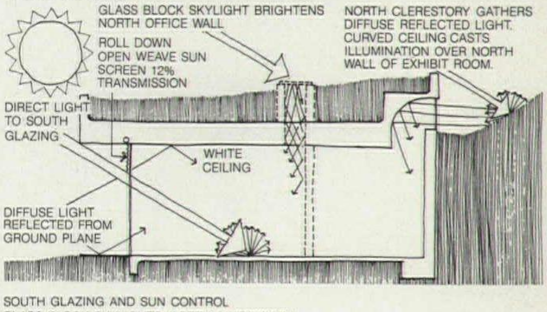
As an added passive feature, the skylight over the rest rooms houses a breadbox water heater that can be viewed by means of a mirror from the rest room area.

To verify the energy dynamics of the building, the architects used the CALPAS computer program, adapted to allow for earth sheltering.

Among other honors, the visitor center design received a 1980 Passive Solar Conference award and an Owens-Corning Fiberglas Energy Conservation Award for 1981. Harmoniously integrated into its desert setting, the center offers shelter, independent of time and of energy inputs, and a sensitive architectural response to the natural energies and fragile beauty of the environment. □



WATER HEATING



SOUTH GLAZING AND SUN CONTROL
GLASS BLOCK SKYLIGHTS, NORTH CLERESTORY
DAYLIGHTING

Cabrillo Village Farmworkers Cooperative Housing, Saticoy, Ca

Harvest the sun

Barbara Goldstein

Farmworkers cooperated to save their old village, and then rehabilitated it with the Mutlow Dimster Partnership, who later added 35 new units of solar housing.

Barbara Goldstein is editor of *Arts + Architecture* magazine and a Los Angeles correspondent for *Progressive Architecture.*

One of the most impressive things about the new farmworkers' houses in Cabrillo Village is the very fact that they exist. Designed by John Mutlow of the Mutlow Dimster Partnership in joint venture with Barrio Planners, they are a tangible symbol of the tenacity of a group of people united by a common cause.

In 1975, after years of labor disputes and arguments about their rights, the farmworkers of Cabrillo Village were threatened with eviction by the local growers. Their small community, originally a camp, was of board-and-batten cabins built in the 1930s, in which many of the families had lived for over 20 years.

The growers' ostensible reason for evicting the families was that the state's public health inspectors had found substantial public health and safety violations. In reality, the growers were unhappy about the workers' growing political force and used the violations as an excuse to decimate the community. At this point, the workers were galvanized into action. They pooled the $500 each family had been given as incentive to move, formed a nonprofit cooperative, and bought their houses and the 8.5 acres surrounding them.

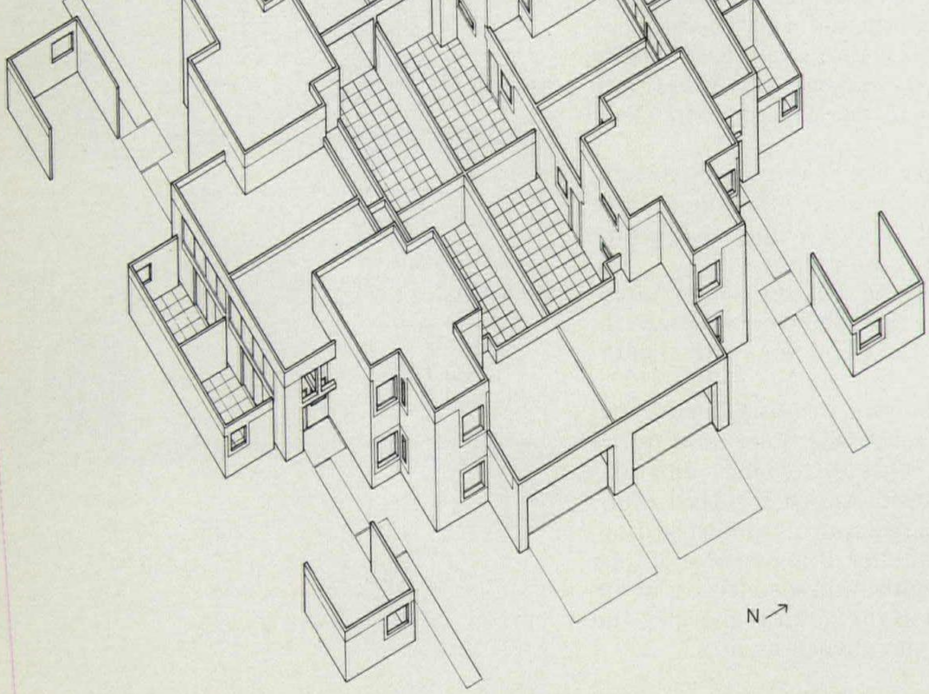
Cabrillo Village is situated in a dramatic location in a valley, with distant views of mountains. Sandwiched between a river and some railroad tracks and surrounded by lemon groves, the village has a high rock berm on two sides as protection from storms.

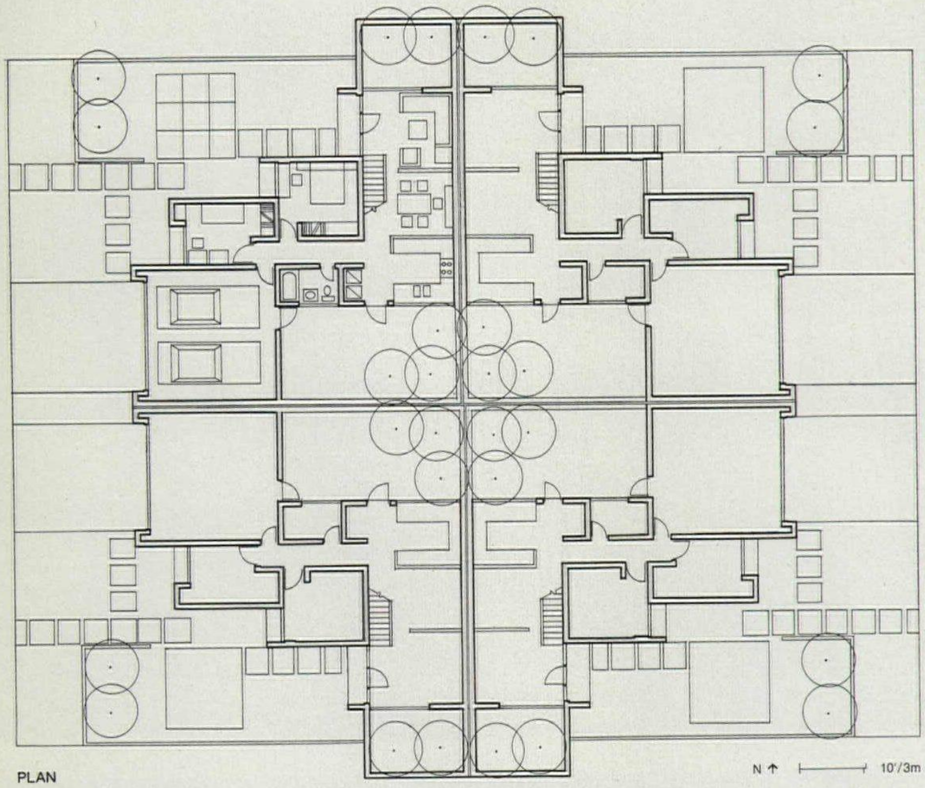
Since 1975, the farmworkers have expanded the community to include a preschool, a cooperative food market, a tile manufacturing plant, and a woodworking shop. In this low-tech, family-oriented society, most people still work in the fields. The old board-and-batten cabins are being rehabilitated in phases. Each has been given a new concrete foundation, insulation and gypsum board inside, and a new kitchen and bathroom. The 35 new units John Mutlow was commissioned to build are for newcomers and relatives of people already in the village.

Although most people really wanted their own little houses on individual lots, like those in the older part of the village, the loans and grants available from the Farmers Home Administration specified multiple dwellings. Therefore, Mutlow designed quadruplexes, organized as courtyard houses surrounding private back yards. Having the same density and lot sizes as the older cabins, the houses face the street, with front doors stepped back from garages. On one side the units are separated from each other by the garages, on another there is a party wall; but because of careful placement of windows, back yards, and side yards, the units seem very private.

Aesthetically, the flat roofs and setbacks give the houses the appearance of squat Mexican adobes. Their small windows, massive forms, and earth-related colors suggest traditional architecture, and this impression is reinforced by incised bands of white stucco that delineate the rooflines and surround some of the windows.

Aside from privacy, a main consideration in Mutlow's design was for energy conservation, which here makes use of a combination of passive and active systems. All of the houses have clerestory windows on the side living room walls so sun can heat the interiors. In the south-facing units, the ceilings are 12 ft high throughout, and heat is absorbed and stored in floors of 6-in. concrete slab covered with quarry tile. (The tile is made and set by people in the village.) Addi-





tional heat is gained through the sliding glass doors in the same wall.

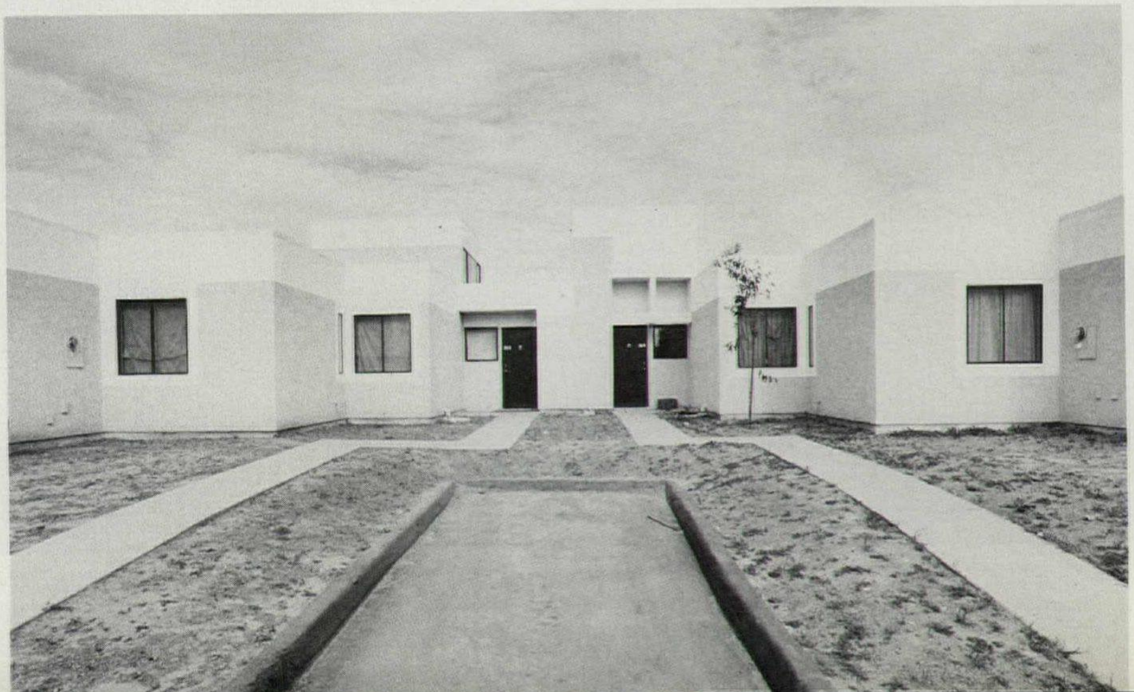
In the north-facing units, there is a 14-ft raised ceiling over the front part of the side wall. Here, the clerestory window is mounted on the *back,* or south side of the ceiling. In order to store heat in the north-facing unit, the architects have suspended an 18-in.-diameter, dark red water-filled tube in front of the clerestory. This, combined with a low-speed fan mounted on the ceiling above it, stores heat and disperses it into the unit. Insulating blinds will soon be installed to reduce heat loss at night. For the same reason, the north-facing sliding glass doors are double glazed. The remainder of the living room has an 8-ft ceiling to reduce the volume needing heat. The north units have carpet on the living room floor.

All of the units have above-average insulation in both the ceilings and the north walls. An openable window at the top of the staircases creates a chimney effect in the houses, drawing warm air up and out when the weather is hot. The passive collection principles have been effective, and the heating bills in the new units have been \$10–\$15 per month lower than the bills in the newly insulated cabins.

The only shortcoming of the passive space-heating system is human intrasigence. Naturally, the use of the living room floor as a heat sink in the south units only functions if the residents leave the floor uncovered. Furthermore, although the sliding glass doors on the south side are not the principal source of solar energy, they do absorb some heat, and their effectiveness is reduced by drawn curtains. Of course, the residents of the houses will realize the advantages of the passive system when they receive their heating bills, and this will offer a positive incentive to make the system work.

Water heating is handled by means of conventional solar panels mounted on the garage roofs, but the architects are experimenting with different systems. Some of the garages have large banks of solar panels feeding energy to large water tanks under the courtyards; others have smaller groups of panels feeding tanks in individual garages.

The clustered quadruplex housing units are designed to be joined to each other either at garages (in plan, top), at entry (right), or both (above). North-facing units have south-facing clerestory to heat water storage tubes (facing page, top); south-facing units gain heat through glazing, for storage in thick concrete and quarry tile floors. (facing page, middle).



Each unit also has an enclosed side yard, planned in the form of a patio, adjacent to the living room, which will be built with money from the Farmers Home Administration, by the villagers themselves. Once built, these 8-ft-high walls will tie the houses together, making each block into a continuous building, like a group of adobe townhouses.

It is interesing to contrast the aesthetics of the new village with the old. While the architects had a romantic notion of creating adobes reminiscent of Mexican architecture, the new units are in sharp contrast to the saltbox appearance of the cabins, with their pitched roofs and wooden sides, brightly colored picket fences, and lush planting.

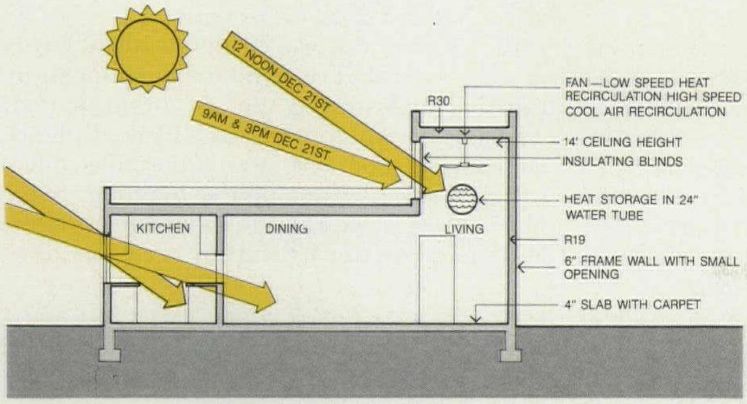
The newer units have an entirely different feeling. Lined up along the street, they seem curiously suburban. Once the side walls are built, this impression will be reinforced. But while the new village lacks the spontaneity of the old, the exposed nature of the solar collectors gives the new houses a slightly funky feeling. And perhaps once the gardens are planted, the new houses will come to have some of the same casual atmosphere as the older ones. The community, in any case, is very pleased with the new houses. An additional 34 and a community building are planned as a second phase, to be carried out by the same architects. □

Both the varying sizes of the families and the different orientation of the units lead to six different house types—three plans and two sections. There are two-, three-, and four-bedroom units, with a rather great variation for a project of this scale. This factor, combined with the setbacks of the walls, made the units somewhat more expensive than standardized unit plans. The planning of the quadruplexes, however, is excellent; both the zoning of individual units and the separation of the units from each other promote privacy for individuals and families.

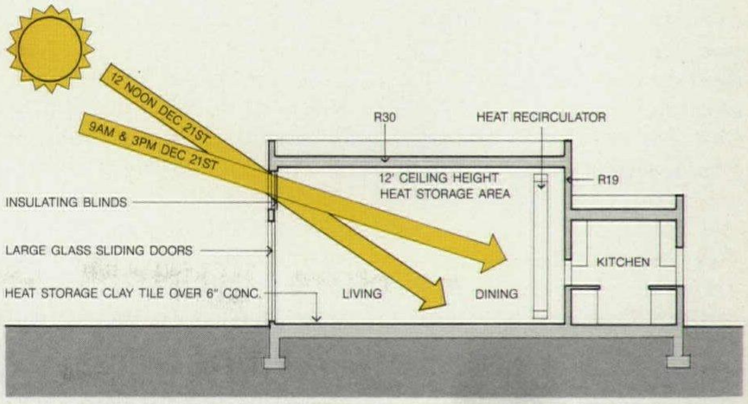
The units are arranged with back yards grouped together. These function as service zones between the kitchen and the garage, and are big enough for sitting or hanging out the wash. The residents of the four-group units can divide this central space as they wish since, although walls were planned for this area, it is unlikely that the village will receive funding to build them. In most cases, the families have already delineated their spaces with fences of some kind.

Data

Project: *Cabrillo Village Farmworkers Cooperative Housing, Saticoy, Ca.*
Architects: *John V. Mutlow of Mutlow Dimster Partnership, Los Angeles, Ca, in association with Barrio Planners, Inc.; John V. Mutlow, Frank Dimster, Frank Villalobos, Jose Jimenez, design team.*
Program: *rehabilitation of an older farmworkers' village and the addition of 35 new two-, three-, and four-bedroom quadruplex family units.*
Site: *a basically flat and relatively arid tract between a railway line and a river on two sides, and rock berms for storm protection on the other two.*
Structural system: *new units of reinforced concrete foundation and slab; wood stud walls and wood joist floors and roof.*
Major materials: *integral color stucco, gypsum board ceiling and partitions; carpet and red clay tile floors (see Building materials, p. 224).*
Mechanical system: *gas-fired forced-air unit; individual and central active solar domestic hot water systems of collectors and tanks. Passive system is a combination of unit orientation with south-facing clerestories and thick masonry floor slab for heat storage.*
Consultants: *Barrio Planners (under architects), landscape; Mutlow Dimster Partnership, interiors; Hitoshi Tatsugawa, structural; Kumar Patel & Associates, mechanical; Energy Management Consultants, Stanley Kiniston, solar.*
General contractor: *McGall Contractors.*
Costs: *$1,560,000; $35 per sq ft.*
Client: *Rodney Fernandez, executive director, Cabrillo Improvement Association.*
Photography: *Tim Street-Porter.*



NORTH UNIT



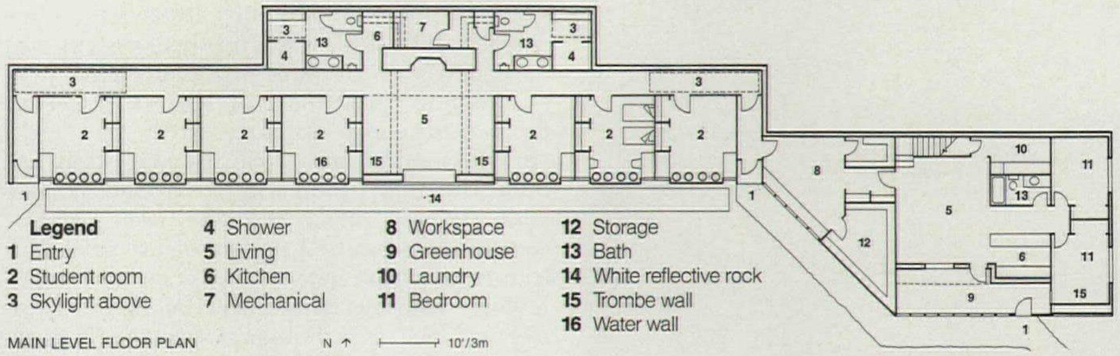
SOUTH UNIT

Sun-Up Dormitory, Carbondale, Co

Passive activism

Sally Woodbridge

Students at a Colorado school collaborated with teachers and architects to design and build a passive solar dormitory.



MAIN LEVEL FLOOR PLAN

Data

Project: *Sun-Up Dormitory, Colorado Rocky Mountain School, Carbondale, Co.*
Architects: *David Finholm, architect and designer; Tom Crews, architect in charge of production; Ronald Shore, solar building design; Doug Davis, hot-water collector design.*
Client: *Colorado Rocky Mountain School, Randolph R. Brown, headmaster, Carbondale, Co.*
Site: *former pasture land that was excavated to a depth of 4 ft, with resulting fill used to berm the building on three sides.*
Program: *a 5600-sq-ft student dormitory to house 14 students in 7 rooms, with a community living room and an adjoining faculty apartment.*
Structural system: *north retaining wall of reinforced concrete attached to glued-laminated post-and-beam; plywood roof deck with waterproof membrane; 18 in. of earth, and sod roof.*
Mechanical system: *wood-fired, hot-water boiler with baseboard radiators for back-up heating; photovoltaic-powered fans.*
Consultants: *Anderson & Hastings, mechanical; Paul Lappala, landscape.*
General contractor: *Floyd Diemoz.*
Cost: *$314,000; $56.12/sq ft.*
Photography: *Doug Lee, except as noted.*

Sally Woodbridge teaches architectural history, is co-author of several books on California architecture, and is a contributing editor to *Progressive Architecture.*

We have all seen movies about "how it was" homesteading in the West. The howling wind banks snow against the walls of the sturdy log house. The occupants feed their dwindling supply of wood to the stove and peer anxiously through the window at the white world outside. An updated scenario might feature the Sun-Up dormitory at the Colorado Rocky Mountain School near Carbondale. Snug in their earth-covered home, sealed with self-inflating curtains and Styrofoam window covers, the occupants smile warmly. Near the building is a large woodpile just about the same size as it was when they cut it in 1979, to fuel a back-up hot water system that has rarely been used.

The 5600-sq-ft building includes a virtual catalog of passive solar strategies: earth-berming, except for the south-facing wall; stacking baskets of rocks between the berm and the massive concrete wall; setting skylight monitors on the sod roof for direct gain in back (north) rooms; and providing Trombe and water storage walls, a passive collector for hot water, a solar greenhouse, and fans for heating and cooling, powered by a photovoltaic array.

These devices were not just ordered up out of a catalog and put together by a skilled crew for an uninvolved client. The whole process of design and construction was an educational experience for students in a school that emphasizes learning by doing.

When Ron Shore, a science teacher, became interested in energy conservation, he assigned his students appropriate tasks such as fitting existing buildings with weatherstripping, storm sash, and double doors. In 1976, students designed and built a passive solar greenhouse to supply fresh vegetables for the school year-round. Interest in energy conservation and alternative living modes grew apace with the need for more student housing. Soon Shore had his students designing prototype passive solar buildings, and he invited his friend, architect David Finholm, to lecture on energy-conscious design. When a $48,000 HUD grant came through for the school project, things got serious.

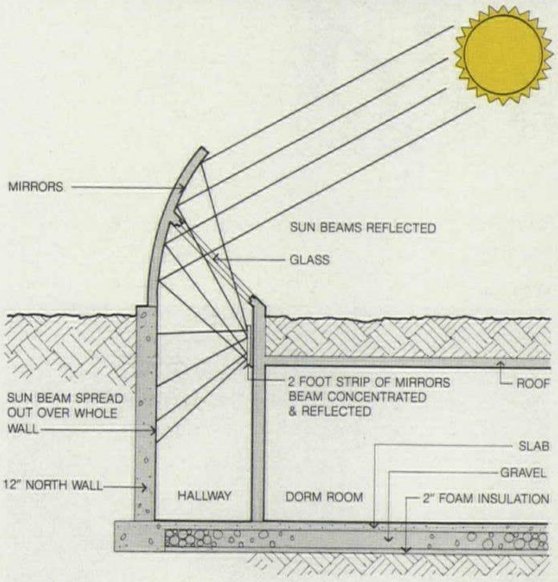
Having settled on a building to house 14 students with separate quarters for a faculty family, Shore and his students had to assess and quantify the energy needs and work up the program. Passive strategies were tested with small thermal models; social needs were charted with questionnaires circulated among the students. What emerged was a simple plan, with rooms arranged on either side of a common living room backed up by a kitchen and bathrooms. The two-story faculty apartment was offset from the dorm space for privacy, but connected to it through a work and storage space. A solar greenhouse on the front of the faculty quarters provides a thermal buffer in the coldest months and a place where freeze-resistant crops are grown.

The basic structure is post-and-beam, with the glued-laminated members attached to the reinforced concrete back wall. A plywood deck with a waterproof membrane holds an 18-in. sod roof. The roof monitors, lined with specular aluminum, reflect the sun's rays onto strips of mirrors, from which they are spread along the masonry wall. This system provides direct gain for all rooms. Sun also shines through the glazed south wall onto the Trombe walls, the plastic water storage cylinders, and the concrete floor slab that rests on gravel fill and 2 in. of insulation.

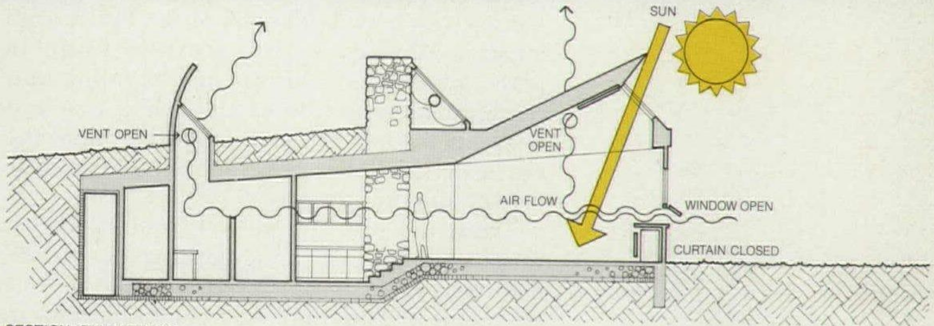
Ron Shore devised a curtain made of layers of thin Mylar that respond to rising hot air by inflating and storing the air for insulation. The curtain is automated by a bank of photovoltaic cells mounted in an adjustable collector that sits in front of the building. Since little power is required to move the curtains, and operation during the day corresponds to

Artog

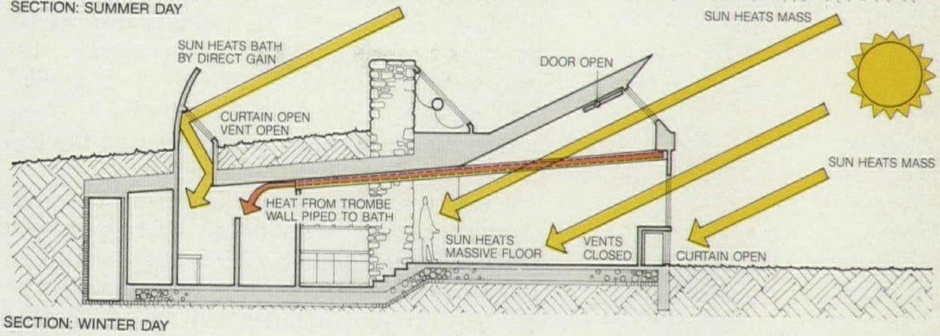
Left: A bank of photovoltaic cells, mounted in an adjustable collector, powers insulating curtains and air-circulating fans. Below: Trombe wall under construction. Bottom center: Plastic cylinders filled with water store heat during the day. Bottom right: Light reflected in roof monitor bounces onto mirror strips and masonry wall.



SECTION A



SECTION: SUMMER DAY



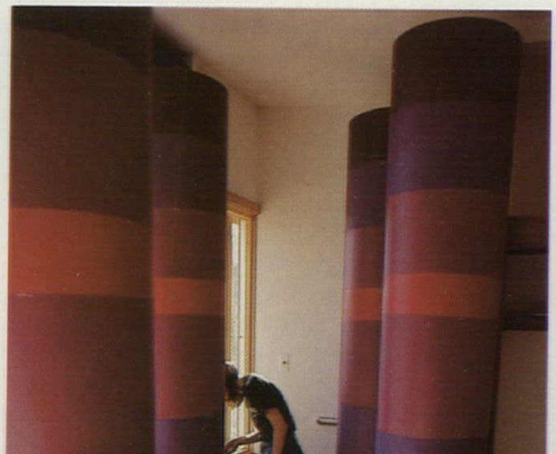
SECTION: WINTER DAY

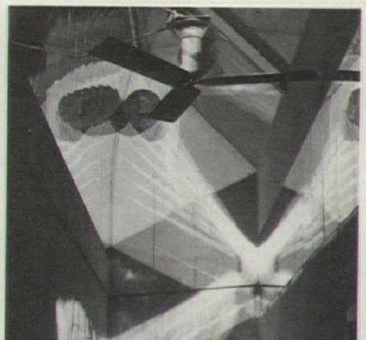
times of battery charging, the two systems are complementary. The cost of the photovoltaic system increased the total cost of the movable insulation by $1.42 per sq ft to $8.92 per sq ft—reasonable, compared with the costs of other available systems. The photovoltaic array also powers fans that carry heat from the Trombe walls through air ducts to the kitchen and bathrooms.

During a winter day, openings are uncovered, and the insulation curtains are raised to allow heat gain. At night, the inside vents are opened, and the collected warmth flows through the interior. In summer, the process is reversed. Insulation curtains prevent direct gain during the day, and the building opens at night to dump excess heat.

Plans for wind-powered electricity were scrapped for lack of sufficiently strong winds; the 32-volt d.c. system is now hooked up to the public utility system.

Sun-Up's success over the past two years has prompted the school administration to plan similar construction this summer. Sadly, Ron Shore, the teacher who started it all, was killed in a sailing accident. It would be hard to imagine a more fitting monument to his energetic spirit. □





South Central Bell, Birmingham, Al

Southern Bell

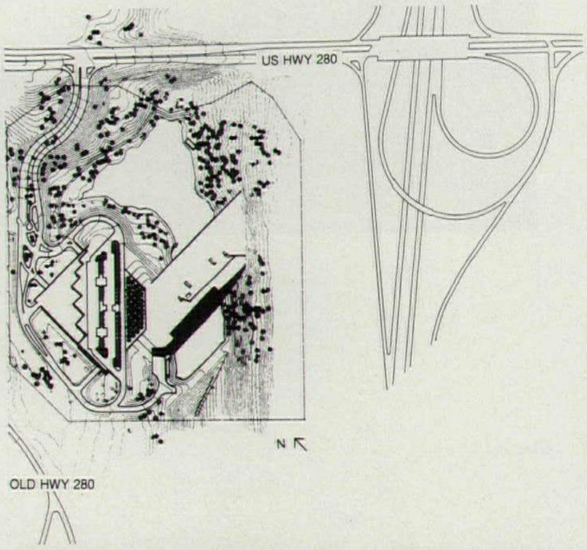
Given a thoughtful program and a beautiful site, the architects have responded with a building that is at once forceful and fitting, using site resources to greatest energy advantage.

A passerby on Highway 280 could easily miss a major new landmark outside of Birmingham. This is partially because the Alabama Operations Center (AOC) of South Central Bell Telephone is roughly 100 ft below the highway, but that is not the only reason. The architects, Giattina & Partners, have sited the building superbly. The steeply pitched valley seems to swallow both ends of the long parallelogram that the office structure forms in plan. That is no illusion; the building *does* plunge headlong into earth at both east and west ends. And the earth from the hill to the east seems to flow across the roof and cascade off the northwest corner.

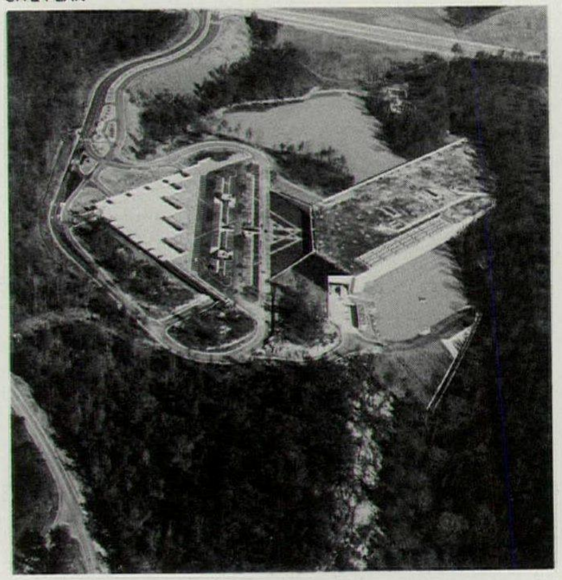
These are just the most obvious signs that this building is up to something out of the ordinary. The design is the result of one competition and the recipient of honors in another. In a limited competition among six Alabama finalists, the Giattina team was awarded the commission. In 1978, as an unbuilt design, it received an honorable mention in the respected Owens-Corning Energy Conservation Awards program.

All of this came about because the client proposed a very responsible set of program goals, and the architects deftly attained them. The program called for minimal alteration of the natural site qualities and specified that "energy conservation must be foremost . . ." in the building design. The 50-acre site is, indeed, endowed with great beauty, with its steep wooded slopes. It is not easy to tuck a 450,000-sq-ft building and 1500 parking spaces away in the woods, but the AOC is a minimal intrusion even now, having just opened. When the full effect of the extensive new planting takes hold—probably in three to five years—it is easy to predict that the compound will have an almost profound beauty. Planted in tall natural grasses, the whole roof will become a meadow, camouflaging what little is visible above roof level now—the skylights and solar collector arrays.

Even the exposed façades, while dramatic, are also simple and straightforward. Both north and south façades look out over water; the lake on the north and the pond on the south are joined by a large tunnel under the building. The façades, stepped inward top to bottom, are broad sweeping bands of precast concrete and reflective glazing bridging the valley. While the overhangs—11 ft for the roof and 6 ft at each floor—provide shading for south glazing, they are aesthetic touches on the north. Visitors enter from the third-level parking lot into a fan-shaped forecourt, planted with ordered rows of vertical trees. This experience will also be heightened as trees mature, although it is pleasant now.

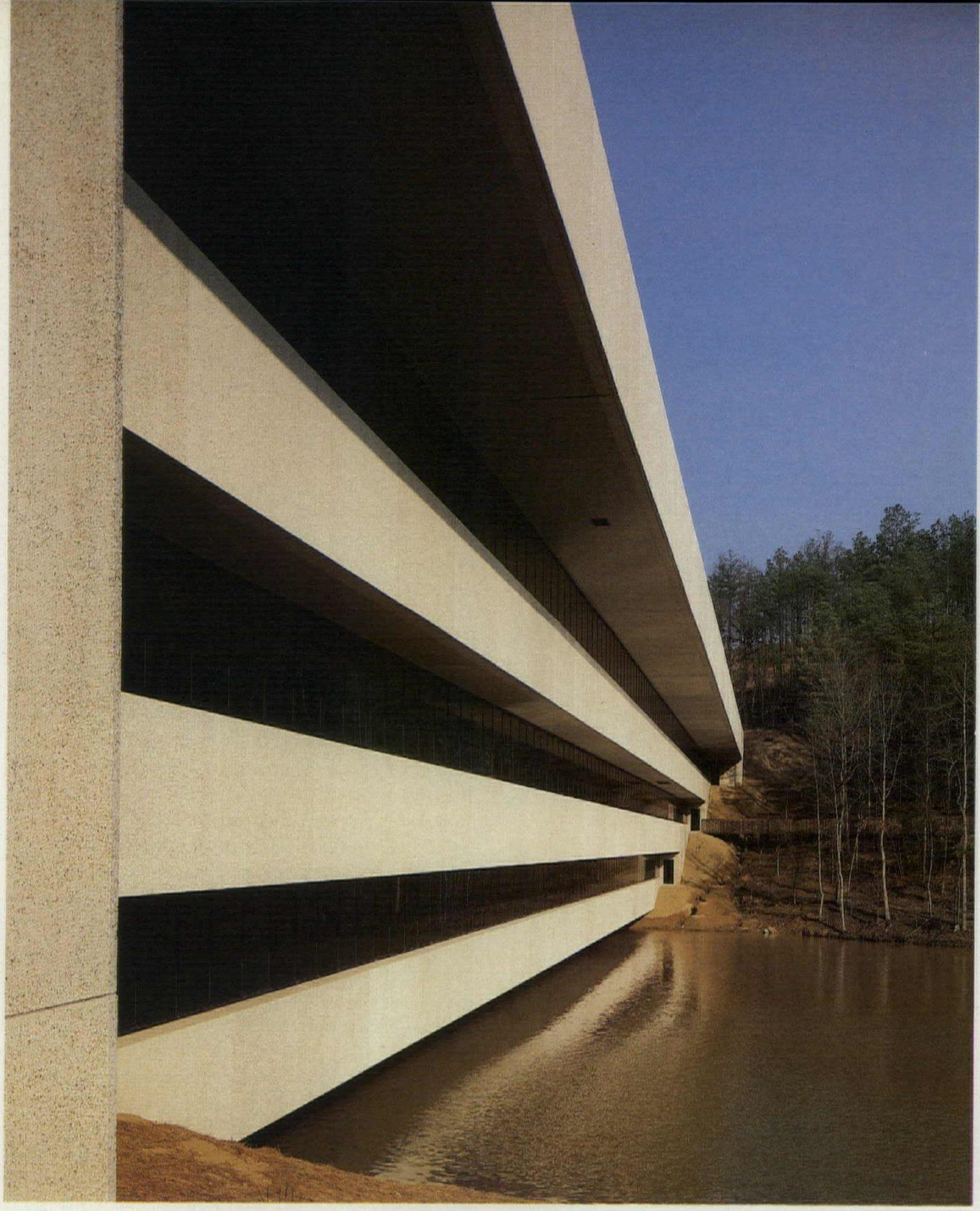


SITE PLAN

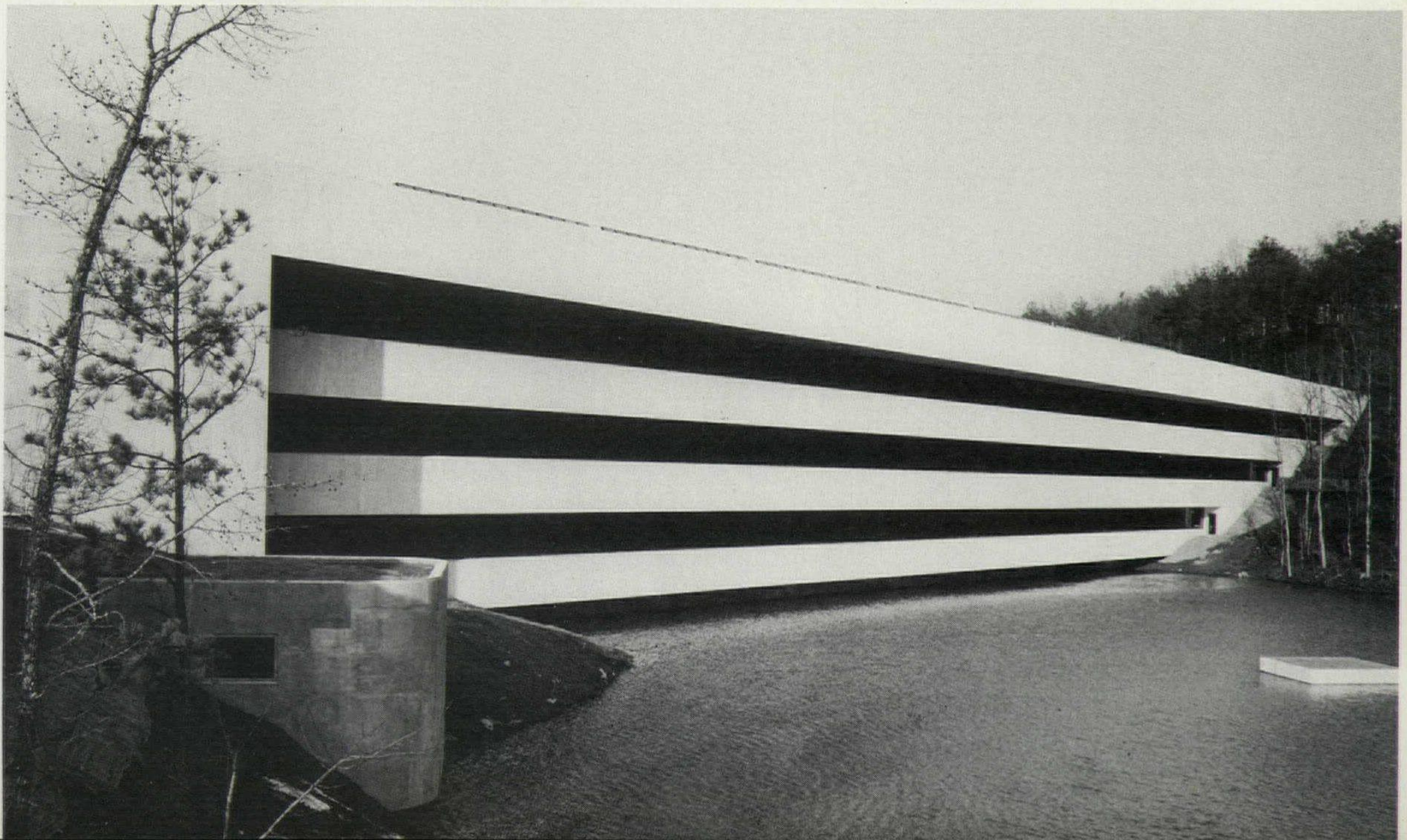


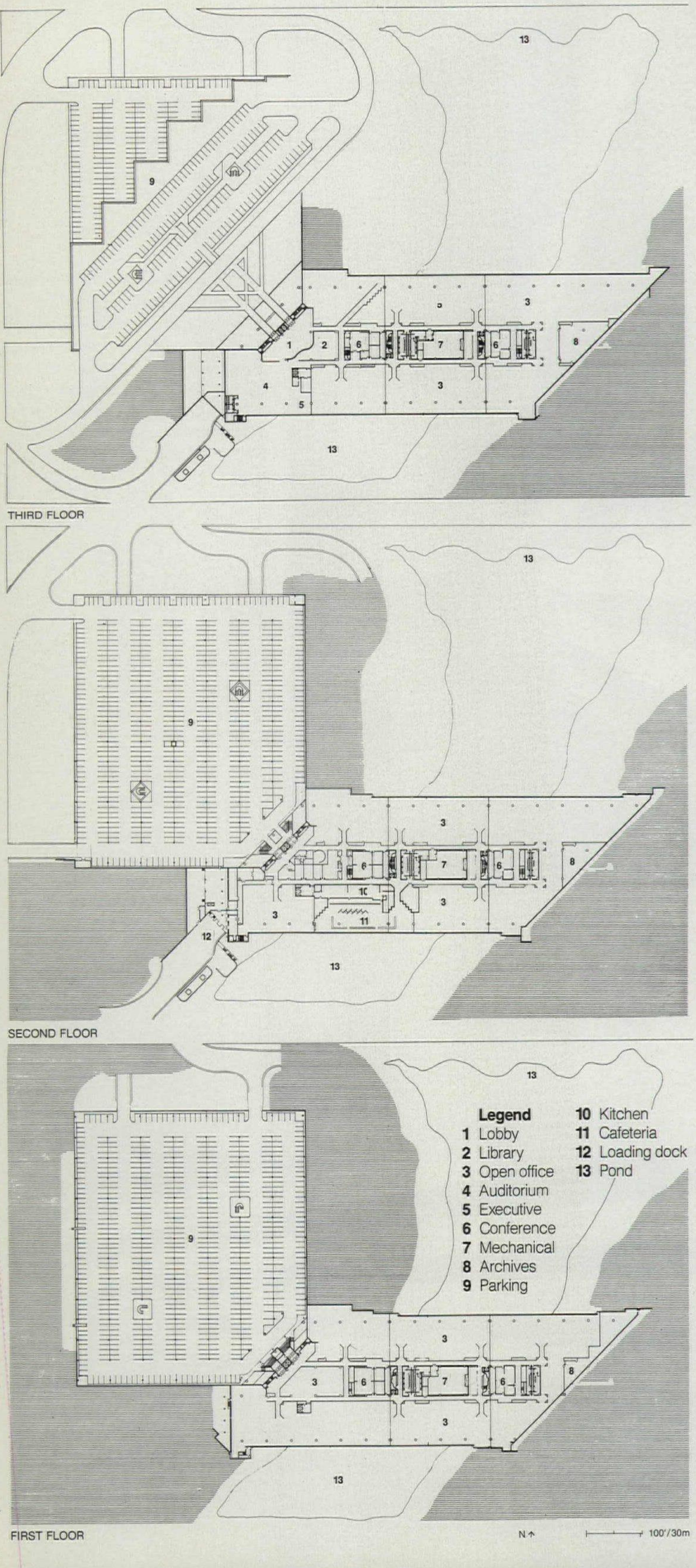
The elements

In energy terms, several of the items already mentioned play large roles in conditioning the building. The 6000 sq ft of solar collector area, not yet operational because of mechanical connection problems, will supplement space heating and domestic hot water requirements. Even without this assist, the annual use of heat is projected to be at a re-



On the south side of the building the cantilevered floors and recessed glazing provide shading and a fine view over the pond. The east end of the structure slices into the hill, which merges with and covers the roof, to form a new meadow (aerial view opposite).





spectable 70,000 Btu/sq ft/year. These results, factored into the accounting system for all Alabama buildings of South Central Bell—about 430 of them—has dropped the building energy ratio for the *state* by 11.5 percent, according to SCB's project manager H.C. Calloway.

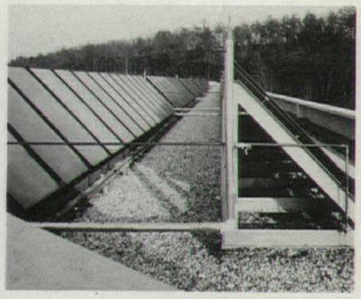
With lighting requirements down at approximately 1.8 watts/sq ft, architect Joseph Giattina feels that there are still areas that are overlighted. The heat goal for the building is 54,000 Btu/sq ft/year, which Giattina and Calloway agree is reachable. In fact, Calloway predicts that the building will settle in at 50,000 Btu/sq ft/year.

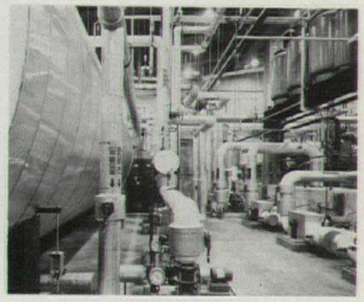
Part of the multifaceted energy solution is working very well. The pond, more than just a nice amenity, is an active part of the system. Even on cold days the water low in the pond is usually above 45 F. It is pumped through two centrifugal heat recovery chillers, said to be cascaded because the first takes heat from the pond water, and passes that heat to the second. The pond water is returned to the lake on the north side of the building. Emerging from the second heat recovery unit, the water is now at 125 F; it goes to a storage tank and is circulated to perimeter coils, from which a variable volume air system takes over. On a chill day this past February, the building was functioning entirely on the pond heat recovery system for the first time. In fact, Calloway says that because of the effective insulation, the electric boiler works only in the early morning to take the night chill off the building. After that, heat from the pond, lights, and people takes over.

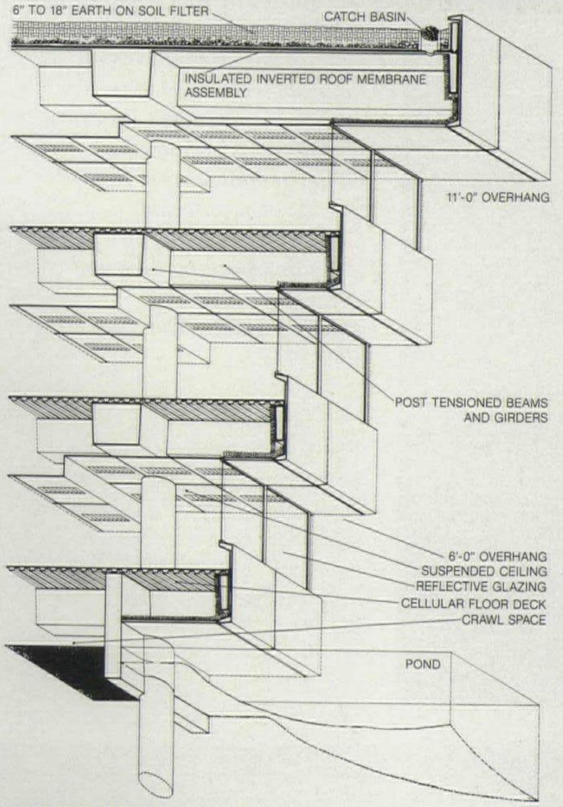
Pond water can also work in the reverse, passing through a chiller condenser in warm weather, in addition to supplying the lawn irrigation system directly. Rejected heat from chillers and other heat sources is reclaimed and stored, completing the system. With the earth-protected roof, buried east and west walls, insulation, shading, solar collectors, and pond system, the building is almost a textbook. Although nothing is made of passive solar in the operations center, it is unlikely that occupants of an office building would be dependable parts of any system that required human participation. There are, of course, more complex pond usage schemes, but this one seems to work for this application.

Views from the interior are very pleasant, and will only get better. On the south side, occupants get an added kinetic effect—rippling light patterns on the soffit and ceiling, reflections from the pond. Cross aisles are kept clear, allowing clear views between north and south glazing. Most office spaces are open, reusing much of the company's earlier furnishings. These have been organized into an informal "system" with new movable screen partitions. While less than opulent, it is a pleasant environment.

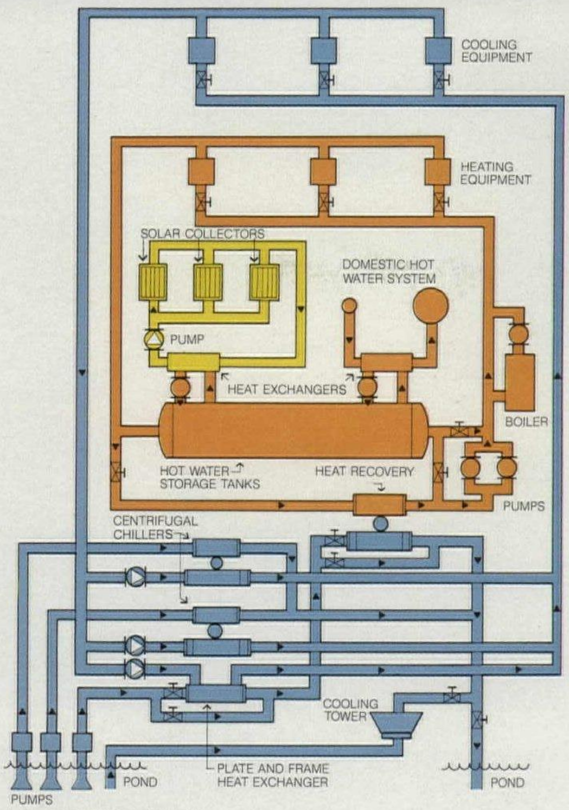
Above and below the office spaces (left), the energy hardware is inconspicuous. The executive area, as in the auditorium, is quite serene.







ISOMETRIC SECTION



HVAC SYSTEM SCHEMATIC

Data

Project: *Alabama Operations Center, South Central Bell Telephone Company, Birmingham.*
Architects: *Giattina & Partners Architects, Inc.; Joseph P. Giattina, Jr., principal in charge; Oren C. Smith and Marzette Fisher, project architects.*
Client: *South Central Bell.*
Site: *heavily wooded 50-acre tract in a previously undeveloped suburban area.*
[Data continued overleaf]

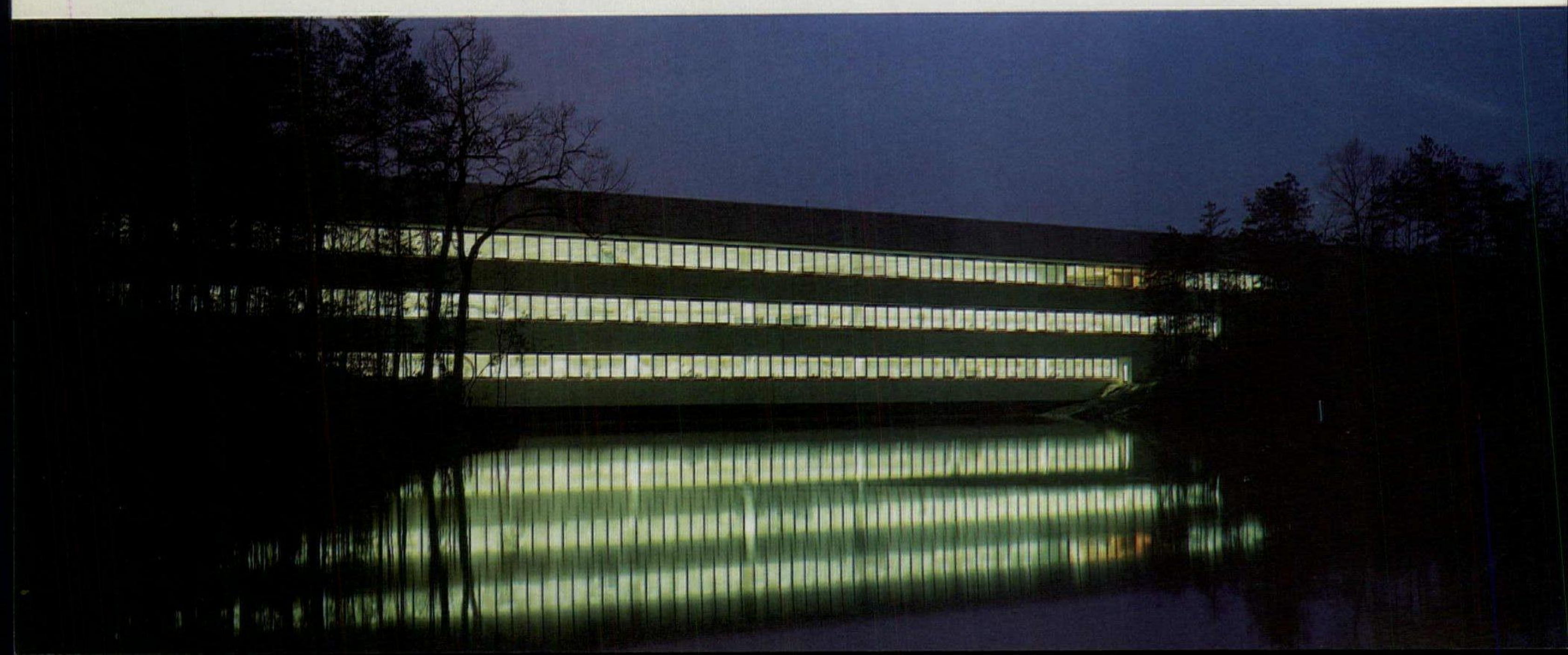
Some areas sparkle. The entry forecourt is a delight, and it leads to a spacious lobby. The lobby, unattended on that February day, is of refined materials: granite, metal grid ceiling with interesting lighting, and precast concrete with a soft-looking corduroy texture. There is a fine medium-sized auditorium and an executive suite and board room that are understated, serene, and pleasant.

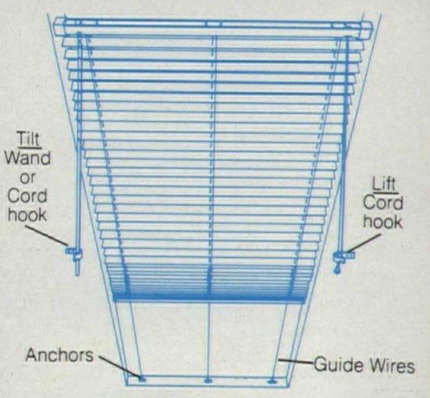
But this building's story is in its remarkable solution to those program requirements we began with. It is strong formal architecture very skillfully integrated with nature and its energy role. It is delightful to be around and will simply become more so. The architects and their clients are justifiably proud.
[Jim Murphy]

Data cont. from page 165

Program: *develop a 450,000-sq-ft headquarters building and parking for 1500 cars; do minimal damage to surrounding site, and make maximum use of energy-conserving measures.*
Structural system: *site-cast beams and girders, post-tensioned or conventionally reinforced. Cellular steel deck. Walls below grade typically 18" reinforced concrete, supported by concrete counterforts with drilled rock anchors.*
Mechanical system: *centrifugal chillers; cascaded centrifugal heat recovery chillers used to remove heat from pond water; 6000-sq-ft solar collector array; variable volume air system; backup boiler.*
Major materials: *(see Building materials, p. 224).*
Consultants: *structural, Hudson, Ball, Marlin & Associates; electrical, Cater & Parks; mechanical, Miller & Weaver; interior, Hatcher Design Associates; landscape, Charles W. Greiner & Associates.*
General contractor: *Blount Brothers Corporation.*
Costs: *$42 million; $67 per sq ft excluding parking deck and sitework.*
Photography: *Wolfgang Hoyt ©ESTO.*

Entry from parking is across bridges (top left); from upper level, visitors enter a spacious reception area (center left). From the north side at night, a luminous bridge spans lake.





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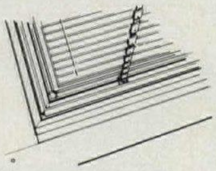

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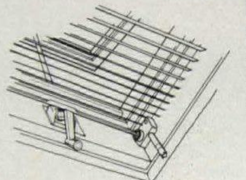

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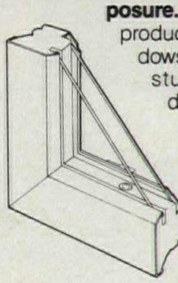

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INTERFACE
1

Writing consultants' specifications

Walter Rosenfeld

Increasing the complexity and sophistication of a building design often guarantees the participation of a consultant. The following article reviews the generic problem of incorporating specs from all types of consultants, including energy-conscious ones.

Walter Rosenfeld, AIA, CSI, is Managing Director for Professional and Technical Services at The Architects Collaborative in Cambridge, Ma.

One of the specifier's major responsibilities is to organize the project manual for each building. In addition to working out a table of contents, he needs to establish details of the document's format, including page layout, job identification, paragraph numbering system, and type face, among others. Decisions, not necessarily difficult ones (Do we underline? What words are capitalized?), have to be made, whether or not the CSI section format is used, and these decisions have to be communicated to everyone involved. A look at entries in the annual CSI specifications competition indicates that there are still many ways of putting together a project manual and that each way has its own rules.

More important, the specifier must coordinate the work of all trades and establish the responsibilities of each within a common contractual framework. Which trade will provide access panels for mechanical equipment? In what form does the architect want shop drawings submitted? Who is responsible for temporary electricity? Such things must be determined at an early stage and written into the different sections to which they apply.

But in actual practice, many sections of a typical project manual are written by people other than the specifier-in-charge. Consultants to the architect may prepare as many as half the pages of the manual (or more) and may be responsible for specifying more than half the cost of the work. As a result, the specifier always faces the problem of how to get consultants to write their sections so that the desired final product is achieved: a project manual consistent in form and content, uniform in appearance, and without conflict in instructions to its users. Ideally, all parts of the document should fit together as though they were written by one person and typed on one typewriter.

Against this need for consistency and uniformity is the consultants' tendency to have different writing styles, organizational notions, paragraphing systems, and technical requirements for submissions, and their natural desire to do all of their specifications the same way on every job. Consultants are often tempted, too, to use their last specification as a basic document, whatever that job was, however it was bid, wherever located, and whoever the client or architect. Or they may want to use their computer-based master sections, even though the format may be totally different and difficult to adapt.

One way specifiers can deal with these problems is to write (and type) consultants' specification sections for them, at least the first few pages (part I of the 3-part section format) in draft form, and to turn these pages over to the consultant along with a brief memo on the style rules to be observed in the remainder of the sections. These documents can be distributed at an early team meeting or by mail, but persistent follow-up is usually required for enforcement. If the architect has computer capability, this part of each consultant's section can be prepared by editing existing masters.

There is no real question here of taking on the consultant's responsibility or liability, since no technical specifications are written for him; only procedural and contractual items are dealt with, and the consultant has the opportunity to review and revise these as may be required. But once the consultant receives this draft, many essential decisions are clear, and he can proceed to write his technical specifications directly, having in front of him a good example of the required format, the chosen numbering system, the correct page layout, the applicable job identification, and even the selected type face. The goal of visual uniformity is much closer.

With this sample in hand, the consultant is also alerted to such things as related work under other sections (for coordination); any limitations of scope; and the special clauses often required by institutional owners or governmental funding agencies. References to the general conditions or general requirements of Division 1, which incorporate a unified system of dealing with shop drawings, record drawings, submittals, substitutions, project closeout, and so on, are established, and the need for each consultant to repeat them, often with unwelcome variations, is eliminated. Consequently, the goal of consistent procedure and coordinated work is more easily achievable.

Since by this method all the basic coordinating information for each consultant's trade is concisely conveyed (the medium being part of the message), a more consistent and complete project manual should result, no matter who writes a particular section. Confusion during bidding should therefore be significantly reduced and avoidable conflicts prevented as the project moves on into construction. □

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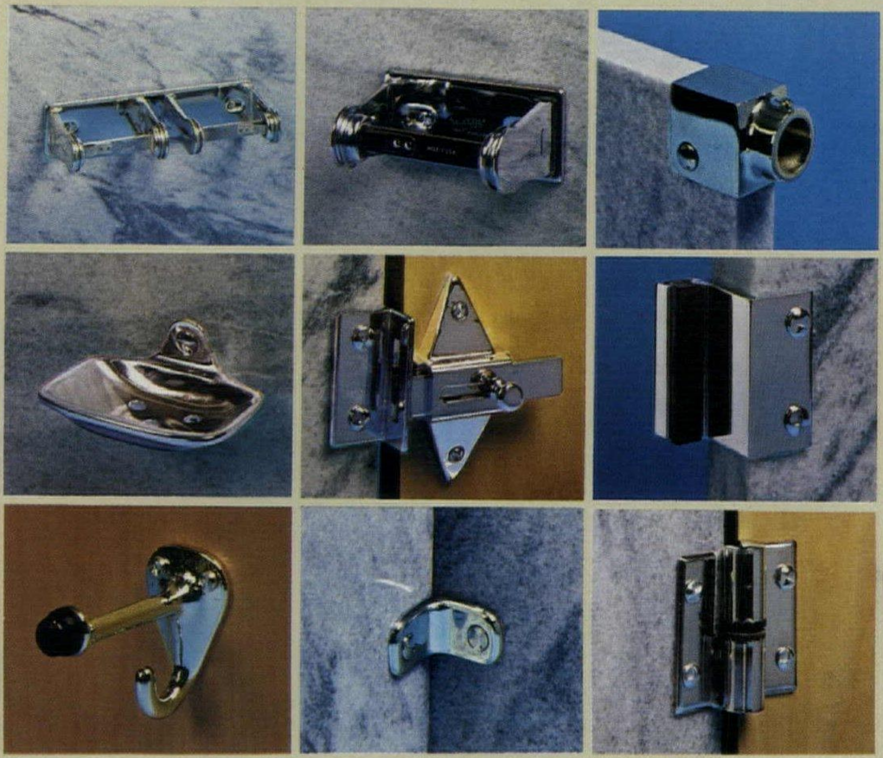

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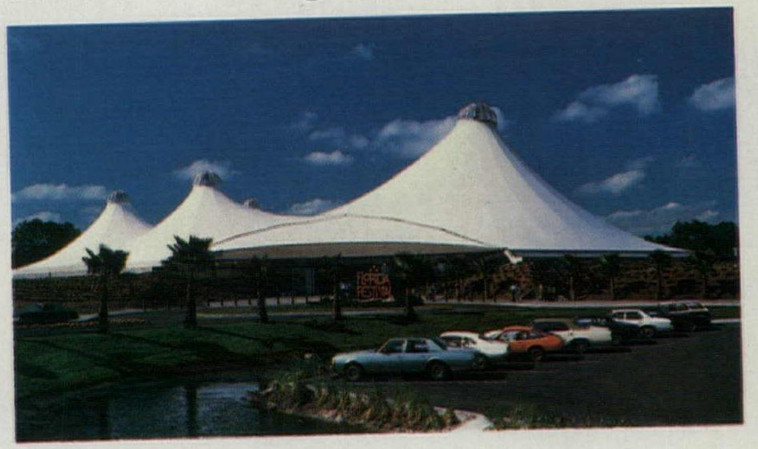

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HAUSERMAN

Uniform standards for wind energy systems

Norman Coplan

Despite their potential as an alternative energy source, wind conversion systems create problems that need to be addressed by building codes and zoning laws.

Much concern has been manifested with regard to legal impediments to the rapid development of solar systems as an alternative source of energy. Many of these legal problems relate to the issue of how to assure access to sunlight in the context of our present zoning statutes and building codes. Of perhaps even more complexity, however, are the legal barriers to the development of wind energy systems as an alternative source of energy. The building codes and zoning statutes prevalent throughout the United States are not necessarily conducive to that development. Further, as with any new product or process, the designers and/or manufacturers of wind energy conversion systems will be subject to legal responsibilities and liabilities, often not well defined, that may be of significant concern.

The small and isolated windmill occasionally seen in rural areas has created very few legal difficulties. Consequently, wind energy has not been the subject in local jurisdictions of very much legislative or judicial attention. This does not mean that the developer of wind energy machines has been given a free hand, but rather that their potential use has not as yet caused legislators to be concerned about the problems which may be engendered. These problems involve the height of the structures or towers which may be used to develop wind energy, noise engendered by wind machines, their possible effect on climate, the creation of "visual pollution," interference with signal reflections of television, the effect of such machines on birds, the possible interference with navigation if placed in oceans or lakes, the dangers of the use of large blades in populated areas, etc. The advantages of a nonpolluting energy source such as wind energy, however, would appear to require increased attention and concentration on how these problems may be resolved.

Modification of existing laws and development of advanced design are both necessary to promote the use of wind energy. If, for example, a tall structure can cause accelerated wind speeds at ground level thereby subjecting persons to personal injury or property damage, the potentiality of liability would be an inhibiting factor in the development of the use of wind energy. Similarly, if a wind energy conversion system violates the peaceful enjoyment of property by a neighboring property owner, his normal reaction would be to seek to enjoin the use of such a system as a public nuisance. Appropriate design would seem to be the only answer to eliminate such retardants to the development of the use of wind energy.

Independent of progress in design, however, modification of zoning laws, building codes, and other statutes for the purpose of facilitating the use of available technology in this area could go a long way to encourage the use of wind as an alternative source of energy. For example, the height of structures is generally regulated by local zoning restriction and may be further affected by state or federal laws. These zoning laws govern not only height, but land coverage, set-back and sometimes even aesthetic values. Height limits can prevent the use of wind machines on existing buildings, prohibit towers, prevent more than one structure on a particular plot of land, or require placement so as to make utilization of the wind machine impractical. Although these barriers could be overcome by securing a variance, this is difficult to obtain, particularly if the structure is aesthetically unpleasing. Here again, design becomes particularly important, as a wind system can be viewed as either a visual pollutant or a picturesque addition to the landscape. In any event, the restrictions on height reflected in our zoning ordinances never contemplated an energy shortage that makes the availability of alternative sources imperative.

Another barrier to the development of wind energy are building codes that prevent technological innovation. Building codes greatly differ, and in the absence of a uniform standard, the development of wind machines is severely handicapped. Perhaps an even greater inhibition to the development of wind energy is the uncertain potential liability of designers and manufacturers utilizing an innovative technology without any established guidelines or standards as to what constitutes a minimum standard of safety. In determining whether a product is unreasonably dangerous, courts use different tests depending upon the jurisdiction. Some courts, for the purpose of determining whether there is a design defect, use the test of feasibility, determined by measuring the likelihood of harm against the cost of prevention. Other courts use the "consumer expectation test." Liability is found if the product failed to perform as safely as an ordinary consumer would expect. In the third test, known as the "unreasonable danger test," the court balances several criteria including the desirability and use of the product, the likelihood of injury, the obviousness of the danger, the ability to eliminate the danger without impairing the usefulness of the product or making it unduly costly, and the availability of other products to meet the same needs. Because of the great need for alternative sources of energy and the innovativeness of wind energy conversion systems, none of these tests may be appropriate.

Perhaps the only answer to allay fears of potential liability and at the same time protect the public lies in continuing efforts to establish and enforce uniform and adequate standards that appropriately address the performance, safety, and location of wind energy conversion systems, but do not discourage their use. □

The Second National

Passive Solar Design Competition

Sponsored by

Passive Systems Division American Section International Solar Energy Society (AS/ISES)

Progressive Architecture

The Passive Solar Industries Council

in conjunction with

The Seventh National Passive Solar Conference and Exhibition Aug. 28–Sept. 2, 1982 Knoxville, TN

The Passive Solar Design Competitions of the Passive Systems Division, AS/ISES have been established for the purpose of providing recognition of outstanding design of passive solar/energy-conserving building with national or regional significance. The competitions are held to promote excellence in the synthesis of architecture and engineering.

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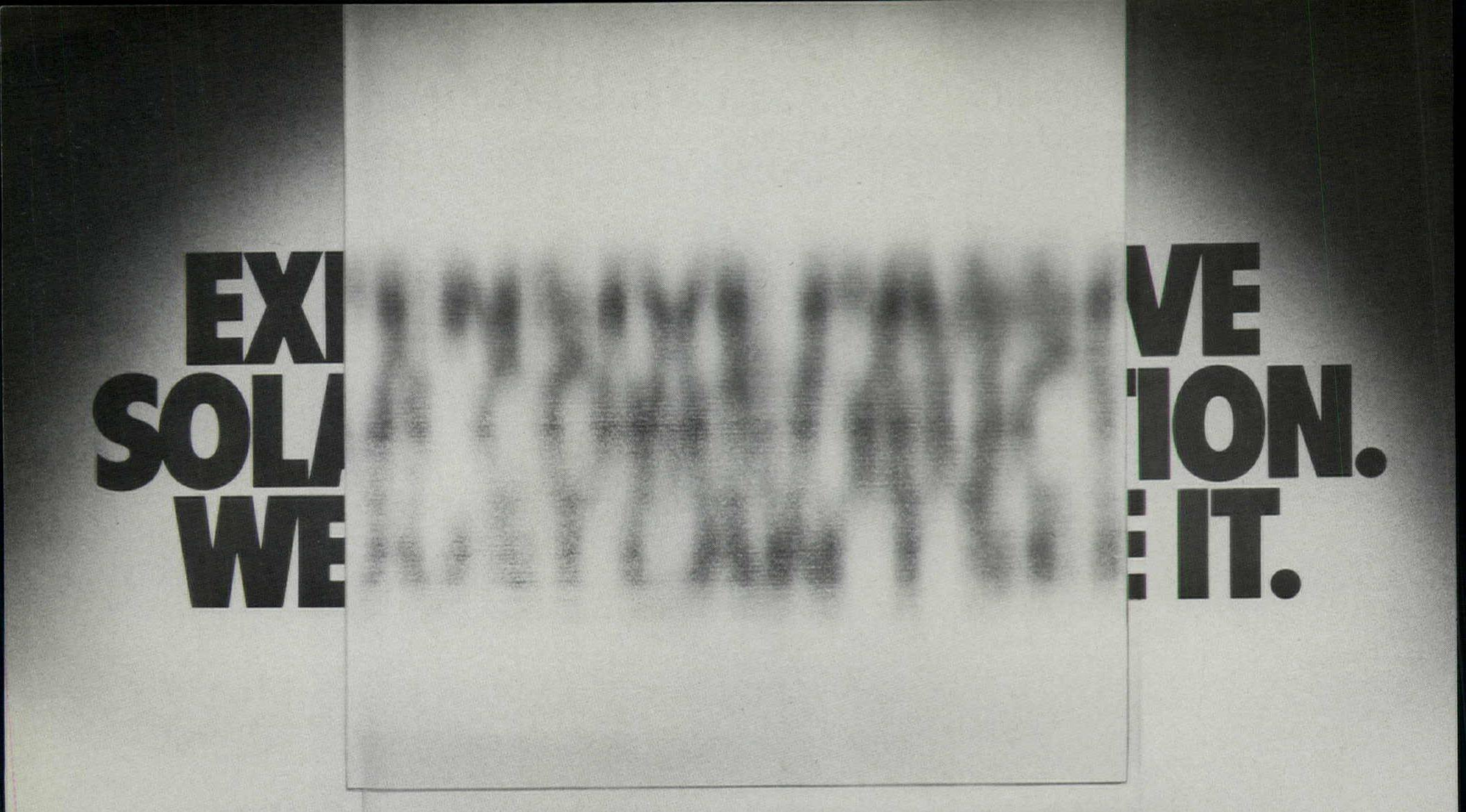
Edward Mazria, AIA, Edward Mazria & Associates, Albuquerque
William Morgan, FAIA, William Morgan Architects, Jacksonville
Susan Nichols, Communico, Santa Fe
Richard Rush, AIA, Progressive Architecture, Stamford, Ct.

Deadline for Registration: June 1, 1982
Deadline for Submissions: July 9, 1982

For **Competition** details and registration form, contact:
Design Competition — NESEA
Box 778
Brattleboro, VT 05301
802 254-2386



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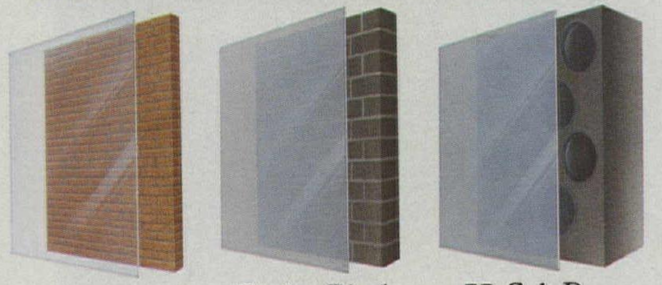

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ISES: The renewable challenge

The Renewable Challenge

Solar Technologies Conference and International Exposition

June 1-5, 1982 Houston, Texas

Each era brings a new set of challenges, and these challenges present the potential for both pitfalls and opportunities. The rise of solar energy in the 1970s, as a practical solution for pressing energy problems, gave promise to new patterns of energy use, use of energy that was both based on renewable resources and environmentally sound.

Today, the renewable energy community that grew and gave leadership during the last dynamic decade is experiencing even more tumultuous change. Dramatic shifts in federal government programs and policies have cast a markedly different character on the face of the solar environment. Diminished research and development programs have put new burdens on larger corporations, entrepreneurial enterprises, and institutions alike. Continuing uncertainty about conventional energy supplies and the ever-present possibility of disruptions at any time mandate more rational energy policies. In the marketplace, persistent and perniciously high interest rates inhibit both solar industry growth and consumer demand. Present realities may appear to have cast a shadow on the expectation of many for a solar future. But progress continues, and the American Section of the International Solar Energy Society is meeting these challenges head on, as they have so many times before.

The urgency of forging a solar future remains high. The challenge to craft a new agenda, based on present-day realities, has never been greater. As the annual meeting and exposition of the Society, "The Renewable Challenge" will serve as a timely forum to build the solar agenda. Solar professionals and concerned energy consumers will meet in Houston to address these and other concerns, as well as share information, opinion, and experience. "The Renewable Challenge" will be the single most important solar event of the year. And it will serve all participants as a fertile marketplace for the exchange of ideas and the conduct of profitable business.

"The Renewable Challenge" conference agenda is comprehensive, and this year it highlights four critical issues of our time: International Renewable Energy Development, Advanced Design & Technology, The Solar Market, and Solar & the Utilities. Featured speakers include internationally recognized authorities in their fields. Daily plenary session speakers include: Dr. Ishrat H. Usmani, Senior Interregional Energy Advisor to the United Nations; Francis de Winter, president of Atlas Corporation and 1982 chairman of the Society; Dr. Paul MacCready, president of AeroVironment and designer of The Solar Challenger; Ronald J. Arnault, president of ARCO Solar; Ralph J. Johnson, president of National Association of Homebuilders Research Foundation; R. Nicholas Loope, president of Solar Energy Industries Association; Dr. Jack Chaddock, president of the American Society of Heating, Refrigeration and Air Conditioning Engineers; Dr. Paul Maycock, author of Photovoltaics; Donald Watson, noted architect and designer of more than 100 solar buildings; Glen Bjorklund, vice president of Southern California Edison; others yet to be announced.

The bread and butter of the Society's annual meeting is again represented by a full schedule of special-topic and technical sessions ranging from photovoltaics and thermochemical conversion to Trombe walls and daylighting concepts. More than 200 papers have been scheduled for presentation during the technical sessions, and all aspects of both social and technological progress in solar energy will be explored.

"The Renewable Challenge" also offers a wide range of special events and programs under sponsorship of highly qualified organizations. These include an Energy Design Charrette for design team competition during the conference; the Renewable Energy Educators Forum; the second Solar Energy Information Symposium; a Renewable Resource Media Festival; and an extensive Renewable Resource Center. Separate preconference workshops, striking a balance between "How To" and "What's New," have been scheduled, ranging from Biofuels to Earth-Sheltered Buildings.

The American Section of the International Solar Energy Society's Exposition promises to be the largest display ever of solar design and engineering services, equipment, and technology. The unprecedented endorsement by the U.S. Department of Commerce's Foreign Buyers Program will ensure a flow of visitors and buyers from abroad. The exposition has already enrolled more than 120 U.S. companies and will be open throughout the conference week. Companies and organizations wishing more information on the exposition should contact Jeff Wolff, TMAC, 600 Beach St., San Francisco, Ca 98109 (800) 227-3477 or (415) 474-3000.

With incisive plenaries, provocative special events, and informative panels and technical sessions, "The Renewable Challenge" will present a comprehensive, realistic analysis of the world of renewable resources today, and a thought-provoking look into the future.

To request "The Renewable Challenge" conference brochure, call toll-free (800) 531-5255, Ext. 817; in Texas (800) 252-9146, Ext. 817. Or write: The Renewable Challenge, AS/ISES, R.I.A.T., U.S. Highway 190 West, Killeen, Tx 76541.

The Renewable Challenge

Solar Technologies Conference and International Exposition

June 1-5, 1982 Houston, Texas

Conference Program

Monday, May 31, 1982

Welcome Reception
7:00

Tuesday, June 1, 1982

Plenary: International Renewable Energy Development
12:30–2:00

Panels:
2:15–3:35

The International Market
Passive Solar Commercial Buildings
Agricultural Applications of Solar Energy
Wind Energy
International Concepts in Design

Technical Session:
2:15–3:45

Design Methods & Controls for Active Systems
Optimal operation of solar and off-peak load managed heating and cooling systems.
Instrumentation and data acquisition system for solar heating systems.
An interactive solar design computer program for architects.
Development of an analytic tool to determine the effects of solar and energy management systems on utility demand curves.
Optimization of a solar industrial process steam system by considering maximum fluid temperature and system present worth.
A simple method to calculate yearly solar fraction of space heating systems.

Technical Sessions:
4:00–5:30

International Markets
Opportunities for nonconventional energy applications in Central America.
Markets for conservation and renewable energy in the Caribbean.
Assessment of solar energy as an alternative energy source for Panama.
California: a preview of the future of solar markets.
Costs and market potentials of solar technologies in New York State.
Assessment of buildings solar market barriers to commercialization.
Surprising aspects of marketing energy conservation in Mexico.

Passive Solar Commercial Buildings
Passive solar concepts for multistory apartment buildings.
The Gulf Building: The most energy efficient office building in the Rocky Mountain region.
Passive solar and hybrid manufactured building systems—precast concrete applications: The Spancrete Project.

Agricultural Applications of Solar Energy
Corn drying bins housed in solar buildings.
A modular commercial solar food dryer: testing and design.
Solar fruit drying in Egypt.
Thermal performance monitoring of passive solar greenhouses in the solar utilization, economic development and employment.
Effectiveness of low-emissivity films for reducing energy consumption in greenhouses.
Development of a solar-powered direct-acting organic Rankine irrigation pump.

Wind Energy Systems
Wind farm development: a case study of land use and environmental regulations.
Costs and market potentials of WECS in New York State.
Integration of wind and solar technologies in electric utility grids.
A practical use of wind energy.
Use of wind power to assist in stripper oil well pumping.
An analysis of SWECS/mechanical heating systems.
Wind energy battery storage research in Hawaii.

Energy and New Aesthetics
Solar and architecture: a new alloy.
Low energy community design and development project.
Solar vandalism.
The oasis myth—organic models, available technology, and a desert solar habitat.
Design of passive solar commercial buildings—in retrospect.

Evacuated and Line Focus Collectors
Solar evacuated collector performance with black fluid.
1.5xCPC type collector with evacuated tube of the fin type: design and performance.
Performance testing of a panel of evacuated tubes with integrated CPC.
Correlation of top loss coefficient for CPC collectors.
Elastically deformed linear focusing solar collector.
Design and performance of a linear Fresnel concentrating PV/thermal collector.

International Dinner
8:00–9:30

Wednesday, June 2, 1982

Plenary: Advanced Design & Technology

Panels:
10:30–12:00

Daylighting
The Solar Curriculum
Solar Energy & Fossil Fuels
Desiccant Cooling & Dehumidification

Technical Sessions:
10:30–12:00

Design Planning I
Design procedures for energy optimization and evaluation of renewable resources in new buildings.
Solar: a building energy design program.
An energy conservation opportunity analysis with microcomputers.
A graphical energy analysis design tool for large buildings using the microcomputer.
Microcomputers and energy analysis.
Hourly solar radiation and weather data for microcomputers.
Building the solar and energy-conserving home: the energy mortgage value design tools.

Solar Radiation
Atmospheric transmission model for a solar beam propagating between a heliostat and a receiver.
Diffuse band correction factors for short time intervals.
Relative validity of SOLMET historical solar data.
ASHRAE clear sky irradiance and the parameterization models.
Diffuse and global solar spectral irradiance under cloudless skies.
Measurements of atmospheric turbidity, urban air pollution parameters, and effects of insolation in San Antonio, Tx.

Photochemical and Thermochemical Conversion
Artificial photosynthesis.
Luminescent solar collectors.
Thermochemical processes for solar hydrogen production.
Biomass radiant flash pyrolysis in a spouted bed reactor.

Technical Sessions:
2:00–3:30

Design Planning II
Solar-ray solar design synthesis.
Reduction of building first costs through energy design.
Energy-efficient daylighting design for a Pacific Northwest office building.
Active and passive feasibility study.
100 percent energy-independent commercial building utilizing solar and wind energy.

Passive Solar Subsystems and Components
Controlled solar energy utilization with windows.
Daylighting design and its economic implications in commercial buildings.
Heating season thermal performance of the Brookhaven House.
Report on tests of a passive phase-change solar diode for space heating.
Earth-sheltered housing in the South Central United States.
Integration of passive details and systems.
Invention disclosure: modular passive solar walls with swivel types of insulation systems.

University Physics Education and Curricula in Solar Energy
Advanced Photovoltaic Research and Development
An overview of advanced research and development activities.
Recent developments in amorphous silicon solar cells.
Photoelectrochemical storage systems.
Advanced silicon sheet growth techniques.
Research on thin film copper indium selenide/cadmium sulfide solar cells.
Progress in new high efficiency photovoltaic concepts.

Green Plants: Future Oil Wells
Development of the Chinese tallow tree as a source of chemicals and energy.
Petroculture: a renewable option for future energy supplies.
Oil and lipid accumulation in oleaginous microalgae.
Alcohol coproduction from tree crops.

Active Solar Cooling
Energy analysis of solar powered desiccant cooling systems.
Energy analysis of solar Rankine cooling systems.
Analysis of solar powered/fuel assisted Rankine cycle cooling system.
Performance of solar-desiccant systems using cooled desiccant beds.
Status of several solar cooling systems with respect to cost/performance goals.
Thermodynamic potentialities of vapor compression and absorption solar cooling systems.
Solid desiccant rotary dryer performance charts.

Solar Radiation II
A low-cost EPROM system for solar data recording.
Measurements of solar radiation in the upper hemisphere using an articulated radiometer.
Direct and diffuse radiation on inclined surfaces in Egypt.
Validation of models predicting insolation above system threshold levels.
Development and comparisons of HP-41C software to predict irradiation of tilted surfaces using cloud cover factors.
Monthly averaged global and diffuse solar radiation in the Pacific Northwest.

Open Forum—Interaction Session I
3:45–5:15

Annual AS/ISES Member Meeting
4:30–6:00

Thursday, June 3, 1982

Plenary: The Solar Market
9:00–10:15

Panels:
10:30–12:00

Solar Marketing
Emergency Preparedness and Community Planning
Performance Problems in Active Systems

Technical Sessions:
10:30–12:00

Monitoring, Performance, and Analysis of Passive Systems
Analytical method for performance modeling of passive solar systems.
Optimal control of passive solar buildings with load-managed storage.
Thermal performance of an envelope house in a cold climate.
The effect of deep earth heat migration to the performance of continuous thermal envelope structures.
Heat transfer inside a passively cooled and heated building.
Measured cooling rates for roof pond cooling systems and simple methods of estimating cooling rates.

The Economics of Photovoltaic Systems
Photovoltaic system design in grid-connected applications.
Survey and evaluation procedures to determine the feasibility of using photovoltaic systems on existing buildings.
A method of estimating the performance of photovoltaic systems.
Photovoltaic array-power conditioner interface requirements.
Optimized low-cost array field designs for photovoltaic systems.
Review of photovoltaic-powered refrigeration for medicines for developing countries.
The technical and economic requirements for small-scale solar-powered pumping stations.
Photovoltaic power for Europe.

Biotechnology and Solar Energy Conversion
Applications of recombinant DNA technology to biomass conversion.
Production of fuels from new lipid crop systems.
The production of methane by anaerobic digestion in large- and small-scale facilities.

Education and Technology Transfer
A task analysis for solar installers.
Solar energy education and training: laboratory facilities.
A multidisciplinary solar energy curriculum project for grades 6, 7 & 8.
Technology transfer of small-scale energy technologies in the U.S. Pacific territories.
The national solar water heater workshop.
A local group, a heliodon, and a glimpse of the future: the musings of a solar public educator.

Awards Luncheon
12:30–2:30

Technical Sessions:
2:45–4:15

New Market Currents
Heritage Village solar utility study.
Solar and energy conservation zoning incentives in Richmond, B.C.: the carrot vs. the stick.
Energy and growth in Austin: the case for conservation and renewable energy development.
Municipal solar utilities in California: a final report.
Market penetration of energy conservation and renewable resource measures: program results from Florida Power & Light Company.

Monitoring, Performance, and Analysis of Passive Solar Systems II
Performance of concrete and masonry storage in passive solar systems.
Thermal performance and design tool comparison for northeast passive solar residences as estimated from Class A audits.
Side-by-side testing of three production type passive solar homes: monitored results.
Passive cooling: a parametric analysis of hourly cooling loads for southern climates.
Roof pond architecture: experience in design, construction, and use.
Advanced mirror films for energy-efficient windows.

Passive Cooling, Ventilating, and Dehumidification
Field performance of naturally ventilated homes.
A unique use of concrete block for cooling applications.
Cooling small, internally heated buildings by natural convection and solar chimney-augmented ventilation.
Economic assessment of passive solar cooling potential in the continental United States.
A computer program for the assessment of passive cooling resources in the United States.
Control of integrated dehumidification and passive cooling systems to produce energy-efficient comfort.

Socioeconomic Aspects of Photovoltaics
International supply-side economics for photovoltaic power systems.
Current markets for photovoltaic systems.
Central station photovoltaics in San Diego: a case study.
Life-cycle cost analysis for low-cost modularized flat-panel photovoltaic array field design.
The industrial energy consuming sector in the U.S. as a market for photovoltaic systems.
Photovoltaic array grounding and electrical safety.

Chemical Aspects of Photovoltaics
Chemical modification of grain boundaries.
Photoelectrochemical solar cells.
The Texas Instruments solar energy system.

Performance Results of Active Systems
Testing of solar heating systems with CPC collectors.
Thermal performance of solar systems in the National Solar Data Network.
Eight months of field monitoring for up to 50 domestic solar water heaters.
Monitored performance of 18 solar hot water systems in the NSDN.
First-year results of the TVA solar water heater laboratory test program.
Experimental investigations of relative testing methods for solar heating systems.

Student Program in Physics
Open Forum—Interaction Session II
4:30–6:00

"On The Rise" Dinner
7:30–10:00

Friday, June 4, 1982

Plenary: Solar & The Utilities
9:00–10:15

Panels:
10:30–12:00

Financing Solar Energy
Builders' Experience in Passive Solar Energy
Energy Management Systems
Community Self-Reliance Concepts and Practices
Solar in the Cities

Technical Sessions:
10:30–12:00

Photovoltaic Collector Technology
Flat plate photovoltaic collector technology overview.
Photovoltaic concentrator collector technology status.
Overview of terrestrial PV cell processing.
Flat plate PV module and array engineering.
Experience in design and testing of terrestrial solar cell modules.
High temperature-high current solar cells for thermophotovoltaic systems.
Demonstration of effectiveness of light-trapping in photovoltaic systems.
Intermediate photovoltaic concentrator systems.

Analysis and Testing of Storage and Collectors
Dynamic response of a packed bed thermal storage unit.
Solar heat storage in the bedrock.
Performance improvements in flat-plate liquid solar collectors.
Orientation of collectors with no horizontal edges.
Comparison of thermal characteristics of residential photovoltaic systems.
The effective concentration of non-tracking, two-dimensional CPC arrays including an economic comparison for PV electricity production.
Effect of heat capacity on flat-plate solar collector performance.

Technical Sessions:
2:00–3:30

The Economics of Renewable Energy
Regional assessment of solar energy pond costs.
Envelope vs. aperture: cost optimization of two passive tract houses.
Competitive assessment of residential solar/desiccant cooling.
Specific economic analysis of thermosyphon domestic hot water systems.
Solar energy use for water and space heating for single-family homes in Wisconsin: base case and maximum solar scenarios.
Economic comparison of active solar systems in northeast Ohio.

Passive Design Tools
Development of a passive solar design manual for the United States Navy.
Regional passive solar design charts.
Analytical solutions for the daily performance of direct gain passive heating systems.
Application of the DOE-2 and BLAST in the predesign phase for passive solar commercial buildings.
Simplified frequency response analysis for passive solar buildings.
Field monitoring of passive cooling retrofit strategies for warm, humid climates.

The Impact of Renewable Energy on the Utilities
Economics of wind energy for utilities.
Grid-connected distributed solar power systems.
Assessing the impact of passive solar systems upon electric utilities.
Influence of solar domestic water heating on electric utility demand.
Joint utility efforts to address solar energy issues.
Simulating impacts of photovoltaics on utilities.

Roof-Mounted Residential Photovoltaic Power Systems
First-year operational performance of the FSEC experimental photovoltaic residence.
The FSEC experimental PV house: simulation and operation.
The Southwest Residential Experiment Station: the second year.
Residential Photovoltaic systems: a summary.
Photovoltaic cooling and energy-efficient houses.
Residential photovoltaic applications in the United States.

Solar Thermal Systems
Evaluation of solar air heating central receiver concepts.
Prediction of convective losses from an external solar receiver of cylindrical geometry.
Technical and economic assessment.
Concentration enhancement of a point focus dish using a nonimaging secondary: a full-scale optical experiment.
Solar furnace test design considering flux variation of solid angle.
Closed cycle reciprocatory engine with organic fluid.

[ISES continued on page 194]

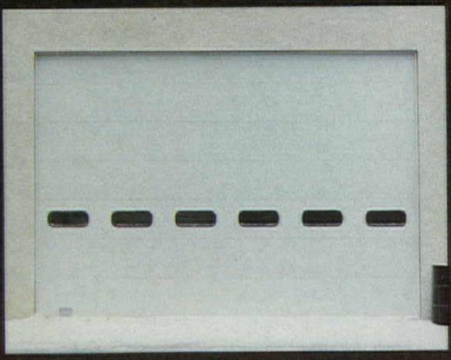
THERMOSPAN™

Introducing A Revolutionary Insulated Sectional Door

The Thermospan concept

Thermospan represents a bold, new approach to insulated sectional overhead doors. This nominal 2″ thick door has a remarkable tested U-value of .11 and is stronger and easier to install than any other sectional overhead door available today.

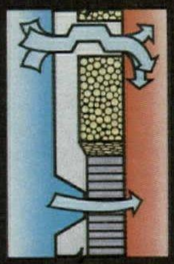
The basic components are simple. For insulation we've sandwiched a polyurethane core between two high-yield galvanized steel skins. A thermal break, placed between the skins during the patented manufacturing process, prevents outside temperatures from being transmitted to interior environments.



Integral horizontal ribs are built into the inner skin, resulting in exceptional strength to weight characteristics allowing extra wide widths. These ribs also control movement that occurs with any thermally efficient building product.

When is an insulated door insulated?

Because the outer surface on a conventional door wraps around and becomes a part of the inner door surface, the inside skin assumes the temperature of the outside skin, greatly reducing the effectiveness of the insulating material. That's why the tested U-values for conventional insulated doors range between .33 and .51.



Thermospan features a thermal break within a homogeneous sandwich of steel/polyurethane/steel. This combined with a total system of factory installed joint and perimeter seals results in an independently tested U-value three times better than conventional doors.

A total insulating system

Efficient, insulating components working together are the key to Thermospan's success. Added to the insulating core, thermal break, and seals, are factory installed, double-glazed acrylic lites to complete the thermally efficient Thermospan system.

If you would like more information on Thermospan, contact Bob Carlson at Dalton International, Inc., U.S. Route 30, West, Dalton, Ohio 44618, (216) 828-2291.

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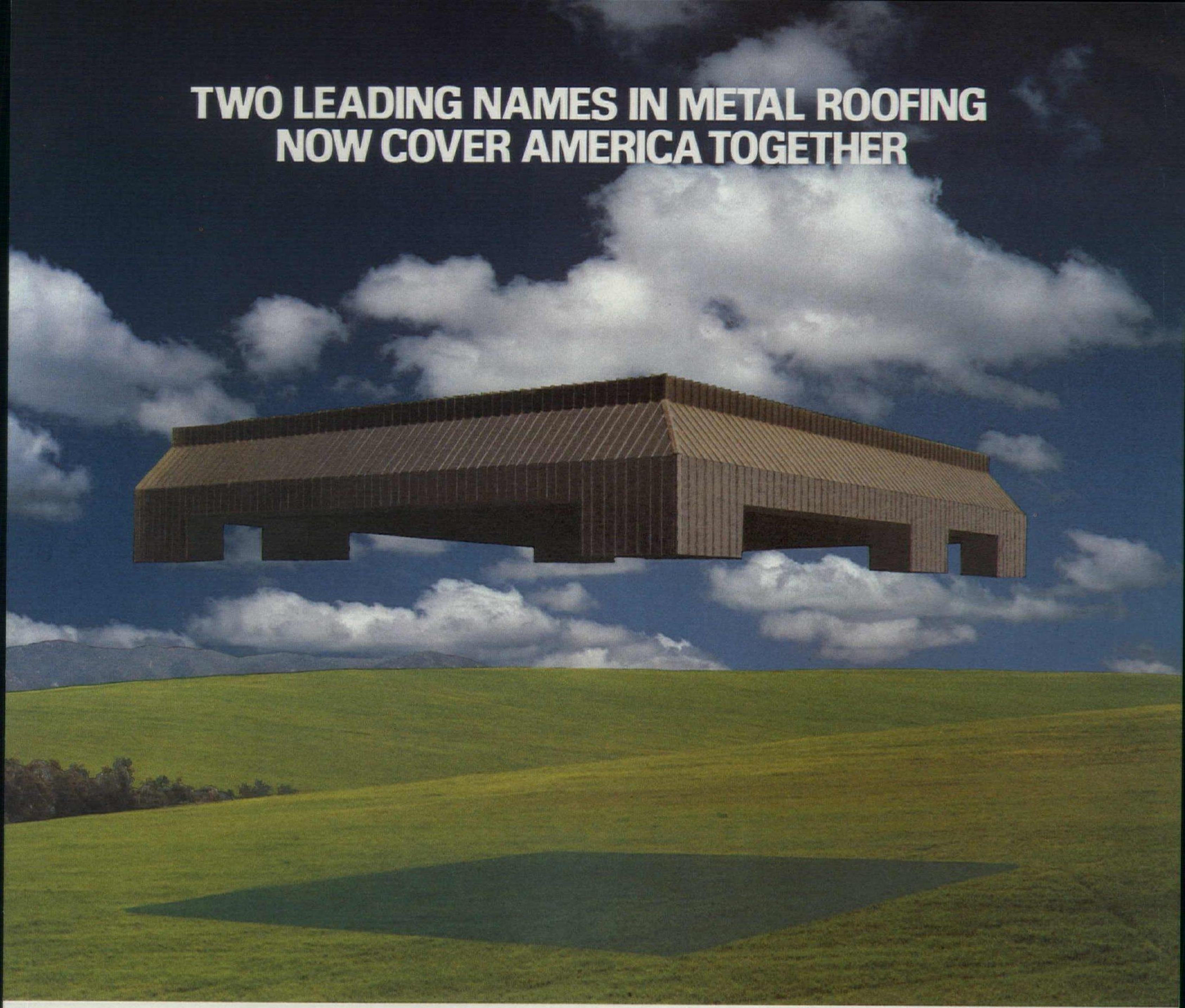

Architectural Engineering Products Company and SPAN Metals Corporation have joined together as wholly owned subsidiaries of Overhead Door Corporation, a name building planners look up to in roofing systems. What AEP and SPAN have done well separately, they can now do even better together.

WITH WEATHERING COPPER The look of pure copper at less than half the cost. That's the basic story of our exclusive Weathering Copper: three layers of copper-bearing acrylic resin applied over an epoxy primer coat to HDG, G90 galvanized steel to a thickness of 2 mils. The new-penny brightness gradually weathers to an aged look of genuine sheet copper roofing-but without the usual signs of corrosion. What's more, the strength and durability of Weathering Copper has been proven by seven tough years of quality performance. For metal roofing, fascia or mansard applications, Weathering Copper complements your most imaginative designs for commercial, industrial and residential projects. For specific details and installation information, see SWEET'S GENERAL BUILDING FILES, Sections 7.2 / AR, 7.3b / SP, 7.7 / AR or phone or write.

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The Renewable Challenge

Solar Technologies Conference and International Exposition

June 1-5, 1982 Houston, Texas

ISES continued from page 191

Friday, June 4, 1982

Flat-Plate Collector Design, Testing, and Rating

Hybrid thermoelectric solar collector design and analysis.
Venting low-cost solar collectors.
The FSEC reference heat source.
Flat-plate solar collector testing facilities at Montana State University.
Wisconsin collector efficiency study.

Evaluation Techniques/Testing

The durability of solar materials.
When is the cost-per-kWh not equal to the cost-per-kWh?
Indoor air pollution in solar-heated buildings.
Energy programming for a 30,000-person new town.
Planning tool for regional governments and developing nations.
A methodology for determining preferred residential passive solar systems.

Technical Sessions: 3:45–5:15

Solar Ponds

Salt transport and gradient maintenance in solar ponds.
An experimental and theoretical study of salt gradient pond interface behavior.
Solar pond regional applicability study: summary of results.
Convective zone structure and zone boundaries in solar ponds.
Construction and first year's operational results of the ANL research salt gradient solar pond.
Electric power generation by solar pond modeling and optimization.

Construction Details

Regional guidelines for the optimization of passive south-wall assemblies.
Advanced residential photovoltaic array designs.
Mounting systems for photovoltaic systems in residential retrofits.
The NCSU solar house: an operational approach to passive solar design in the southeast.
The experience of the solar contractor.

Standards, Law, and Legislation

Solar energy contractor specialty license.
Implementing PURPA 210 for small power producers in New York State.
The use of local tax incentives for solar energy systems.
Providing solar access: using restrictive covenants and solar envelopes in planning solar subdivisions: case studies.
The evolution of the Kansas passive solar tax incentives.
State and local implementation of Florida's solar specialty contractor license.
The Florida solar standards program.

Photovoltaic System Performance and Reliability

The 2000-ft-deep photovoltaic powered well.
The 100 kW solar photovoltaic power system for the Beverly High School, Beverly, Ma: performance and operational experience.
Photovoltaic power system for the Oklahoma Center for Science & Art.
Phoenix Sky Harbor Airport solar photovoltaic concentrator project.
Linear Fresnel lens photovoltaic and thermal system at the Dallas-Ft. Worth Airport.
Commercial application of a photovoltaic concentrator (CAPVC) system operation.
The 200 kW solar breeder.

Solar Power Systems

Overview of solar technology development in international cooperative agreements: seven systems from design to operation.
Coolidge Solar Power Plant: two years of operation.
The Crosbyton System.
Design, installation, and testing of a 100kW$_e$/700kW$_{th}$ solar power plant.
The MBB-heliostat development program.
Solar One: the 100 MW$_e$ Central Receiver Power Plant at Barstow, Ca.

Solar Domestic Hot Water Systems

Field testing of commercially available SDHW systems in Minnesota.
Solar development in Baghdad, Iraq.
The Atlas solar-augmented, gas-fired domestic water heater.
Novel drainback system for service hot water at the Memorial General Hospital.
A thermal performance comparison of three solar domestic hot water heaters.
Optical performance optimization of solar gain through tilted glazing/reflector combinations.

The Politics of Solar Energy

New Mexico State's solar program.
The politics of solar energy.
Future U.S. energy option: economic and environmental values in conflict.
Matching energy source and use.
An economic analysis of federal solar energy programs.
Education: a key to the future of solar energy.

[*ISES continued on page 198*]

Solar Technologies Conference And International Exposition

June 1-5, 1982
Albert Thomas Convention Center
Houston, Texas

Houston, the Energy Capital of the World, will host the SOLAR TECHNOLOGIES CONFERENCE AND INTERNATIONAL EXPOSITION, June 1-5, 1982 at the Albert Thomas Convention Center. This premier international solar energy showcase is the largest ever held for solar technologies and products.
The Exposition will run concurrently with the annual meeting of the American Section of the International Solar Energy Society (AS/ISES).

EXHIBIT PROFILE
With over 300 exhibits, this outstanding show will represent a panorama of solar-and renewable energy-related fields — from architectural design to engineering and consulting services — and will feature materials, components, and complete systems for alternative energy applications. Products exhibited will include: Complete solar systems, solar system components, energy management systems, collectors, distillation units, process heat packages, instrumentation-measurements devices, passive systems and components, power generation, heat recovery systems, biomass conversion systems, design aids, educational packages . . . and much more.

FOREIGN BUYERS PROGRAM
The U.S. Department of Commerce has selected the Solar Technologies Conference and International Exposition for promotion under the Foreign Buyers Program. The International Business Center, sponsored and operated by the Department of Commerce, offers a comfortable meeting place for visitors and exhibitors from all over the world. Commerce officials will personally assist international buyers in accomplishing their business objectives. Interpreters, as well as a variety of other services, will be available to all international visitors.

THE CONFERENCE
"The Renewable Challenge" - Solar Technologies Conference sessions in Houston will offer discussions and papers of general interest as well as a number of special programs for specialized professions. The major subthemes of "The Renewable Challenge" are "Solar and the Utilities", "Advanced Technologies", "The Challenge of Commercialization", and "International Projects and Programs".
For advanced registration information, write directly to:
The Renewable Challenge, AS/ISES,
RIAT, Highway 190 West, Killeen, Texas 76541.

FURTHER INFORMATION
For complete information on exhibiting or attending the Solar Technologies Conference and International Exposition write T.M.A.C., Dept. CN, 680 Beach St., Suite 428, San Francisco, CA 94109 U.S.A. Tel: (415) 474-3000; Telex 278725 TMAC UR.

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High-Energy Solar Glass

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This translates into additional BTU's per square foot in single and multi-family dwellings and low rise commercial buildings, particularly when SOLAKLEER is applied to the southern exposure.

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For the name of the nearest manufacturer or distributor, please write to our Solar Glass Division, General Glass International Corp., 542 Main Street, New Rochelle, NY 10801 or call (914) 235-5900.

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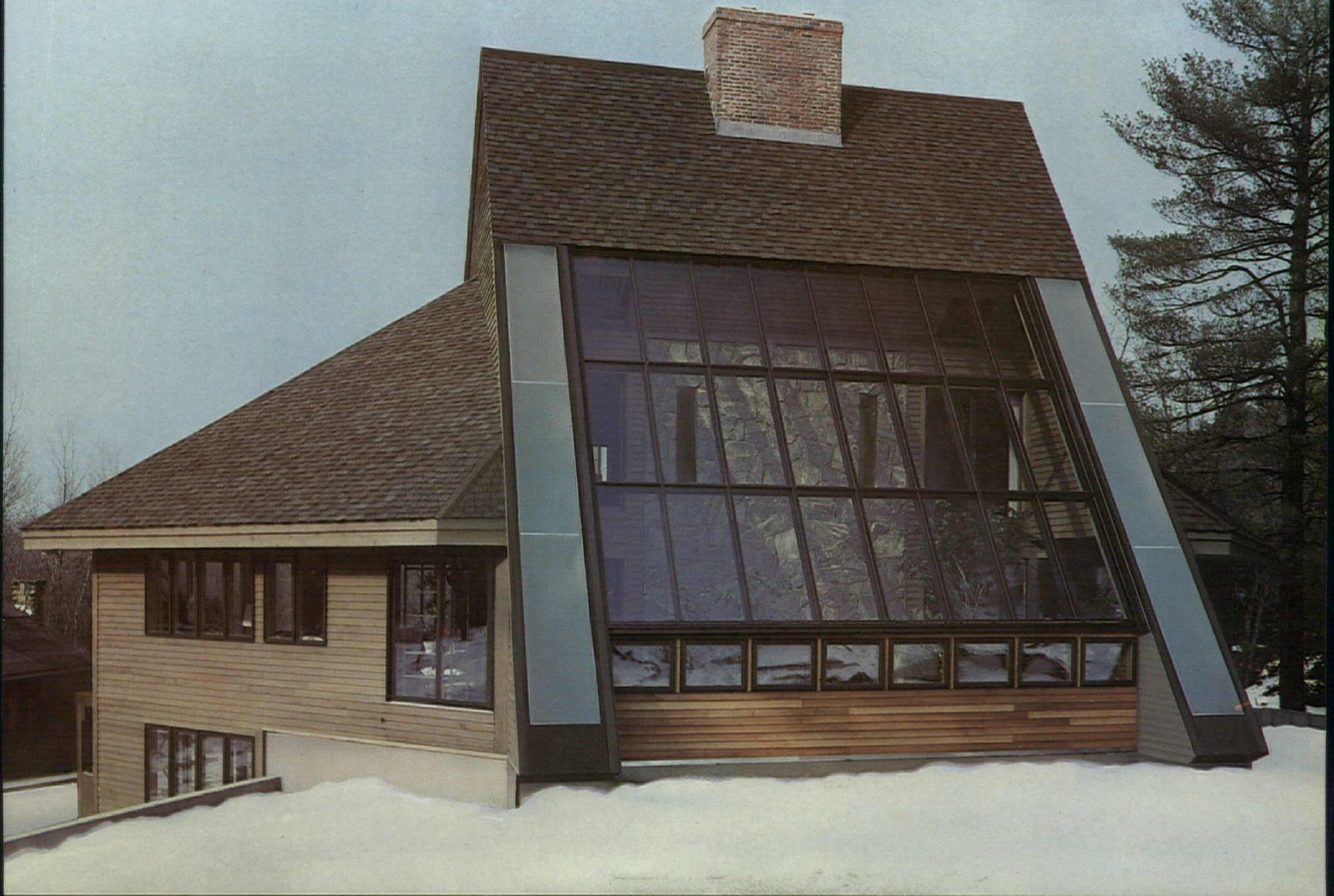


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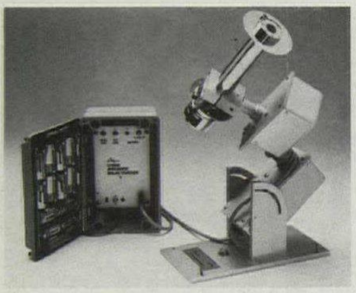
The Renewable Challenge

Solar Technologies Conference
and International Exposition

June 1-5, 1982 Houston, Texas



Li-Cor. LI-2020 Automatic Solar Tracker for up to two months of continuous measurement of normal incidence solar radiation.
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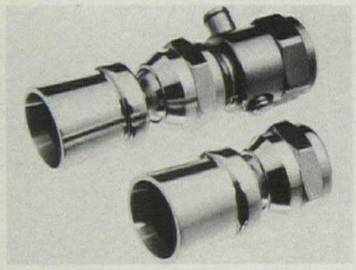

New Resource Group. NRG water-saving showerhead reduces flow by 66 percent and saves the average homeowner $200 per year in energy costs.
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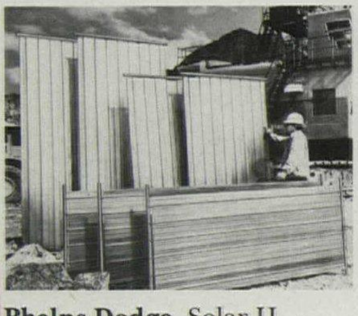

Phelps Dodge. Solar II high-efficiency solar plates are designed to last up to 30 years.
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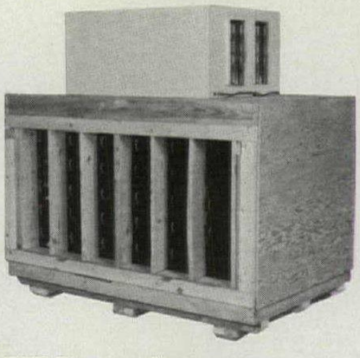

PSI Energy Systems. Thermol-Green™ commercial and residential greenhouse heating uses Thermol 81-The Energy Rod™ to store heat.
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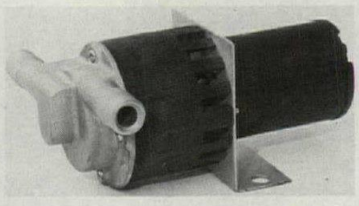
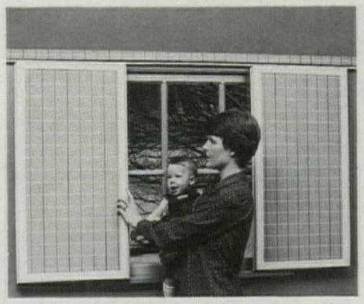
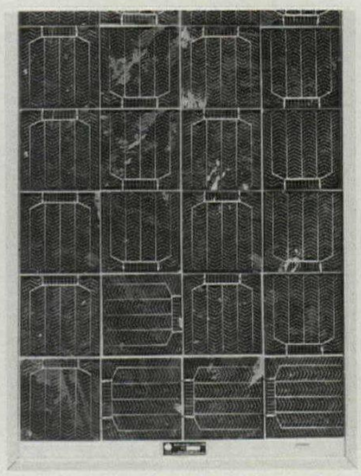


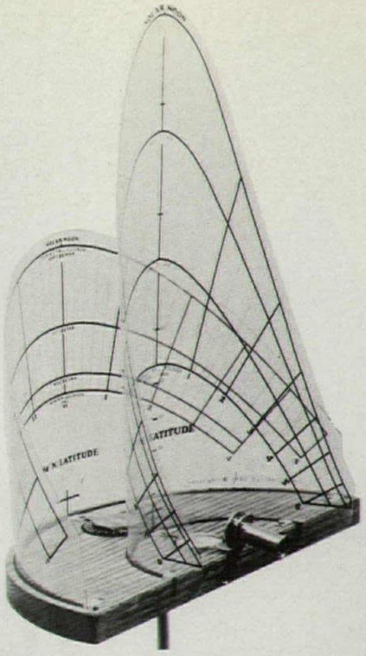
Milton Roy Co., Hartell Div. 12 and 24 UDC Circulator Pumps used for photovoltaic applications.
117 on reader service card



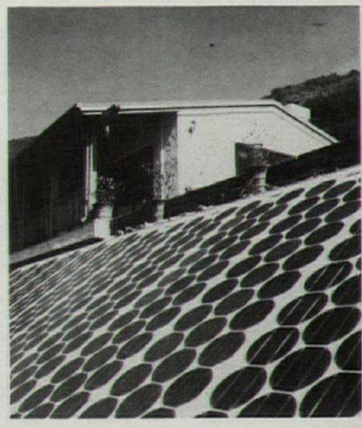
Solar Systems Design. Thermal Wall insulating rigid interior window insulation available in sliding, folding, or bifold styles.
120 on reader service card



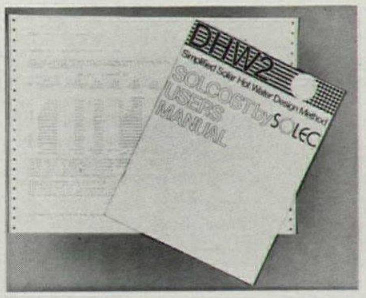
Solarex. SX Series™ solar electric panel features square semicrystalline silicon solar cells, a departure for photovoltaics.
119 on reader service card



Solar Access Associates. Solar Site Selector visual solar access tool determines optimum direct radiation and shading patterns.
118 on reader service card



Solarwest Electric. Twelve ARCO photovoltaic modules provide this home with 1500 watt hours of electricity per day.
121 on reader service card



Solar Energy Corp. SOLEC simplified domestic hot water design method is explained in an easily understood manual.
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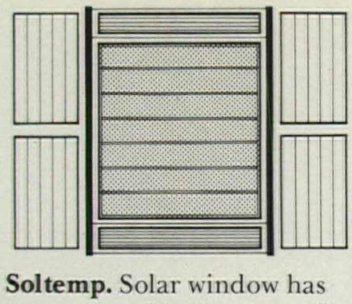

Soltemp. Solar window has programmable thermostatic control. It produces warm air, hot water, and electricity and provides ventilation.
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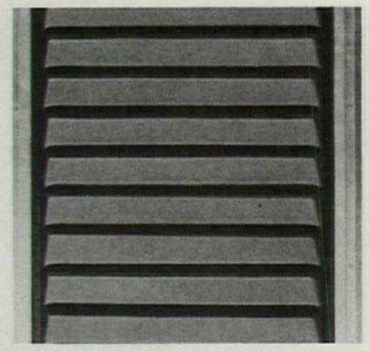

Sun-Co Solar Corp. The Solar Shutter active hot air collector is self-contained with add-on design for heating one or more rooms.
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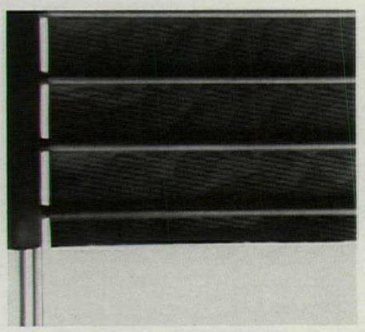

Terra-Light. Copper solar absorber plates offer high performance, long life, and reasonable cost. A range of configurations is available.
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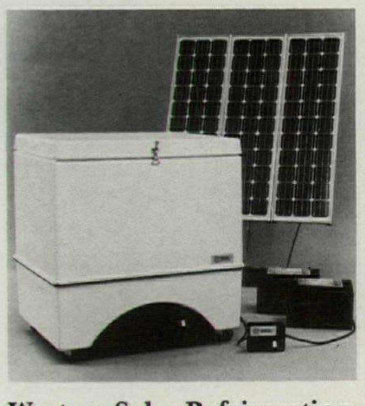

Western Solar Refrigeration. Photovoltaic-powered systems for rural medical and domestic applications include medical refrigerator.
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WE STRETCHED OUR PRODUCT TO PROVE A POINT.
1 Independent Test Report
Recently, we had our TAM-GLASS™ fiberglass roofing felts and three-ply membrane samples tested by Structural Research, Inc., a leading materials testing laboratory.
Though our own tests and customer applications have proven our product to be superior, these new independent test results confirm and quantify our claims.
2 Isotropic Felt Quality
TAMKO Wet Process
Continuous Strand Process
Competitive Wet Process
As shown in the 20x magnifications above, TAMKO's special wet process uniformly distributes fibers in a 360° multidirectional orientation. This isotropic characteristic permitted the TAM-GLASS felts to demonstrate average breaking strength of 57 (lb/in) in both the machine and cross-machine directions—29.5% higher than required for Type IV felts.
As further demonstrated in the membrane test, isotropic strength helps the finished membrane to perform more evenly under the stresses encountered in actual use.
3 Membrane Performance
Standard ASTM dogbone samples exhibited three-ply ultimate strength of 246 (lb/in) in the cross-machine, or weakest, direction at 0°F—46 pounds in excess of the 200 (lb/in) NBS suggested minimum.
"TAMKO TAM-GLASS Type IV felts and membrane samples exceeded all applicable ASTM and NBS suggested performance criteria.
"For the felt sampling portion of the test sequence, SRI developed a special microcomputer program to generate a more random sampling than required by ASTM D 146"
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Ask for your free copy of the Test Report brochure.
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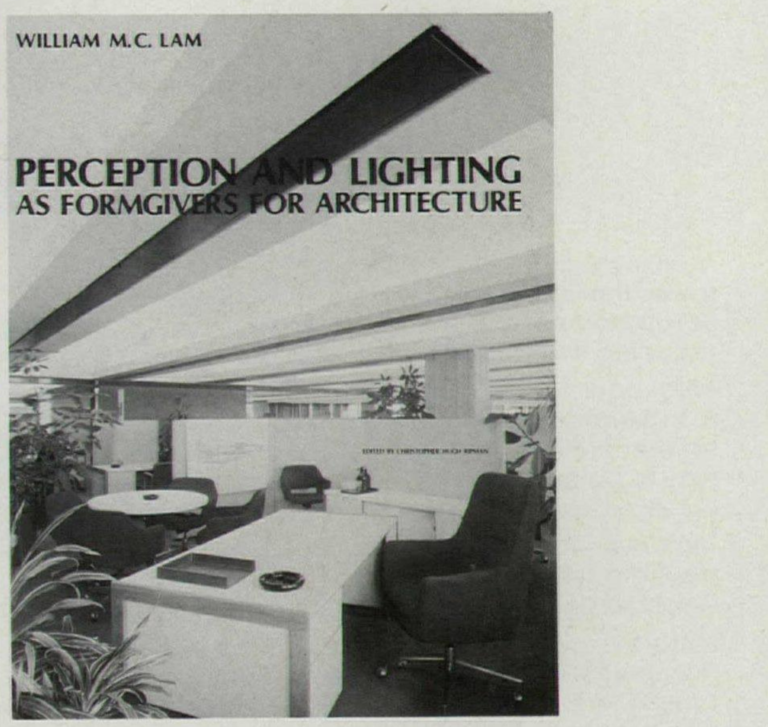
Forms of lighting

Books



Perception and Lighting as Formgivers for Architecture *by William M.C. Lam. New York, McGraw-Hill Book Co., 1976, 310 pp., $44.50.*
Daylight in Architecture *by Benjamin H. Evans. New York, McGraw-Hill Book Co., 1981, 204 pp., $29.95.*
Reviewed by Scott Matthews, a partner in Van der Ryn Calthorpe & Partners, Sausalito, Ca.

The opening statement of Bill Lam's *Perception and Lighting as Formgivers for Architecture* asserts "Light has always been recognized as one of the most powerful formgivers to the designer, and great architects have always understood its importance as the principal medium which puts man in touch with his environment." With a few notable exceptions, however, the evolution of artificial light sources, in particular the fluorescent tube, has improved neither the aesthetic quality nor the visual comfort of the luminous environment in our buildings. The work of designers of the caliber of Wright, Aalto, and Kahn, and such exceptions to the norm as Philip Johnson's Crystal Cathedral notwithstanding, the interior architecture of our age hardly represents, in Corbusier's words, "the masterly, correct, and magnificent play of masses brought together in *light*."

In Lam's view, designers have yielded control over the luminous environment within buildings to others, ". . . to electrical engineers, who have been primarily trained to meet minimum footcandle requirements; to building owners, who come to them with misconceived programmatic objectives; and to misguided government officials, who have been brainwashed by propaganda from the lighting and power industry into adopting and enforcing irrelevant and obstructive codes in the name of progress."

These are strong words for a field in which professional criticism usually extends no deeper than the façade, but their essential validity is immediately apparent to the eye, especially [*Books continued on page 206*]

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So when you need information on fire doors, security, hardware, or installation, your Ceco high performance door specialist is a good guy to know. See us in Sweet's. Or write:
The Ceco Corporation, 1400 Kensington Road, Oak Brook, IL 60521.

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"The door people"™

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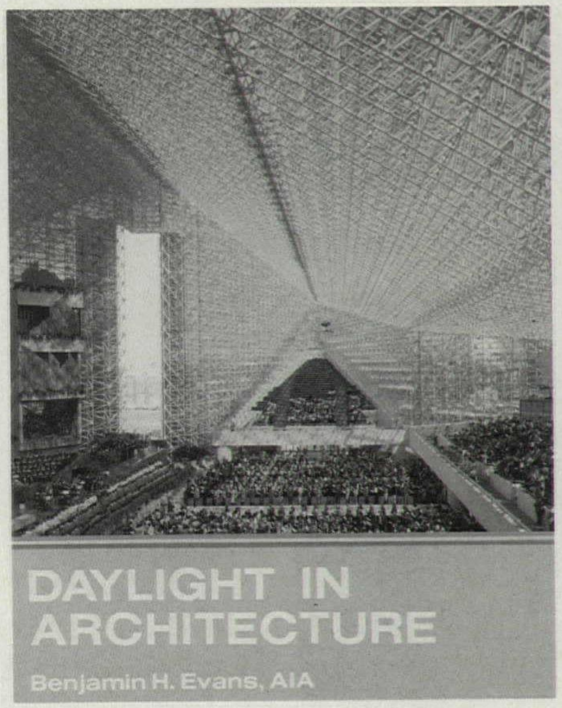
Books continued from page 204



in working environments: The interior architecture of our offices and factories relates much more to the dimensions of the 4-ft fluorescent tube and the geometry of the suspended ceiling grid than to the biological needs of the occupants for visual stimuli and relaxation, variety of experience, and perceived connection to the outdoors.

On one level, this book is a manifesto. While its tone is not the strident and absolutist exclamation that often marks demands for architectural reform, its call is no less urgent for being quietly reasoned. The thesis is that most modern buildings are consciously conceived as city-scale environmental sculpture, designed from the outside in, with their luminous environments a low-priority afterthought. This approach is totally in error, as is the current custom of lighting by footcandle level. Rather, design should proceed from the inside out, and interior spaces should be designed to satisfy human as well as functional needs. In a successful, or in Lam's terms *relevant* environment, ". . . calculation of specific *levels* of illumination is much less important in lighting design than consideration of the *quality* of illumination in terms of its distribution and characteristics, the *information* conveyed by the pattern of the sources, and the degree to which they reinforce or contradict the relationships established by the architecture, and the planned activities."

The basis for this statement is Lam's work on perception. He lucidly explains the interaction between human or "biological" needs (such as orientation in space and time, variety of experience, and control over personal territory), the process of visual perception, and conventional considerations in lighting design, such as brightness, glare, and contrast. These chapters alone are worth the price of admission and should be required reading for anyone involved in designing environments for human activities.

Lam designs by observation. He initially seeks out built examples of similar environments for field trips by the entire project design team. On-the-spot evaluations of what works, what doesn't, and why are followed by conceptual design sessions conducted *en charrette.* Scale models are used to test design options subjectively, and if budget and design complexity warrant, full-scale mockups of building elements and even entire rooms are built for measurements to refine a scheme's integration with partitions, furniture, etc. Presenting the "how" of a qualitative design approach is not nearly as straightforward as its "why," since its tools are observation and the rules of thumb of experience, not codes, tables, and formulas. Lam gives an illustrated narrative discussion of his methods of practice, along with a set of "rules of thumb." Unfortunately, too little of his experience is communicated

[*Books continued on page 208*]


Don't design an open office with a closed floor.
When you design an open office, you're providing the ability to adapt quickly and easily to changing needs. It can't be done with furniture and landscape screens alone.
Support systems must adapt as readily as office personnel. That's what the open office is all about. And that's one reason successful open offices are based on Donn access floors.
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Architect: Joseph Young
Floor Contractor: Lauren Burt, Inc.

Books continued from page 206

here for the book to serve as a handbook for practice. On the other hand, this may be deliberate, since Lam's purpose, stated in the preface, is to convey principles, not technique.

Perhaps in consolation, the results of the application of these principles is extensively illustrated in some 55 short case studies of many of Lam's realized projects. It is here that Lam makes his case for the integration of the design process from the start, with the architect, lighting designer, and engineers creating, as a team, the building's conceptual design. This advocacy originated with a simple need for greater ceiling heights to permit the use of indirect lighting. While this space could be bought at the expense of increased building height, a far more elegant and less expensive solution is to borrow volume from the ceiling cavity by integrating, in space, form, and function, the building's structural, HVAC, power, and lighting systems. If actively pursued, this integration itself becomes a powerful form determinant, defining massing, structural system, and hierarchy of spaces, as well as what happens at the ceiling plane.

It is a credit to Lam's vision that the spaces illustrated are interesting and visually exciting, although to some several of the more extensively integrated examples may seem ponderous, busy, or forced. It is also to Lam's credit that these schemes were realized at all; such coordination is difficult, and requires both design skill and the tact of a diplomat (or bulldog perseverance) if the scheme—and the team—is to hold together. Unfortunately, most of the case studies are somewhat shallow. Fewer case studies, treated in greater depth, would have been preferable. Especially useful would be discussions of the HVAC-related tradeoffs made in these projects. Claims are made for improved duct runs, more rational layout, and so forth, but the need to conform layouts to a more restrictive structural grid raises questions.

Many of the lighting installations presented in Lam's case studies were designed before the oil embargo and the subsequent interest in energy conservation. Nevertheless, they are remarkably efficient, if one discounts those schemes where no local task lighting was used and all illumination must be provided by 3+ watts per sq ft of indirect cove lighting. Daylighting is mentioned and valued highly, but more for its *visual information* than its footcandles; the discussion is principally concerned with its visual integration with light from electric sources.

From the late 1950s until the mid-1970s, the techniques of daylighting, like higher learning during the Dark Ages, were husbanded in a few centers of research, chief among them the British Research Establishment. The bible of the field, covering most of the significant work at BRE and elsewhere, is *Daylighting* by Hopkinson, Petherbridge, and Longmore. Although published in 1966, it remains the preeminent resource for both the principles and techniques of using daylight in buildings. The book's perspective, however, is that of design primarily for cloudy northern climates, and several of its references and rules of application are either inappropriate for use in much of North America, or have been superseded by subsequent research. What is needed is a North American companion to *Daylighting,* combining universal principles with techniques appropriate to our brighter skies and more severe climates, and including recent technical advances in controls and in quantifying the often counterintuitive relationships between daylighting and energy performance.

Ben Evans's *Daylight in Architecture* is not this ambitious, but is nevertheless very welcome. He is uniquely qualified to write on daylighting in North American buildings; he and a very few other stalwarts alone kept the flame alive in the Dark Ages between their developing what is now the IES Lumen Method of daylight calculation (while devising daylighting standards for Texas baby-boom schools in the 1950s) and the current resurgence of interest in their work. This book is intended for the practicing architect and generalist who needs *design* techniques to apply now and cannot afford the luxury of going back to first principles or of evaluating research findings. Its emphasis is on the presentation and evaluation of concepts relating to schematic architectural de-

[*Books continued on page 210*]

Books continued from page 208

sign: fenestration size and placement, room dimensions and shape, exterior and interior controls, surface reflectances, choice of glazing, etc.

In the interest of clarity and, presumably, to keep the discussion from becoming mired in technical detail, simplifications are sometimes made that may cause some disagreement from other experts in the field and confusion to the reader if other references are consulted. Take, for instance, Evans's statement: "Most daylighting study techniques are based on the presumption that no direct sunlight will penetrate the building fenestration, for the simple reason that direct sun on the interior is considered to produce undesirable seeing conditions, particularly if direct sun reaches visual tasks such as desks and chalkboards."

This is certainly true with respect to chalkboards and desks, since sunlight's excessive brightness can produce both visual discomfort and disability glare. It is not true for many interior conditions, such as reception areas, casual sitting in libraries, and eating places, where the seeing needs are not determined by critical reading tasks. Furthermore, the primary reason analysis techniques have not until recently considered direct sunlight is that it is very difficult to calculate the effect of multiple reflections of sunlight within a room without computer assistance. Other statements involve technical disagreements among those working in the daylighting field, such as whether full-scale glass should be used in model studies when testing glazing option (Evans prefers acetate) and whether diffuse daylight has the same fraction of visible light per unit of energy (Lumens/Watt) as sunlight (Evans says more: much long-wave radiation is absorbed by ground or water vapor in atmosphere). Issues such as these do not affect the validity of Evans's recommendations, but the designer intending to employ daylighting extensively would be best served by augmenting *Daylight in Architecture* with Lam's chapters on perception and the sections of *Daylighting* dealing with general principles.

The most useful sections of *Daylight in Architecture* will probably be those discussing the use of models. Evans, correctly taking the designer's viewpoint, acknowledges the usefulness of mathematical quantification, but asserts that models not only allow the evaluation of more complex schemes than is possible numerically but, far more important, permit the designer and client to form subjective judgments of the performance, mood, and "feel" of a scheme. His discussion, giving principles for the construction of models, a consumer survey of available instrumentation, and step-by-step instruction for their accurate testing, is the best presentation of the subject available and will save many times the book's price for any designer contemplating the use of models to evaluate design options.

Daylight in Architecture also includes several case studies of recent buildings, mostly well known (i.e., Kimbell Art Museum, Yale Center for British Art, National Gallery East Building), which were designed at least to welcome daylight if not to save energy by using it in place of electric illumination. These, like Lam's, are not really case studies, since many of the luminous environments shown are not evaluated, but only described. This, however, may be deliberate, in that both authors intend that readers visit buildings to see for themselves what works, what doesn't, and why.

There are, unfortunately, some glaring omissions in *Daylight in Architecture*. Some, like the short shrift given to numerical quantification and the integration of daylight with electric illumination, are undoubtedly intended, since the rapidly evolving state-of-the-art of computer modeling of daylight effects and of microprocessor-based controls for electric lighting would have dated their discussion before the book was published. Others, such as the omission of *all* the figures illustrating one of the life-cycle cost benefit analyses given in the appendix, indicate a sloppiness of production that is inexcusable in a $30 book. Such quibbles are relatively minor, however, considering the value of what is included. For some time, *Daylight in Architecture* will be the best basic reference available for designers who are intrigued with the idea of daylighting, eager to use its concepts, but unsure of how to go about it. ☐


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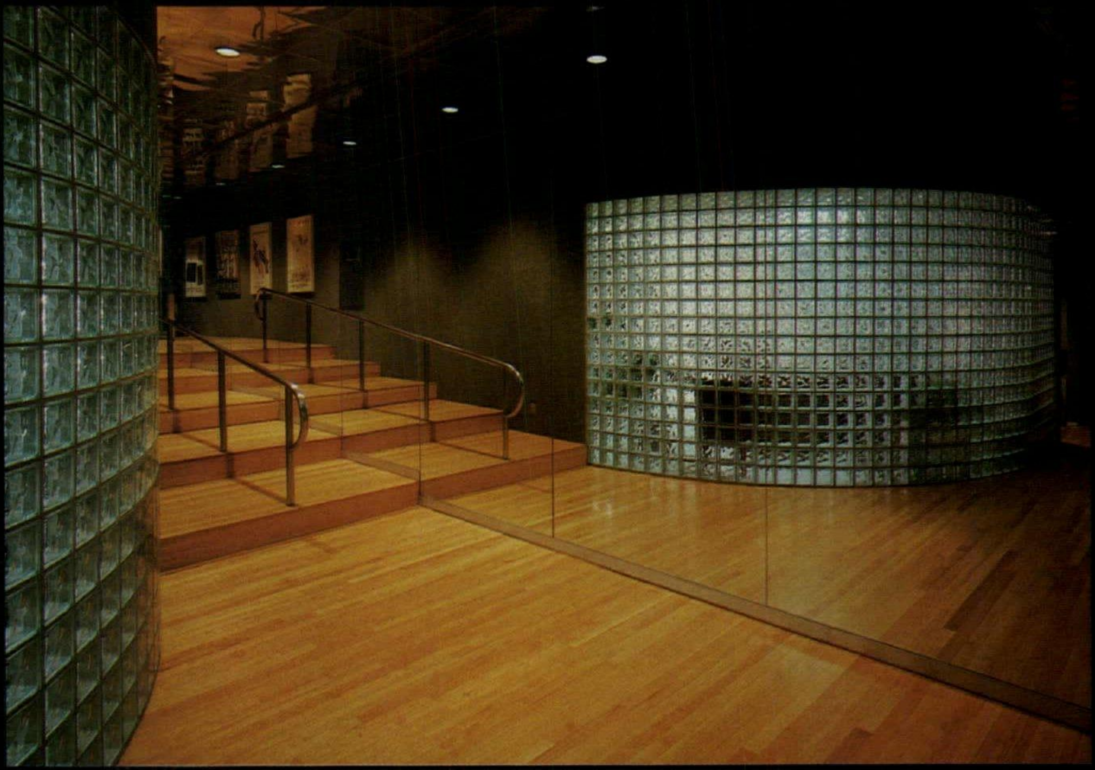

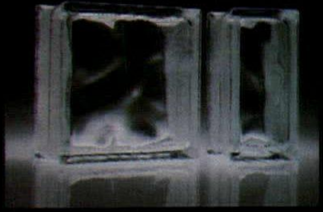

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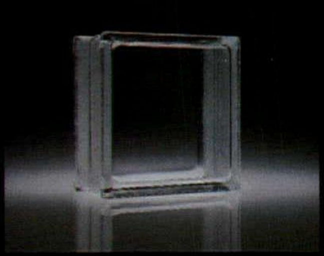

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Products and literature

Other than times of war and economic calamity, there have been few periods in modern history that have been as influential on the manufacture of products for building use as the last ten years. Turning the tide of energy consumption has for some meant shackles, but for others, opportunity. An enormous number of new products have crossed the threshold of P/A during that time. No one knows what portion of them has endured to expand our product vocabulary. The sheer scope of new product endeavor has been revolutionary.

Solid-state technology has made a major contribution. The cost of instrumentation, for example, is now within the range of conventional use. Portable weather stations, energy-auditing devices, and building energy-monitoring instruments have created an entire market among energy-oriented professionals. For building operation, solid-state, computerized control devices have expanded in capability and applicability while shrinking in size, cost, and complexity to use.

Another major force has been the direct use of the sun. Active solar collectors are an obvious recent addition to the product vocabulary. After the initial onslaught, the number of different collectors has decreased; the testing and regulation of products has increased. Where a manufacturer may have offered only a solar collector before, he may now offer a system or total design capability.

While active solar collectors are still relatively new and exotic, products like greenhouses and skylights in passive solar or daylighting applications have found expanded markets because of the general emphasis on energy.

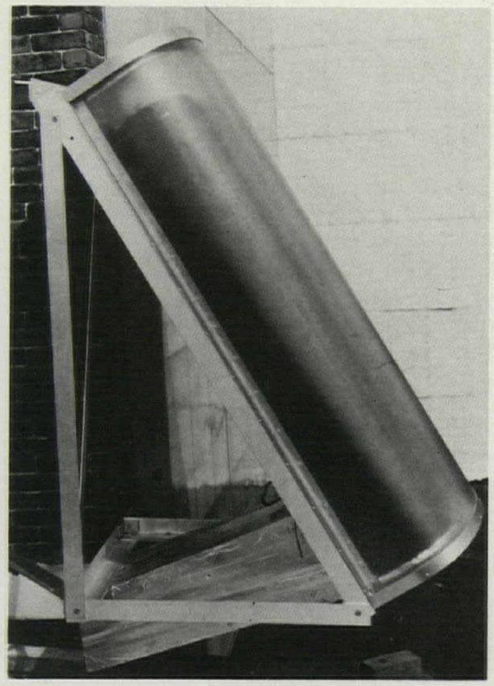
Some products have applied existing, but more sophisticated chemical technologies to buildings for the first time: selective coatings, high-temperature adhesives, eutectic salts, and photovoltaic cells, to name a few. Other segments of the traditional industry have been reoriented. The major building materials—interior, exterior, and structural—are still in the process of having their uses redefined in energy terms. Words such as "window blinds" have been replaced by concepts such as "window management." Insulation can now be found outside the wall or at night over a window. Mechanical equipment strategy for buildings has been rethought and redesigned for greater efficiency. Ten years ago, for example, heat pumps were limping along as an equipment prospect. Today there exist fascinating blends of heat-pump technology and heat-storage capacity.

As we look into the next ten years, it is such blends of new technology that hold great fascination. As each new technology solidifies and produces reliable design methodology, mixes and matches become an enticing possibility.

What follows is a selection of this year's crop of new energy products and energy-related literature.

The following items are related to the April theme—energy conservation.

Products



Sun-Lite® passive solar water heater works on existing water pressure. It consists of two 30-gallon lined steel tanks plumbed in series, enclosed in an insulated metal frame and double glazed. It has an optional freeze protection device for cold climates. Solar Components Corp.
Circle 127 on reader service card

Wesper 2 is designed to automatically transfer excess heat from greenhouses and sunspaces to the living area. When the air reaches a factory-preset temperature of 75 F, the shutter opens and the fan turns on to transfer heated air. When the space cools and drops below the preset temperature, the fan shuts off and the shutter closes. Another feature allows warmer house air to be drawn into the sunspace if desired. Weather Energy Systems, Inc.
Circle 128 on reader service card

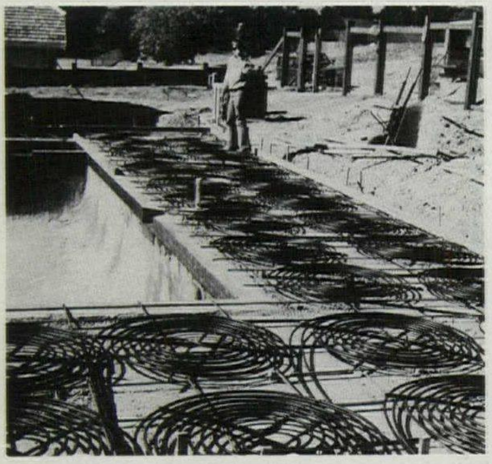
Solar Pac space-heating systems include collectors, mounting hardware, preassembled heat exchange module, electronic controller, sensors, storage tank with insulation, and domestic hot water storage. Choices are offered in frame finish, glazing, and absorber plate coating. Several sizes are available. Paolino Energy Products.
Circle 129 on reader service card

SC4 Solar Collector features black-chrome-coated absorber plate combining copper flow tubes bonded to a copper absorber sheet. The housing is insulated and has a light-diffusing glass cover framed in painted extruded aluminum. SC4 collectors are completely factory assembled and can be connected in parallel, series, or a combination of the two. Lennox Industries.
Circle 130 on reader service card

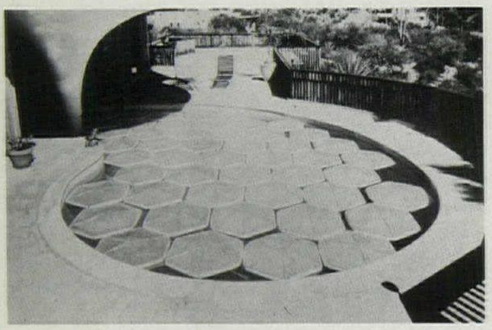
Air type solar energy collector has a finned absorber to improve efficiency. The cover is two sheets of tempered [*Products continued on page 214*]

Products continued from page 213

glass, weather stripped and enclosed in a brown-tone frame. Fins are coated with nonselective flat black paint. The back and sides are insulated. Intended for residential or commercial space heating, the collector can also be used with a heat exchanger in water-heating systems. Solar Shelter.
Circle 131 on reader service card



Solarpave™ solar heating system uses concrete paving over collecting coils to heat water. Coils of ½-in. polybutylene plastic pipe, 4 ft in diameter, are placed side by side and embedded in concrete. Used for pool heating, the coils are connected to the pump and filtering system. An area approximately the size of the pool is said to be sufficient to heat the pool properly. Pool deck, driveway, and walkway are suitable for Solarpave installations, according to the manufacturer. Bowmanite Corp.
Circle 132 on reader service card



Sebra Solar Petals™ for pools are lightweight hexagonal solar collectors formed to a peak at the center to create a 1-in. air space that traps warm air. The approximately 3-ft-wide units that float on the surface are said to increase water temperature 12 to 18 F and reduce evaporation as much as 80 to 90 percent. Vacuum formed of GE's Lexan® polycarbonate film, the petals are more easily handled than pool blankets and can be stacked for storage. Engineering & Research Associates, Inc.
Circle 133 on reader service card

Solar space heating/air conditioning/hot water heating system is an advanced version of one designed by Nebraska architect and builder Robert Thiesen. It uses hot water collectors and a water source heat pump. Liquid-type collectors fitted with concentrating lenses are mounted inside a triangular glazed chamber which can be built into the roof or mounted at ground level, protecting the collectors from severe weather. A large volume of water holds accumulated heat to keep the building warm for a period of several days. By concentrating the sun's energy on the collector panels, temperatures approaching 220 F can be generated in a few minutes, according to the manufacturer. Delta-Rā Solar Systems, Inc.
Circle 134 on reader service card

The A-24 solar collector is an air type flat plate designed for flush mounting on the roof. Primarily for new residential units, it can be used for space heating and hot water systems. Absorber plate has black chrome finish, glazing is tempered glass, and frames are anodized aluminum. General Solar Systems Div., General Extrusions.
Circle 135 on reader service card

Rodwall is a modular system of rods containing phase-change salts. Placed behind direct-gain glazing, they collect solar energy, reduce glare, and provide storage within normal wall thickness. When the sun sets, the rods turn, allowing the insulated side to protect heat storage. A small fan assists in circulating the heat. In the summer, the tubes can be reversed to provide cooling. Sunwood Energy Products, Inc.
Circle 136 on reader service card

Helio-Pak solar modules for closed-loop solar hot water heating and space heating have external double-wall heat exchangers, pumps, controls, sensors, expansion tank, pressure gauge, pressure-relief valve, and check valve. The modules are available in several models for up to 300 sq ft of collector area and can be used with glycol, synthetic hydrocarbon, or silicone fluids. Heliodyne, Inc.
Circle 137 on reader service card

A heat exchange module for solar domestic water heating systems uses any type of commercially available antifreeze in its closed loop system. It features a high efficiency copper tube-in-tube, double-walled heat exchanger with inner and outer fins. A positive external leak detection system assures quick detection and repair of leaks. Internal parts include a stainless steel pump, a high-capacity expansion tank, and solid-state controls. The module contains UL-approved components and has a five-year warranty. Solar Industries, Inc.
Circle 138 on reader service card

CMT Slimline 2800 solar collector reduces the number of units needed for heating domestic hot water. Quick-Set™ mounting components reduce installation time. The collectors are 4′ x 12′ and the manufacturer says two of these lightweight units will provide heating for a typical 80-gallon system in northern latitudes. The collector has an all-copper absorber plate with flat black paint or black chrome selective surface, back and side insulation, and low-iron glass cover. Frame is steel-reinforced aluminum. Solar Industries, Inc.
Circle 139 on reader service card

System 600 control for small commercial buildings provides energy and facilities management. Designed for buildings of 50,000 sq ft or larger, it is expandable to 600 control points managed from a central location. According to the manufacturer, it is adaptable to additional devices, such as color graphic CRT, or software, such as direct digital control. Capabilities include peak demand limiting, duty cycling, and chiller/boiler profile. MCC Powers, Mark Controls Corp.
Circle 140 on reader service card

SmartStat 1000 energy management is a solid-state microprocessor-based system for controlling single or multistage HVAC equipment, including heat pumps. For use with gas-fired, oil-fired, or electric systems, it provides three set-back programs to fit any schedule. Energy savings as much as 30 percent have resulted from its use, says the manufacturer. NSI Control Products.
Circle 141 on reader service card

A differential solar heating control, P-100, features a freeze backup system, storage tank protection, and a snap-in diagnostic tool for instant trouble shooting. An integrated circuit, together with other components, turns the pump on and indicates when freeze protection is necessary. A graphic faceplate shows which mode the system is in, and lights indicate whether power is on, the solar system is on, or the freeze protection is operating. Pyramid Control.
Circle 142 on reader service card

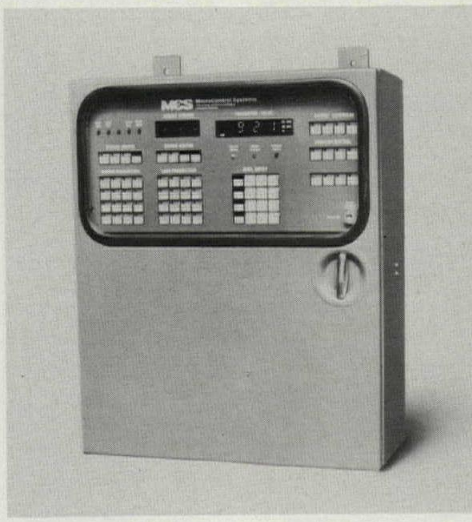
EC 700 series programmable time controllers offer precise scheduling of electrical loads and control up to 64 events per day on as many as 12 circuits. Programming is done on an easy-to-use keyboard, and a microprocessor holds the program in memory. In the event of
[*Products continued on page 216*]

Products continued from page 214

a power outage, a minimum 24-hour memory carryover is provided by a rechargeable battery. As power returns, outputs are staggered in sequence to avoid overload. Applications include heating, air conditioning, ventilating fans, indoor and outdoor lighting, security systems, water heaters, and industrial processes. AMF Paragon.
Circle 143 on reader service card

A color graphic terminal is available as an option for the DCS 5000 energy management system. Each screen shows a schematic display of equipment such as air supply systems, boilers, valves, etc., with flow direction of pump lines indicated by arrows. Alarms are signaled by both a change of color of the equipment value and a blinking illumination of the data. The color change remains until the equipment returns to normal status. Litton Energy Control Systems.
Circle 144 on reader service card

A computer interface to energy control systems, in combination with a desk-top business computer, provides automatically for all controlled loads in the central control system. It has up to 48 on/off functions per day and permits workday and holiday scheduling. Operation requires no special training. The total system consists of interface unit, computer, software, and signal receivers. It uses the building's a.c. wiring, eliminating the need for dedicated wiring. Leviton Manufacturing Co., Inc.
Circle 145 on reader service card



MCS-1 and MCS-2 energy management systems monitor and control electricity, gas, oil, steam, and other forms of energy. They offer temperature monitoring and control, time-of-day, demand control, and duty cycling. They are easily programmable and have a direct entry touch panel that eliminates the need for specialized training, computer language, and codes. They are equipped with emergency back-up battery power. MicroControl Systems.
Circle 146 on reader service card

Energy Commander™ control systems permit use of multiple smaller engine generator sets rather than one large set. The modular system can be expanded to meet increased power demands. Systems are available for emergency power, prime power, and peak shaving applications. Zenith Controls, Inc.
Circle 147 on reader service card

Watchdog™ energy management systems consist of a main unit with a terminal panel and one or more output panels. EM-24 handles up to 24 loads; EM-64 has a maximum capacity of 64 loads; both are expandable. Features include peak demand control, load cycling, time-of-day scheduling, simple operating procedures, built-in diagnostics, and error message. Square D Co.
Circle 148 on reader service card

TS-2000 microprocessor-based energy management system for light commercial applications allows the operator to program a different heating and cooling schedule each day of the week. It switches automatically from heating to cooling as required. Suitable for restaurants, retail stores, and churches, the system is said to save as much as 30 percent of heating and air-conditioning costs. It is designed to use existing thermostat wiring. Printed Circuits International.
Circle 200 on reader service card

Insulated panels, intended for window replacement and curtainwalls, have R-values from 3.5 to 27.79. Panels have various cores and substrates to conform
[*Products continued on page 218*]

Products continued from page 216

to design conditions and building specifications. Finishes available are porcelain on aluminum, painted, and anodized. Mapes Industries, Inc.
Circle 201 on reader service card

A fabric tension system, for passive solar structures requiring sun control, consists of two motors mounted in parallel roller tubes that reel and unreel a shading fabric to cover the glass surface. It is suitable for greenhouses, skylights, atriums, and similar glass enclosures. Somfy Systems.
Circle 202 on reader service card

Heatkeeper™ movable insulation for windows rolls up from the bottom yet, according to the manufacturer, it keeps cold air trapped to the outside when partially open, while providing daylight and a view to the outside. A version of Heatkeeper operates in an inclined position for use in atriums and skylights. Operation is manual or by means of motorized units. Hopper & Co.
Circle 203 on reader service card

Rollex rolling shutters on window exteriors, used for years in Europe, provide energy savings, as well as protection against intruders and severe storms. They are made from heavyweight PVC plastic that can be reinforced with a metal beam. A perforated band alternating between solid slats admits light and air. In raised position, the slats are nested in a storage box above the window; they slide on metal tracks into a locked position when fully closed. Operation is from inside by means of manual or motorized controls. The Foldette Co.
Circle 204 on reader service card

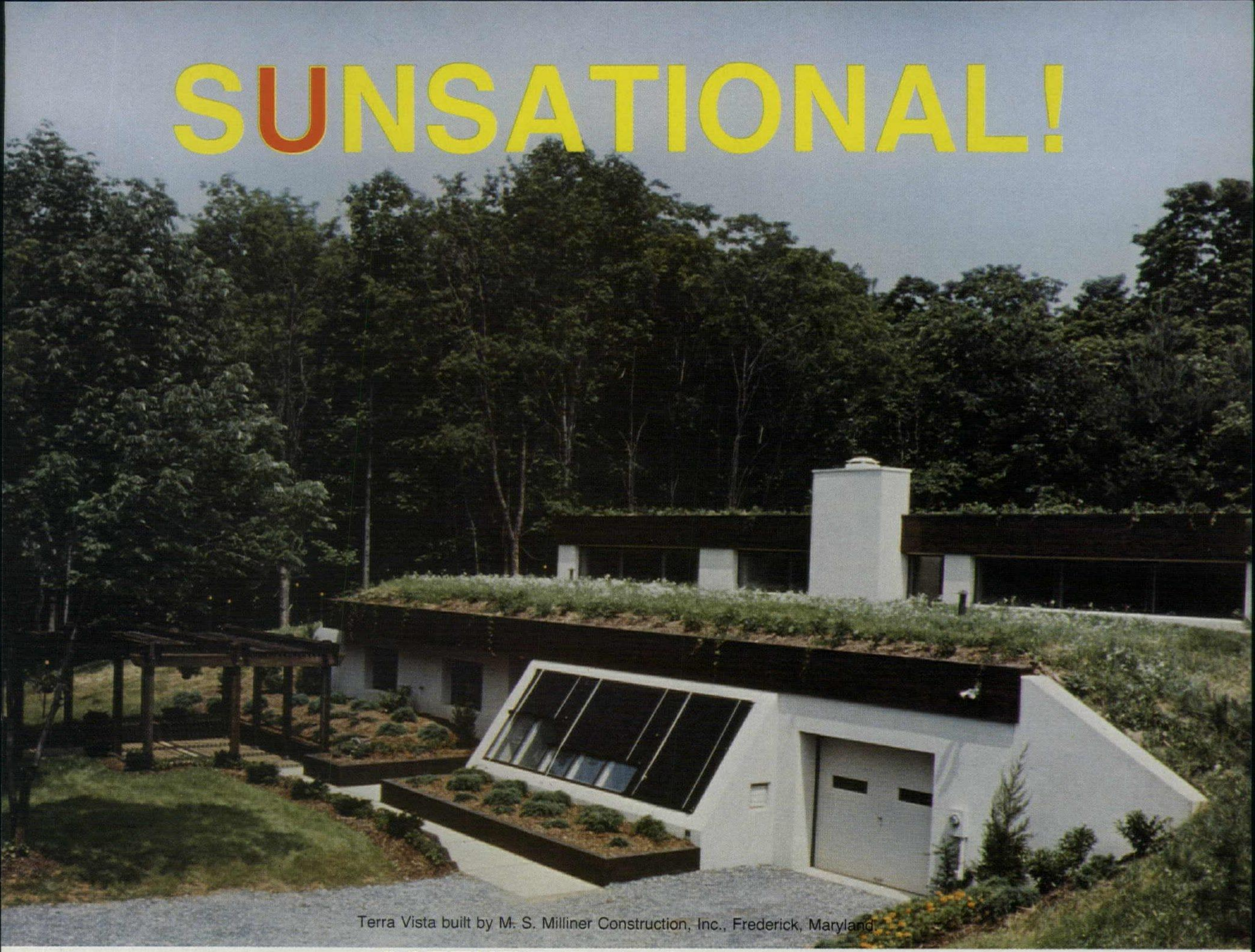
Insulated roman window shades are said to reduce heat loss by 83 percent and achieve a resistance to heat flow of R-7.69 when installed over wood-frame double-hung sash windows. The shade consists of a four-layer insulating fabric, interior decorative fabric, and a magnetic edge seal. Warm Window Division, Energy Alternative Systems.
Circle 205 on reader service card

Windows that tilt and turn, for new construction and retrofit, come in four styles: with 1-in.-thick glass and thermal break; double-glazed with optional integral Venetian blind; triple-glazed with optional integral Venetian blind; and fixed-light picture window to match the operating units. Hardware design allows the window to be turned for easy maintenance and cleaning or tilted from the top for comfortable indirect ventilation. Three Rivers Aluminum Co.
Circle 206 on reader service card

Low voltage recessed lighting fixtures that use lower wattage lamps require less energy, resulting in reduced costs. The fixtures, which provide precisely controlled accent lighting, come in four styles: black step baffle, gold cone, eyeball, and regressed eyeball. Each fixture contains its own 12-volt transformer and is designed to use a 25-watt or 50-watt PAR-36 12-volt lamp. The new fixtures conform with the National Electrical Code that requires thermal protection in all residential recessed fixtures. Progress Lighting.
Circle 207 on reader service card

Energy-Kote® ceiling panels radiate heat to objects, providing comfort at lower temperatures than systems that heat air. Each panel is individually wired and reaches operating temperature in about four minutes, according to the manufacturer. The heating element requires no resistance wires. Depending on climate and building insulation, panels on 15 to 20 percent of ceiling area will provide adequate heating. TVI Energy Corp.
Circle 208 on reader service card

Therma-Ray ceiling panels radiate heat to the floor and to solid objects, rather than heating the air. The manufacturer says that they can reduce heating costs up to 50 percent compared with the cost of oil, gas, electric baseboard, or heat pump systems, since the ceiling surfaces are heated to no greater than body temperature. Besides panels, there are 2′ x 4′ ceiling grids and floor panels. The system, which is said to cost one-half to one-third as much as conventional systems, is designed to last the life
[Products continued on page 220]



Terra Vista built by M. S. Milliner Construction, Inc., Frederick, Maryland.

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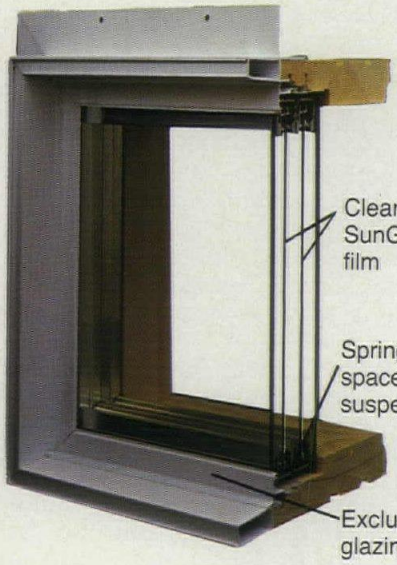

SolaireFilm wood windows and doors are a simple, beautiful way to put passive solar energy to work for you.

SolaireFilm units look like conventional triple pane windows and doors, but what a difference! Between the glass layers is a center lite of clear, resilient SunGain™ film, developed by energy researchers at 3M. A special anti-reflective coating on the film allows more of the sun's energy to pass through, yet layer for layer, the film insulates as effectively as glass.

SolaireFilm units are available in selected sizes of Weather Shield wood windows, patio doors, and insulated entrance systems. Quad pane glazing – 1-3/4" thick overall – has two lites of film in the airspace and is offered in our direct set windows.

For easy installation, low maintenance, and energy efficiency – it's SolaireFilm wood windows and doors – exclusively yours from Weather Shield!

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Products continued from page 218

of the building, without maintenance or repair. Therma-Ray Manufacturing.
Circle 209 on reader service card

The Sencon insulated wall system provides a thermally efficient exterior renovation for older buildings at low cost. It can be applied over concrete block, precast concrete, brick, gypsum sheathing, metal, or wood stud framing. An insulation board of extruded polystyrene is covered with reinforced fiberglass mesh. To this are added a bonding agent, a blend of urethane-modified cement, and a coating of acrylic clear glaze sealer. The system is available in several colors and textures. Sencon Manufacturing, Inc.
Circle 210 on reader service card

Wind turbines in 8 to 12-ft diameters produce a high output relative to size ranging from 500 W to 2 kW. They are omnidirectional, and according to the manufacturer they have a speed of rotation that remains fairly constant over a wide range of wind speeds. A 12-ft unit is said to be capable of supplying a typical household with all its electrical needs on a time-average basis. Wind Energy.
Circle 211 on reader service card

Solar Pathfinder™ can be used to facilitate solar site analysis. Included with the instrument are overlays to expand its function in determining the percentage of solar energy available seasonally at a specific location. Solar Pathways, Inc.
Circle 212 on reader service card

Literature

'Energy Conservation and Solar Energy for Historic Buildings: Guidelines for Appropriate Designs' provides architects with information about energy-conscious measures appropriate for historic buildings. The 32-page report reviews key historic features, effective energy-saving measures, and integration of these measures with historic buildings. It was prepared for the Technical Preservation Services Division of the U.S. National Park Service by Thomas Vonier Associates. The booklet is $6.95 a copy, prepaid, from The National Center for Architecture and Urbanism, 1927 S St., NW, Suite 300, Washington, DC 20009.

'Is Your Building Growing Old Before Its Time?' offers simple solutions for modernizing commercial buildings. It outlines a step-by-step approach to building modernization: survey of environmental systems; analysis of operations; engineering assistance; and installation. Honeywell, Inc.
Circle 213 on reader service card

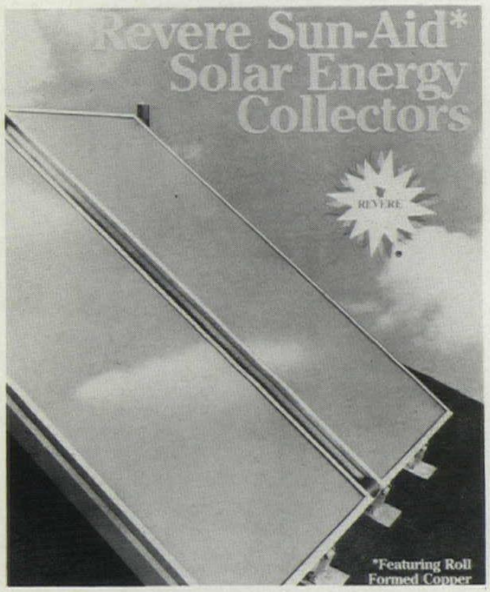
The Current Courier energy management control system is described in a four-page brochure that covers the basic components and functions of the system. A special hotel/motel application of the keyboard provides control of up to 999 room, zone, or floor HVAC and electrical systems. Environmental Control Division, American Air Filter Co.
Circle 214 on reader service card

Power Perfect 5000 energy management brochure discusses the system's ability to maximize energy savings and maintain building comfort for occupants. It is said to be a cost effective energy control system for single building installations. Johnson Controls.
Circle 215 on reader service card

Solution™ 1600 desk-top computer can handle 83 independent programs and more than 50,000,000 switching commands per week. It controls any energy-consuming load, such as lighting, heating, and air conditioning, and can activate security systems. A four-page brochure provides specifications [*Literature continued on page 222*]

Literature continued from page 220

for the system components. It is suitable for applications in buildings varying in size from single-story retail outlets to multistory office complexes. National Energy Corp.
Circle 216 on reader service card



'Sun-Aid™ Solar Energy Collectors' brochure describes this recent design using a roll-formed, all-copper absorber plate. Illustrations show both internal manifold and end outlet models and three different mounting options. Sample engineering specifications are provided. Revere Solar and Architectural Products.
Circle 217 on reader service card

'Stainless Steel Solar Collector Panels' describes the design, manufacture, and use of stainless steel absorber panels for solar hot water and heating systems. The 32-page publication includes charts tables, diagrams, and illustrations covering heat transfer characteristics, solar efficiency, corrosion resistance, mechanical properties, and typical installations. Request a free copy of publication SS011-581-5M-GP from Committee of Stainless Steel Producers, American Iron and Steel Institute, 1000 16 St. NW, Washington, DC 20036.

'Passive Solar Energy Lifestyles' describes sloped glazing for residential and commercial remodeling and new construction. The glazing incorporates skylights that can be opened to adjust heating and cooling requirements. The glazing is suitable for greenhouses and sunporches or interior applications such as sunrooms, solariums, atriums, lobbies, or studios. Wasco Products, Inc.
Circle 218 on reader service card

'Greenhouse Living' illustrates several greenhouses and glass enclosures to be used for gardening, living space, and solar collection. The full-color, 12-page brochure discusses the best type of installation to meet specific requirements. Sizes range from small window greenhouses, to large solar additions, to free-standing gardening structures. Lord & Burnham, Division Burnham Corp.
Circle 219 on reader service card

Fretric vertical blinds are offered in five different fabrics and 154 colors. Three of the fabrics are made from yarns that are inherently flame retardant. Strips are woven 4¾ or 5 in. wide, with almost invisible selvages to prevent fraying. A sixth fabric can be used where greater darkening is desirable. The strips, designed to hang free, have weights heat-sealed into the hems to prevent excessive movement. A 12-page brochure illustrates patterns in color and includes detail drawings of the system's components. Carnegie Fabrics.
Circle 220 on reader service card

'Blind Imagination,' an eight-page brochure, illustrates ways in which blinds can be used. Drawings illustrate the hardware used to operate the blinds and identify the components. A chart shows the 84 colors available. Suggested specifications are included. Marathon Carey-McFall.
Circle 221 on reader service card

External shading systems for residential and commercial use are designed to reduce solar heat gain and glare. The systems include a durable, retractable maintenance-free awning or sun screen and a headbox into which it rolls for concealment and protective storage. All
[*Literature continued on page 224*]

Manufactured in the U.S.A. under license from **Drabert** West Germany

How Mercedes Benz and Cuyahoga Vocational High School solved their parking problems.

Nova, an exceptionally comfortable, stacking chair, can cater to the upscale image of corporate dining rooms, or stand up to the pandemonium of teen agers in cafeterias and classrooms.

Nova. A three-year guarantee.

Nova's unique cross-frame design eliminates the need for easily-breakable welded connections found in many other systems.

So after successfully testing it in over 250,000 sittings, each up to 220 pounds, without any damage, we offer a three-year structural guarantee on each chair.

The shell, molded in either nylon or polypropylene, is light enough to move, yet heavy enough to provide extra strength and durability. And unlike painted metal shells, the color is integral, so a scratch on the surface only reveals the same color underneath.

Nova. Unlimited options.

When Gerd Lange designed the Nova system in 1970, winning one of Germany's leading design awards, he planned for almost every option.

You can order upholstered pads that can be replaced right on the premises, chair-stacking dollies, ganging frames, tandem units with or without tables, tandem riser mounts (for theater riser steps), fixed pedestal bases (that bolt into the floor), book racks, glide feet, tablet arms, removeable-top tables, tabletop dollies, even a variety of ashtrays.

But if you're ingenious enough to think of something more, we can probably make it on special order.

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Since its invention in 1970, Nova has sold by the tens of thousands all over the world.

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And, of course, Cuyahoga Vocational High School.

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ai

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Literature continued from page 222

systems are corrosion resistant, manufactured of anodized or electrostatically painted aluminum alloy, with nylon bearings and stainless steel springs. The 4200 and 2000 awnings and 5100 vertical sun screen, as well as interior black-out shade 6100, are described in a four-page color brochure. Levolor Lorentzen, Inc.
Circle 222 on reader service card

'Is the Wind a Practical Source of Energy for You?' explains factors that determine the feasibility of wind energy systems. The 12-page pamphlet discusses potential legal or environmental problems, energy requirements, and wind resources. Information is included about selecting a wind system and its components. Copies are available without charge from Conservation and Renewable Energy Inquiry and Referral Service (CAREIRS), P.O. Box 8900, Silver Spring, Md 29097.

Duraflex™ polybutylene pipe in an earth coil to increase the efficiency of a heat pump is the subject of a four-page report. It summarizes how a 2000-ft coil of pipe was buried in a series of circles outside a building and hooked into a 3-ton heat pump to reduce the amount of purchased energy required. According to the report, the system generated 650,000 Btu. Shell Chemical Co.
Circle 223 on reader service card

SMI Wall Systems brochure describes an exterior insulation system made up of four layers: insulation board, reinforcing fabric, base coat of synthetic plaster and Portland cement, and a finish coat. The eight-page color brochure illustrates methods of installation and provides technical data about physical properties, R-values, and U-values. SYenergy Methods, Inc.
Circle 224 on reader service card

Building materials

Major materials suppliers for buildings that are featured this month as they were furnished to P/A by the architects.

Vocational Technical Education Facility, St. Paul, Mn (p. 128). *Architects: Architectural Alliance, Minneapolis, Mn.* Brick: Ochs Brick and Tile Co. Windows, curtain wall, aluminum doors, and clerestories: Kawneer. Glass block: Pittsburgh Corning. Interior wall panels: Capaul. Doors: Eggars Corp., Curries Manufacturing, Dalton Corp. VAT: Kentile Floors. Acoustical ceilings: United States Gypsum. Paint: Benjamin Moore. Hardware: Yale, Von Duprin. Elevators: Dover Corp. Lighting: Keystone, Columbia, Sterner. Plumbing and sanitary: American-Standard, Sloan Royal. Sprinklers: Aurora. Converter, heating accessories, circulation pump: Taco. VAV boxes, S.A. controls, absorption unit: Trane. Fin tube radiation: Standard.

Hawkweed Group Offices, Osseo, Wi (p. 132). *Architects: The Hawkweed Group.* Poured concrete footings and floor slab. Wood frame, including all-weather wood for subsurface walls. Exterior walls: 1 x 8 shiplap pine. Interior walls and ceilings: gypsum board. Wood windows: Andersen. Doors: Morgan. Asphalt roofing: GAF. Sealant: Dow silicone. Insulation: Owens-Corning Fiberglas. Exterior paint: Samuel Cabot "double white." Interior paint: Pratt & Lambert Lyte-all Flowing Flat. Door hardware, brushed chrome: Schlage. Door closers: LCN. Communications: General Telephone. Handrails: cherry from site. Fluorescent lighting: Harvstone. Exterior lighting: Romex. Plumbing fixtures: Kohler. Shelving/files: Anderson Hickey. Chairs: Global Upholstery.

Mississippi County Community College, Blytheville, Ar (p. 134). *Architects: Cromwell, Neyland, Truemper, Levy & Gatchell, Inc., Little Rock, Ar.* Reinforced concrete footings: Razorback Concrete. Steel structure: Searcy Steel Co., Merco Steel Co. Reinforced concrete walls: Razorback Concrete, Searcy Steel Co. Concrete slabs and floors: Razorback Concrete, Merco Steel Co. Textured concrete: Elwin G. Smith. Insulated sandwich panels: Kawneer. Glazed vertical curtainwall: Kawneer. Sloping and radial frame and glass: IBG International. Aluminum and glass entry: Kawneer. Interior doors: Weyerhauser,
[*Materials continued on page 226*]

Materials continued from page 224

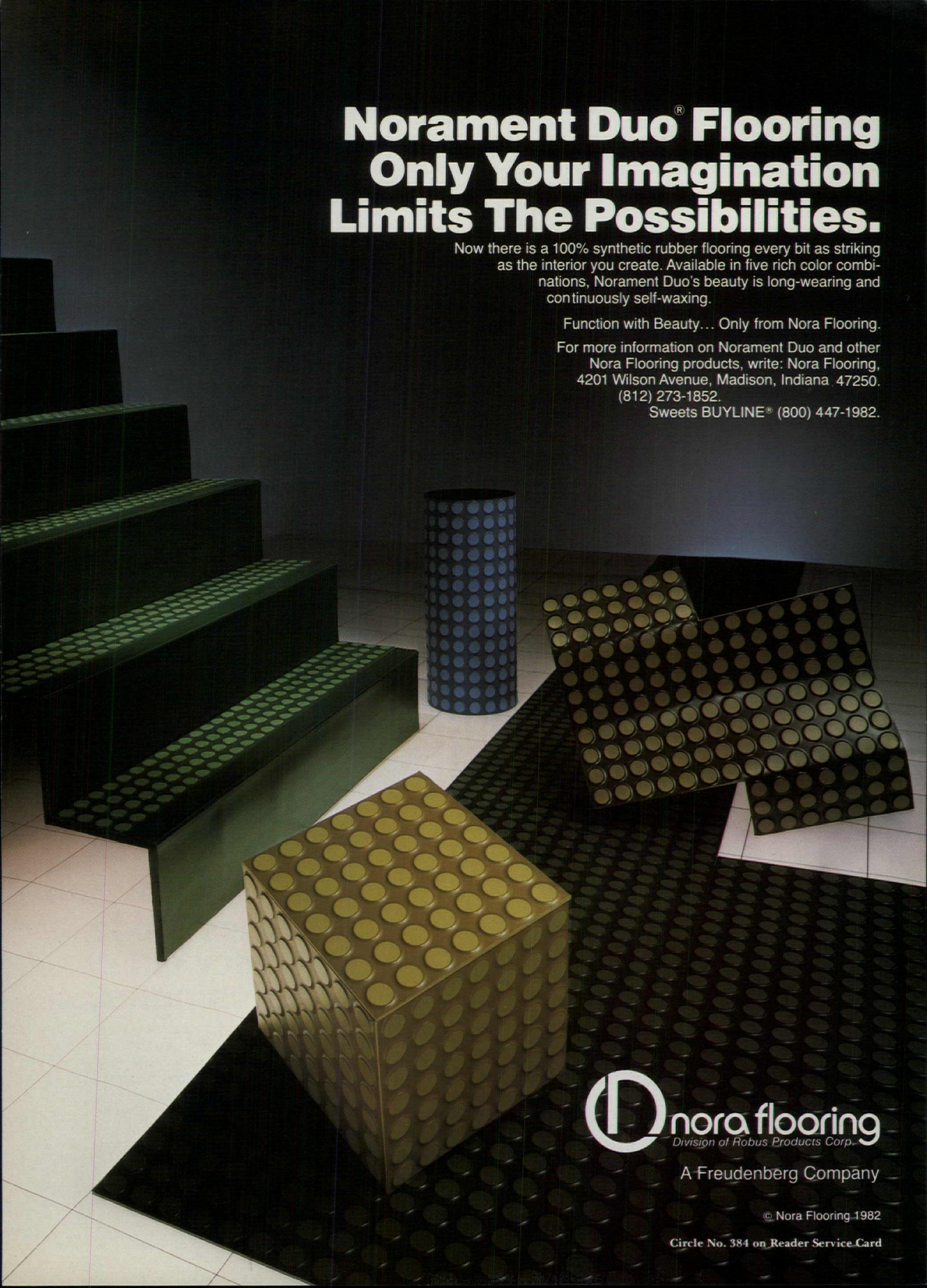
Continental Door Corp. Metal sectional doors: Overhead Door Co. Ceilings: Owens-Corning Fiberglas. Built up roofing foamed in place: Owens-Corning Fiberglas, Western Waterproofing. Sealants: Western Waterproofing. Insulation: Owens-Corning Fiberglas. Scuppers: Searcy Steel Co. Hinges: Hager Hinge Co. Locksets, deadbolts, and panic bars: Russwin. Fire pull stations: Simplex. Auditorium seating: American Desk Mfg. Co. Wood laboratory equipment: Taylor Equipment Co. Hydraulic elevators: Westinghouse. Lighting: Lightolier. Plumbing and sanitary: Crane Co. Flush valves: Sloan Valve Co. Washroom accessories: Bobrick. Water fountains: Western Drinking Fountains. Boiler: Bryan Steam Corp. Water storage tanks: Gaskell Co. Electric chiller: Carrier Corp. Air handling units and cooling tower: Marley Co. Energy management system for HVAC and lighting: Honeywell, General Electric. Carpets: Robertson, Lees, Bigelow. Vertical blinds: Louver-Drape. Horizontal blinds: Levolor. Auditorium seating: Heywood-Wakefield. Concentrating solar collectors: Solar Kinetics. Solar PV cells: Solarex Corp.

One University Plaza, Fairfax, Va (p. 138). *Architect: Alternative Design, Walter Roberts Architect, Reston, Va.* Reinforced concrete, composite roof slab: Lehigh Portland Cement Co. Roof deck: United Steel Deck, Inc. Windows: Howmet-Terrel. Doors: Kawneer. Floors: Metropolitan Ceramics. Ceilings: Armstrong. Roofing: Carlisle Corp. Waterproofing: Tremco. Insulation: Integrated Insulation Systems; Owens-Corning. Drains: Josam Manufacturing Co. Wood stud partitions: Holcomb & Hoke Manufacturing Co. Movable partitions: Foldoor. Exterior clear finish: Flood Co. Interior paint and varnish: Duron Manufacturing Co. Hardware: Mont Hardware; Falcon; LCN; Kawneer. Kitchen equipment: Dwyer. Handrails: Robson-Downes. Exterior lighting: Devine Lighting, Inc. Interior lighting: Columbia Lighting, Inc.; Lam, Inc.; Westinghouse. Dimmers: Lutron Electronics. Plumbing fixtures: Kohler. Fittings: Moen. Flush valves: Sloan Valve Co. Bathroom partitions: Global Steel Products. Bathroom accessories: A & J United Machine and Metal Products. Water fountains: Halsey Taylor. Heat pump: General Electric. Pneumatic controls: Honeywell. Carpet modules: Lees. Lamps: McGraw Edison. Acoustical panels: Armstrong.

Sundance, Reston, Va (p. 140). *Architect: Alternative Design, Walter Roberts Architect, Reston, Va.* Concrete spread footings: Lehigh Portland Cement Co. Concrete masonry: Cherrydale Concrete Block Co. Gypsum board: Gold Bond. Wood casement windows: Rolscreen Co. Metal insulated doors: Stanley. Ceramic tile: Franciscan. Sealant: General Electric. Insulation: Owens-Corning. Exterior clear finish: Flood Co. Interior paint: Benjamin Moore. Hardware: Ironmonger. Kitchen equipment: Amana; Thermador; Waste King; Maytag. Insulated curtains: Thermal Technology Corp. Lighting: Peter Barna Lighting Design. Plumbing fixtures: American-Standard. Fittings: Fearless Faucets; Moen; Architectural Complements.

Sisko House, Metuchen, NJ (p. 142). *Architects: Kelbaugh & Lee, Princeton, NJ.* Concrete block foundation and Trombe walls. Slab on grade floor. Wood frame. Exterior red cedar shingles. Gypsum board interior walls. Wood windows: Caradco. Operable skylight: Velux. Fixed skylight: Wasco. Steel exterior door, foam core: Benchmark. Interior wood panel doors: Spartan. Overhead doors, foam core: Raynor. Carpet: Armstrong. Vinyl sheet flooring: Flexco. Asphalt roof shingles: Bird & Son. Cellulose fiber insulation. Clear creosote on shingles: Cabot. Exterior oil paint, interior latex. Stainless steel door levers: Almet. Plastic lever handles, interior: Hervi from Ironmonger. Exterior lighting, low-pressure sodium: Moldcast. Plumbing fixtures and fittings: Kohler. Plastic bathroom accessories: Toobs. Fiberglass shower stall: American-Standard. Black chrome selective foil for Trombe wall: Berry Solar Products. Exhaust fan: Chelsea. Glass-doored fireplace: Fuego.

Bonilla House, Cream Ridge, NJ (p. 144). *(Architects: Kelbaugh & Lee, Princeton, NJ.* Concrete block foundation and Trombe walls. Wood frame. Floors slab [*Materials continued on page 228*]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Materials continued from page 226

on grade, 2 x 8 pine for upper floors. Exterior walls 1 x 6 cedar. Interior walls gypsum board and 1-in. yellow pine boards. Wood awning and casement windows: Caradco. Roof window: Velux. Ponderosa pine interior doors: Morgan. Overhead door: Raynor. Flooring maple and quarry tile from Germany. Roll roofing and built-up. Cellulosic fiber insulation. Exterior clear creosote: Cabot. Interior transparent wood finish: Water-Lox. Plastic door levers and handrails: Hervi from Ironmonger. Exterior steel door levers: Schlage. Kitchen cabinets: Allmilmö. Refrigerator: Subzero. Cooktop and oven: Chambers. Dishwasher: KitchenAid. Burglar and fire alarms: ADT. Exterior lighting, low-pressure sodium: Moldcast. Interior lighting: Lightolier. Plumbing fixtures: Architectural Complements. Whirlpool bath: Jacuzzi. Wood/gas furnace: Yukon. Wood stove: Rais, Denmark. Exhaust fan: Chelsea. Blinds: Levolor, Riviera.

Iowa Public Service Company corporate headquarters, Sioux City, Ia (p. 146). *Architects: Rossetti Associates, Detroit, Mi, in joint venture with Foss, Englestad, Heil Associates, Sioux City, Ia.* Iron spot brick: Sioux City Brick and Tile. Terra cotta: Gladding McBeam. Ceramic tile: Franciscan Ceramics. Gypsum board: U.S. Gypsum Co. Clear glass and aluminum entrance doors and frame: Kawneer. Plastic laminate interior doors: V.T. Industries. Hollow metal doors: Steelcraft. Garage door: Inryco. Quarry tile: American Olean. Carpet: Capitol. Wood floors: PermaGrain. Ceiling systems: U.S. Gypsum. Built up roof felt: GAF. Insulation: Vulcan, Owens-Corning. Metal stud and gypsum board partitions: U.S. Gypsum. Folding partitions: Modernfold. Paint: Pittsburgh. Hardware: Stanley hinges, Schlage locksets, LCN door closers, Von Duprin panic exit hardware. Kitchen equipment: Hobart, Vulcan, Blodgett, Victory. Telephone system: Northern Telecom. Intercom: Altec. Raised floor: Donn Products. Operations center equipment: IBM. Control center: Leeds & Northrup. Building management computer system: Honeywell. Lockers: Interior Locker. Signage: Unitec Architectural Signage. Elevators and escalators: Westinghouse. Fluorescent lighting: Columbia. Custom HPS and metal halide atrium lighting: Northern Light. Electric distribution: General Electric. Lavatories: Du Pont Corian. Water closets: Kohler. Plumbing fittings and flush valves: Sloan. Toilet stalls: Global. Water fountains: Halsey Taylor. Fan coil units: International. Air handling equipment: Bohn. Nylon rugs: Spectrum Design. Wool rugs: Tai Ping. Table lamps: Castelli. Acoustic panels (wood) and desks: Harvey Probber. Metal filing and cabinets: Storwall. Table tops: Harvey Probber; bases, Krueger. General seating: Herman Miller. Other seating: Metropolitan, Claud Bunyard, Knoll. Vertical blinds: Louver Drape. Fabric: Boris Kroll. Panels (other acoustic): DeCoustics.

John Nutting Apartments, Amherst, Ma (p. 150). *Architects: Juster Pope Associates, Shelburne Falls, Ma.* Cedar clapboards: Atlantic First Colony by MacMillin Bloedel. Gypsum board: U.S. Gypsum. Windows: Andersen Corp. Insulated steel doors: Taylor Building Products. Vinyl tiles: GAF. Carpet: Gulistan. Asphalt shingles: GAF. Batt insulation and sheathing: Owens-Corning Fiberglas. Stain: Olympic. Latex paint: Pratt & Lambert. Hinges: Stanley. Lever handle: Sargent. Oven: Jenn-Air Corp. Double sink: Elkay. Cooktop: Chambers. Washer and dryer: Westinghouse. Exterior lighting: Moldcast. Interior lighting: Progress. Water closets: American-Standard. Plumbing lever controls: Delta. Showerheads: Symmons. Heat pump: Carrier Corp. Kitchen cabinets: St. Germaine Woodworking. Exterior benches: Sitecraft by Rosenwach, Inc.

Visitor Center, Antelope Valley, Ca (p. 154). *Architects: The Colyer/Freeman Group, San Francisco, Ca.* Reinforced concrete: A.V. Ready Mix Inc. Concrete block: ORCO Block Co., Inc. Reinforced concrete pan joist system: The CECO Corp. Windows: Kawneer. Glass block: Circle Redmont. Doors: Kawneer; J-Door, Inc. Ceramic pavers: Dallas Ceramic Co. Sprayed acoustical [*Materials continued on page 230*]

Materials continued from page 228

ceiling: American Energy Products. Membrane waterproofing: Carlisle Tire and Rubber Co. Insulation: Dow Chemical. Paint: Dunn-Edwards Corp. Hardware: Kawneer; Hager Hinge; Schlage; LCN; Builders Brass Works. Wind electric generator: Jacobs Wind Electric Company. Curtain fountain: PEM Fountain Co. Lighting: Prescolite; Peerless; Halo. Plumbing fixtures: American-Standard. Plumbing fittings: Chicago Faucet. Flush valves: Sloan Valve Co. Bathroom partitions: Bobrick Washroom Equipment, Inc. Plastic laminate: Sanymetal Products Co. Water fountain: Haws Drinking Faucet Co. Cabinets: United Wood Products. Exterior sunshades: Halu-Rollscreen. Thermal shades: Appropriate Technology Corp. Drapery hardware: FABCO.

Cabrillo Village Farmworkers Cooperative Housing, Saticoy, Ca. (p. 156). *Architects: John V. Mutlow of Mutlow-Dimster Partnership, Los Angeles, Ca.* Stucco: La Habra. Aluminum windows and clerestories: Regency Aluminum Products. Roofing: Johns-Manville. Insulation: Owens-Corning. Interior paint: Dunn-Edwards. Kitchen equipment: Gaffers & Sattler. Lighting: Halo, Lite Trend. Fiberglass tubs: Hess Co. Water saver toilets: Norris. Faucets: Price Pfister. Heating: Payne, Glass-Flex. Fans: Hunter. Solar storage tanks: Mor Plo/American. Solar collectors: Raypack. Wood structure: Louisiana-Pacific. Partitions: U.S. Gypsum. Doors: Lifetime Door. Concrete: Colton Cement. Carpet: Armstrong. Paint: Dunn-Edwards. Hardware: Westlock. Kitchen cabinets: Rubottom Mfg. Co. Cable TV: Century TV.

Sun-Up Dormitory, Carbondale, Co (p. 160). *Architect: David Finholm, Aspen, Co.* Windows: Pella. Greenhouse roof window: CY/RO Industries. Roof membrane: Mameco International. Interior insulation: Owens-Corning. Exterior styrofoam insulation: Dow SM. Hardware: Lawrence Brothers; Schlage; LCN; Von Duprin. Kitchen cabinets: Mastercraft. Energy-saving appliances: Amana; Litton. Insulating curtains: Thermal Technology Corp.

Alabama Operations Center, South Central Bell Telephone Company, Birmingham, Al (p. 162). *Architect: Giattina & Partners, Birmingham, Al.* Concrete reinforcing: Ceco Corporation. Post-tensioning tendons: Prescon Corporation. Precast concrete fascias and soffits: Exposaics Industries. Glazing: PPG Industries. Pivoting aluminum windows: Marmet Corporation. Skylights: IBG International. Glass entrance doors: Blumcraft. Aluminum and glass entrance doors: Kawneer Company. Granite paving and lobby floor: Capitol Marble & Granite Co. Carpet tile: Carpets International. Clay tile flooring: Gail International. Ceiling system: Johns-Manville. Roof insulation: Dow Chemical. Inverted roofing membrane and adhesive waterproofing membrane: W.R. Grace & Company. Open office partitions: Steelcase. Private office demountables: Donn Corporation. Paint: Glidden. Hinges: McKinney. Locksets and closers: Russwin. Building management system: Honeywell. Exterior signage: Spanjer Brothers. Interior signage: Vomar Products. Kitchen equipment: Hobart, Market Forge, The C. Schmidt Co., The G.S. Blodgett Co., Toastmaster, Victory, Shelley Manufacturing Corp., Industrial Washing Machine Corp., Traycon Manufacturing Co., Salvajor Co., G.S. Blakeslee & Co. Hydraulic elevators: Westinghouse. Stainless steel handrails: Livers Bronze Co. Plumbing fixtures: Kohler Co. Flush valves: Sloan. Slow closing faucets: T&S Brass & Bronze Works. Toilet stalls: Sanymetal Products. Washroom accessories: Bobrick. Water fountains: Filtrine Mfg. Sprinklers: Reliable Sprinkler Co., High-efficiency chillers: York Division of Borg-Warner. Heat recovery chillers: Carrier Corp. Solar collectors: Sunworks Division of Enthone. Open office area lighting: Columbia. Conference room lighting: Versa-Tech Corp. Electric distribution: Square D (main power); H.H. Robertson (underfloor).

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Coming next month

Architecture of Death, the subject of landmark cemetery and memorial designs of the past, went into eclipse in recent decades as the subject of dying was banished from polite conversation. Recently, however, the commemoration of the dead has again become the subject of some eloquent design, to be examined in a cluster of articles in this issue.

P/A's Furniture Competition will be the subject of an extensive report, with generous illustrations and jury comment. The second annual running of the contest has produced a large crop of winners, effectively embodying a range of attitudes from utterly practical to symbolically critical.

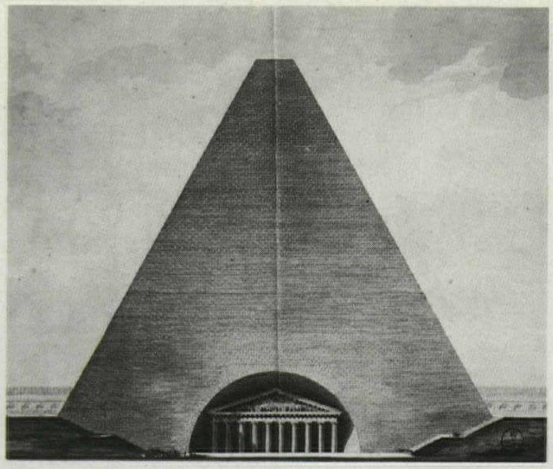
Office Partition Systems will be the subject of an Interior Technics article examining the features and promised benefits of the numerous offerings in today's market.

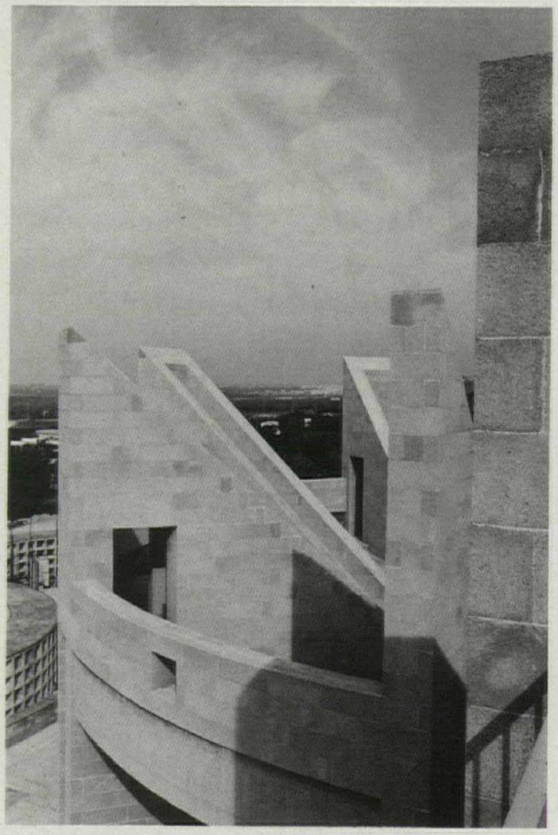
Computer Graphics, also known as Computer Aided Design and Drafting or CADD, will be the subject of a thorough briefing by an acknowledged expert in the field. Increasing sophistication and decreasing costs are making these systems feasible for a wider range of firms and tasks. But don't discard your pencil sharpener until you have absorbed this wisdom on the subject.

And that's not all; there will be features on some interesting new buildings, news, columns, the latest word on products and books, plus . . .

NEOCON will be previewed in a portfolio of interiors products to be unveiled. Now in its 14th year, the big conference and showroom open house at Chicago's Merchandise Mart will, of course, be bigger than ever. Even if you can't attend, P/A's preview will keep you informed.

P/A in June will encompass a collection of featured buildings—and a new landmark interior—that have nothing in common except their exceptional quality as architecture.





Cenotaph design by Etienne-Louis Boullée (top); Cemetery in Italy by GRAU (middle); award-winning corner table by Richard Davidson (bottom).

P/A in May: cemeteries, furniture, partitions, computers...

Here are two of the best elevator operators in the world.

In their day, white gloved elevator operators were the best way to get from one place to another. Times changed. So much so, that even the mechanical programmers designed for the first automatic elevators became inadequate.

Twelve years ago, Schindler Haughton replaced mechanical programmers with integrated circuits. The equipment was so advanced that this electronic chip could analyze more than 27,000 possible service combinations (and select the best one) in 10 milliseconds. It took our competitors a decade to catch up. Now we have even more advanced microprocessing equipment. It's the best of its kind.

Today, Schindler Haughton is part of the world's second largest elevator company with a full line of geared, gearless and hydraulic elevators and escalators. Each supported by systems that dramatically improve passenger service and reduce operating expenses.

Times have changed. And so have we. But we're still committed to delivering white glove service in a push button world.

We're #2 in the world and going one better.

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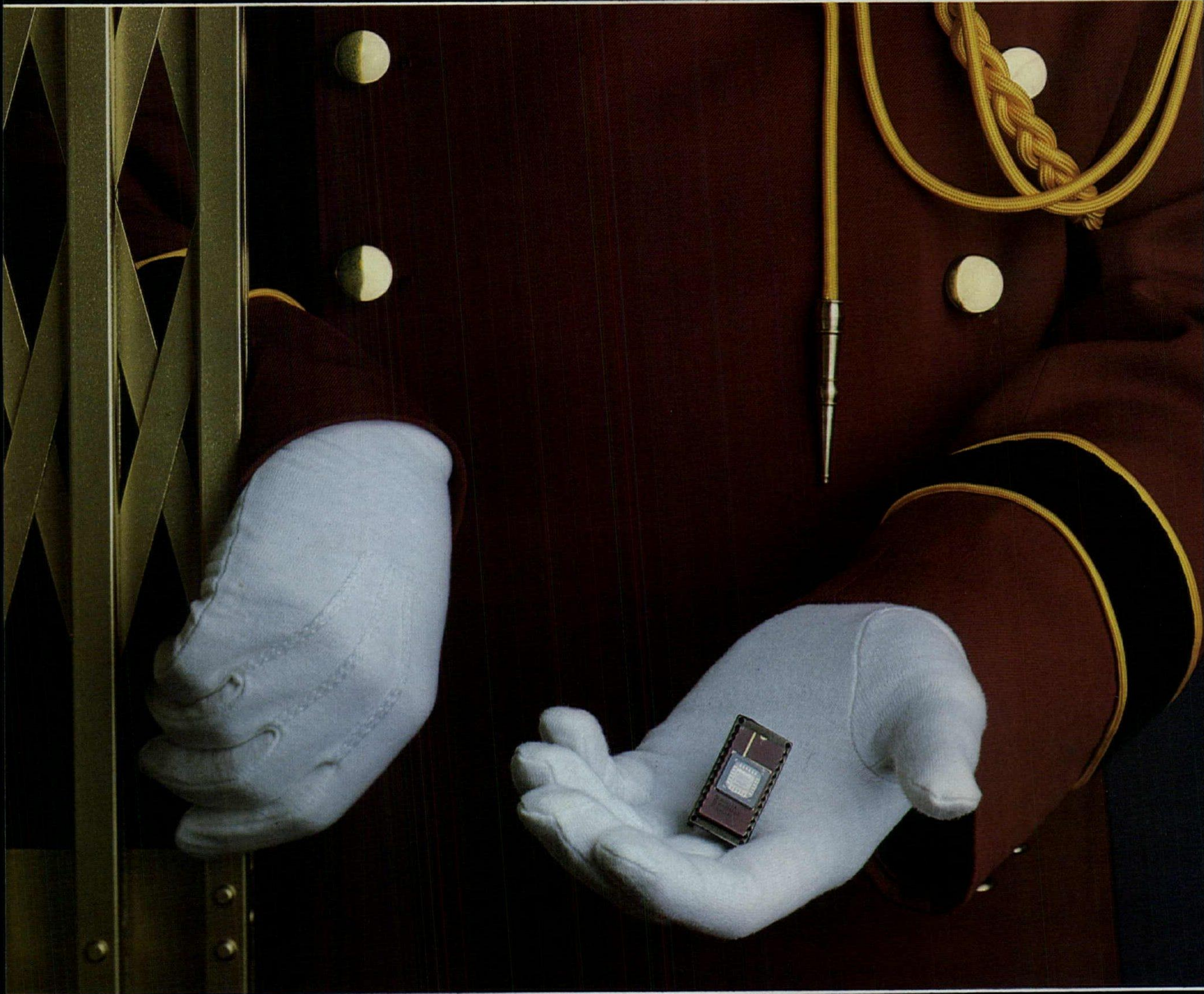

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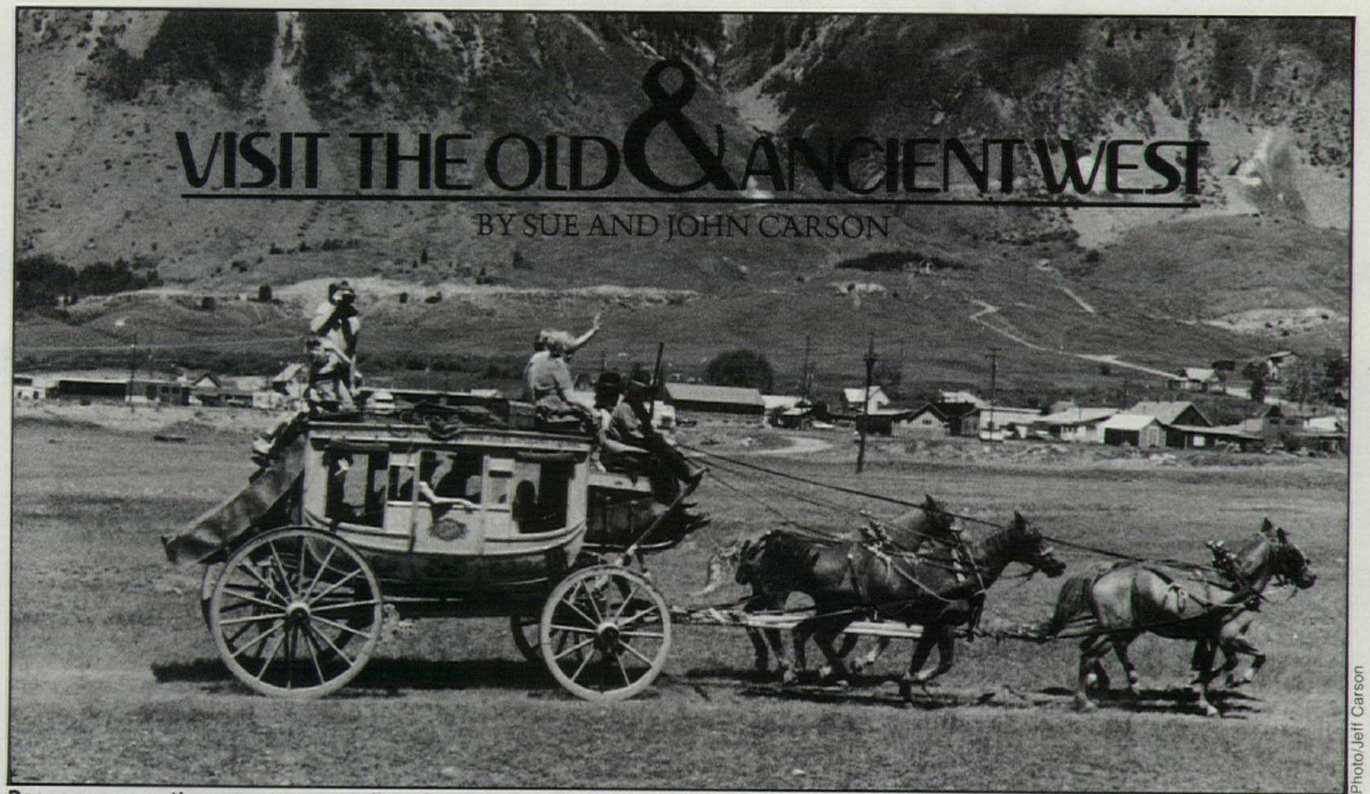
SCHINDLER 1874

VISIT THE OLD & ANCIENT WEST

BY SUE AND JOHN CARSON



Photo/Jeff Carson

Passengers on the narrow-gage railroad are greeted by a stagecoach at Silverton.

Nestled in a valley in southwestern Colorado, about midway between the Grand Canyon and Denver, Durango is worth at least a two-day visit on an auto tour of the Rocky Mountain states.

Durango's location between the region's foremost natural wonder and its largest metropolis is historical as well as geographical. The small (population 12,555) city's two major attractions are relics of the pre-Columbian era and of Colorado's rollicking mining days of the late 1800s.

Mesa Verde National Park, 38 miles west of Durango on U. S. 160, contains extensive ruins and artifacts from an American Indian culture that disappeared some 700 years ago.

Rising 2,000 ft above the semi-arid valley, the mesa first was occupied by Indians sometime between A.D. 550 and 750. About 1200, the Indians vacated the top of the mesa and built a series of villages made up of apartment-like pueblos hanging on the side of the cliffs.

By 1300, the Indians had abandoned the mesa entirely. Their majestic homes remained hidden as the Spanish conquistadors traveled through the valley. Finally, in 1888, two cowboys searching for stray cattle stumbled upon one of the most spectacular cliff dwellings.

After a trip up a narrow winding road, park visitors can drive around the top of the mesa and stop to view the ruins. Paths lead to most of the pueblos. Some, such as Spruce House, can be reached with easy walks. Others, such as Cliff Palace, the largest of the dwelling complexes, require a climb down a tight winding path and up a primitive ladder.

A comprehensive museum traces the development of the mesa Indians' civilization from their arrival until their departure, when they apparently were assimilated into other tribes.

From the highest point on the mesa—8,572 ft altitude—six mountain ranges in four states can be seen. Visible, too, is the Four Corners country of the Navajo Reservation, the only place in the U. S. where four states meet.

Century-old train. Durango also is the home station for the "Silverton," the last regularly scheduled narrow-gage train operating in the U. S.

Pulled by a smoke-belching steam locomotive, the Denver & Rio Grande Western Railroad train includes passenger cars built as early as 1878. Newer cars have been built to match the style of that era. Coal stoves still heat the cars on cool days.

A 90-mile round trip to Silverton, an old silver-mining town, takes all day. Tracks wind through the breathtaking beauty of Las Animas Canyon and the San Juan National Forest. Towering mountains, rushing

Photo/Michael Carson

The "Silverton" winds through spectacular mountain scenery.

streams, and whispering forests provide a view of the Rockies not available while speeding along interstate highways.

When the train arrives in Silverton, it is met by a stagecoach and horseback riders. A 2-hour layover allows plenty of time for lunch at the Silverton Hotel, complete with entertainment. Smaller lunchrooms also are available. Shops selling items such as turquoise jewelry, leather goods, western hats, and samples of silver line the streets of the town, which was declared a National Historical Monument in 1962.

The train operates daily from Memorial Day weekend through September. Reservations must be obtained in advance from the Denver & Rio Grande station in Durango—the train is always sold out.

Skis, horses, rafts. Sightseeing represents only part of Durango's array of

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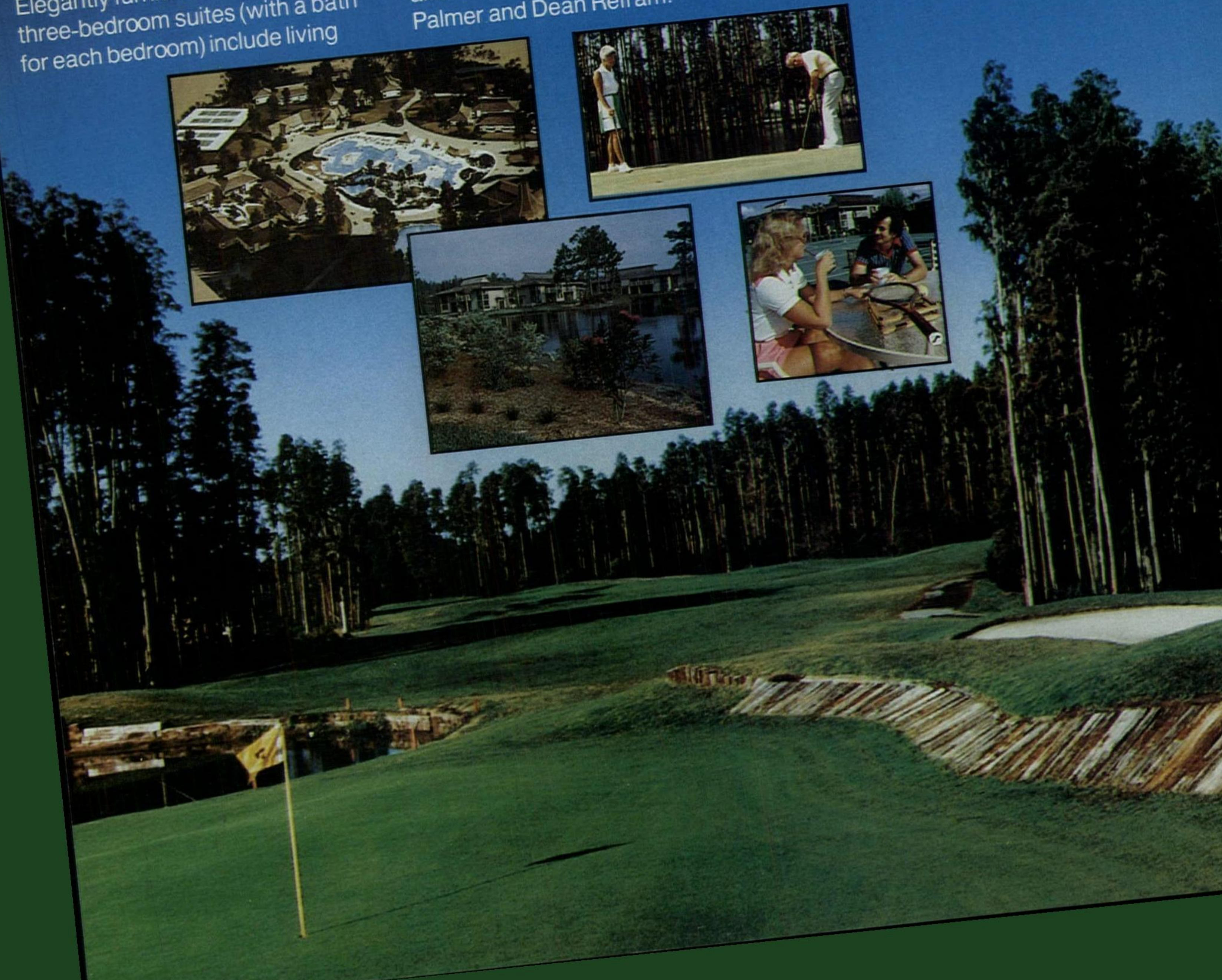

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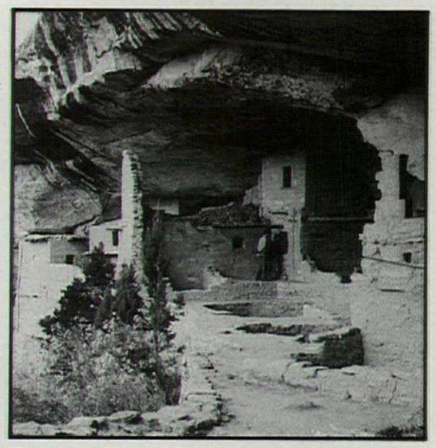

Balcony House is the second largest of Mesa Verde's "apartment" complexes.

offerings to visitors. Recreation opportunities abound.

Twenty-five miles north of Durango in the San Juan forest is Purgatory, southwestern Colorado's largest ski area. In winter it offers 510 acres of ski trails, five double chairlifts, and two rope tows. From May through October, when other attractions are drawing tourists to Durango, Purgatory remains open by operating an alpine slide. A chairlift ride to the top of the slide is followed by a 2,300-ft ride on a one-person sled down winding sculptured tracks.

Durango is surrounded by numerous alpine lakes and mountain streams. Twenty miles northeast is Lake Vallecito, one of Colorado's largest lakes. Lined by resorts and lodges, the lake offers excellent fishing for rainbow trout, brown trout, kokanee salmon, and pike.

Located in the center of a big-game hunting area, Durango has a number of licensed guides available to lead hunters to elk, deer, or bear.

Several guest or "dude" ranches are located in the area, one of them accessible only by horseback or the Silverton train.

Full- and half-day raft tours are available on the Animas River. Raft excursions several days long travel along the Dolores and San Juan rivers.

Bunk and grub. Durango has 47 hotels and motels, including the General Palmer House on Main St., which dates back to the early mining days and is one of Colorado's oldest continuously operated hotels. Named for

What makes this radar detector so desirable that people used to willingly wait months for it?

Anyone who has used a conventional passive radar detector knows that they don't work over hills, around corners, or from behind. The ESCORT® radar warning receiver does. Its uncanny sensitivity enables it to pick up radar traps 3 to 5 times farther than common detectors. It detects the thinly scattered residue of a radar beam like the glow of headlights on a dark, foggy road. You don't need to be in the direct beam. Conventional detectors do. Plus, ESCORT's extraordinary range doesn't come at the expense of more false alarms. In fact, ESCORT has fewer types and sources of false alarms than do the lower technology units. Here's how we do it.

The unfair advantage

ESCORT's secret weapon is its superheterodyne receiving circuitry. The technique was discovered by Signal Corps Capt. Edwin H. Armstrong in the military's quest for more sensitive receiving equipment. ESCORT's Varactor-Tuned Gunn Oscillator singles out X and K band (10.525 and 24.150Hz) radar frequencies for close, careful, and timely examination. Only ESCORT uses this costly, exacting component. But now the dilemma.

The Lady or The Tiger

At the instant of contact, how can you tell a faint glimmer from an intense radar beam? Is it a far away glint or a trigger type radar dead ahead? With ESCORT it's easy: smooth, accurate signal strength information. A soothing, variable speed beep reacts to radar like a Geiger counter, while an illuminated meter registers fine gradations. You'll know whether the radar is miles away or right next to you. In addition, the sound you'll hear is different for each radar band. K band doesn't travel as far, so its sound is more urgent. ESCORT keeps you totally informed.

The right stuff

ESCORT looks and feels right. Its inconspicious size (1.5Hx5.25Wx5D), cigar lighter power connector and hook and loop or visor clip mounting make installation easy, flexible, and attractive. The aural alarm is volume adjustable and the alert lamp is photoelectrically dimmed after dark to preserve your night vision. And, a unique city/highway switch adjusts X band sensitivity for fewer distractions from radar burglar alarms that share the police frequency while leaving K band at full strength.

Made in Cincinnati

Another nice thing about owning an ESCORT is that you deal directly with the factory. You get the advantage of speaking with the most knowledgable experts available and saving us both money at the same time. Further, in the unlikely event that your ESCORT ever needs repair, our service professionals are at your personal disposal. Everything you need is only a phone call or parcel delivery away.

Carrying case and visor clip included

Corroborating evidence

CAR and DRIVER . . . "Ranked according to performance, the ESCORT is first choice . . . it looks like precision equipment, has a convenient visor mount, and has the most informative warning system of any unit on the market . . . the ESCORT boasts the most careful and clever planning, the most pleasing packaging, and the most solid construction of the lot."

BMWCCA ROUNDEL . . . "The volume control has a 'silky' feel to it; in fact, the entire unit does. If you want the best, this is it. There is nothing else like it."

PLAYBOY . . . "ESCORT radar detectors . . . (are) generally acknowledged to be the finest, most sensitive, most uncompromising effort at high technology in the field."

PENTHOUSE . . . "ESCORT's performance stood out like an F-15 in a covey of Sabrajets."

AUTOWEEK . . . "The ESCORT detector by Cincinnati Microwave . . . is still the most sensitive, versatile detector of the lot."

The acid test

There's only one way to really find out what ESCORT is all about. We'll give you 30 days to test it for yourself. If you're not absolutely satisfied, we'll refund your purchase as well as pay for your postage costs to return it. In fact, try an ESCORT and any other detector of your choice. Test them both for 30 days and return the one you don't like. We're not worried because we know which one you'll keep. As further insurance for your investment, ESCORT comes with a full one year limited warranty on both parts and labor. This doesn't worry us either because ESCORT has a reputation for reliability. We know that once you try an ESCORT, radar will never be the same again. So go ahead and do it. Order today.

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Just send the following to the address below:

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- ☐ Any special shipping instructions.
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Department 522
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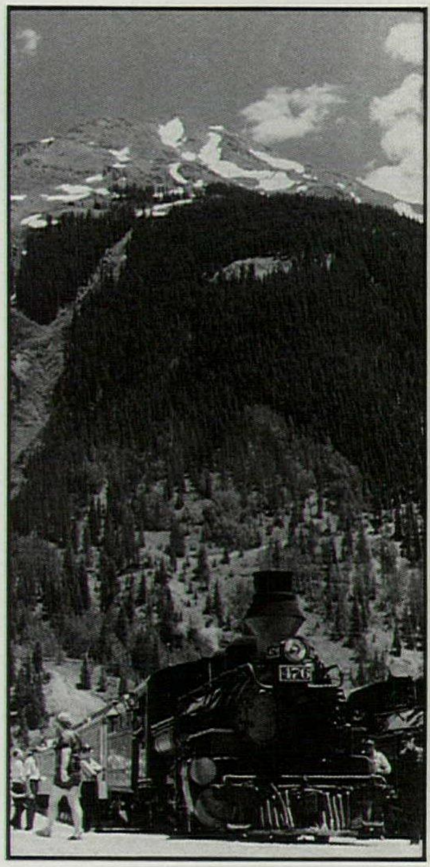
Gen. Jackson Palmer, founder of the Denver & Rio Grande, the completely restored hotel features Victorian atmosphere and brass chandeliers.

Dining in and around Durango can range from a cookout on a ranch to a gourmet dinner in a 19th century hotel dining room.

Both within 15 miles of Durango, the Bar-D Chuckwagon and the Cowboy Bar-B-Q offer ranch-style cooking served in tin plates and cups. Exuberant western shows follow the meal.

After dinner in the Opera House dining room at the old Strater Hotel on Main St., diners can see Gay '90s melodramas and vaudeville acts from the 1850-1915 era at the nearby Diamond Circle and Abbey Square theaters, which offer nightly entertainment from June through September.

And just a few blocks from where the highway leading to the ancient ruins crosses the century-old narrow-gage tracks, modern fast-food addicts can satisfy their cravings. Two all-beef patties are available beneath the Golden Arches. ■



Photo/Jeff Carson

Cookson insulated rolling doors clamp down on energy waste

Cookson has a *proven* way to gain on thermal losses—our new insulated rolling door.

To make this door an energy-saver, Cookson puts solid (not foamed) polyurethane insulation between two rolling door slats to give more thorough coverage. Exclusive slat interlock design and Cookson Weatherbar* weatherstripping give you all the advantages of a rolling door in a true, energy-saving system.

Cookson insulated and non-weatherstripped, non-insulated doors, both with 22 gauge exterior slats, were installed in a sealed, heated box. The Hughes Aircraft Company, Industrial Products Division, used their Probeye® Infrared Viewer and video thermography system to record visually the actual heat loss (within .5°C) through each door.

HERE'S INFRARED PROOF

The Cookson insulated rolling door has been tested by an independent laboratory using the ASTM C-236 Guarded Hot Box Test. Test results available on request.

Official testing proved the effectiveness of the Cookson design, but, we went one step further.

At Cookson, we think actual performance is more important than theory when it comes to saving energy dollars. So we used infrared thermography to visually show the effectiveness of the Cookson Insulated Rolling Door in a side-by-side comparison with a conventional door.

With equal amounts of heat applied to each door, a Hughes Probeye® thermal video camera accurately measured heat loss through the doors. The video images (right) are dramatic proof that the insulated door saves energy.

COOKSON ROLLING DOORS

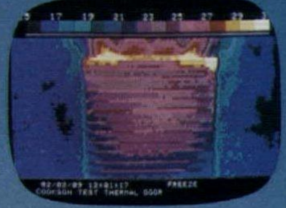
700 Pennsylvania Avenue, San Francisco, CA 94107, (415) 826-4422.

800 Tulip Drive, Gastonia, NC 28052.

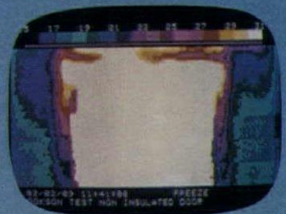
Write or call for technical data sheet on the Cookson Insulated Rolling Door or a copy of our 28-page catalog of rolling doors, grilles, and accessories.

Circle No. 323

INSULATED DOOR

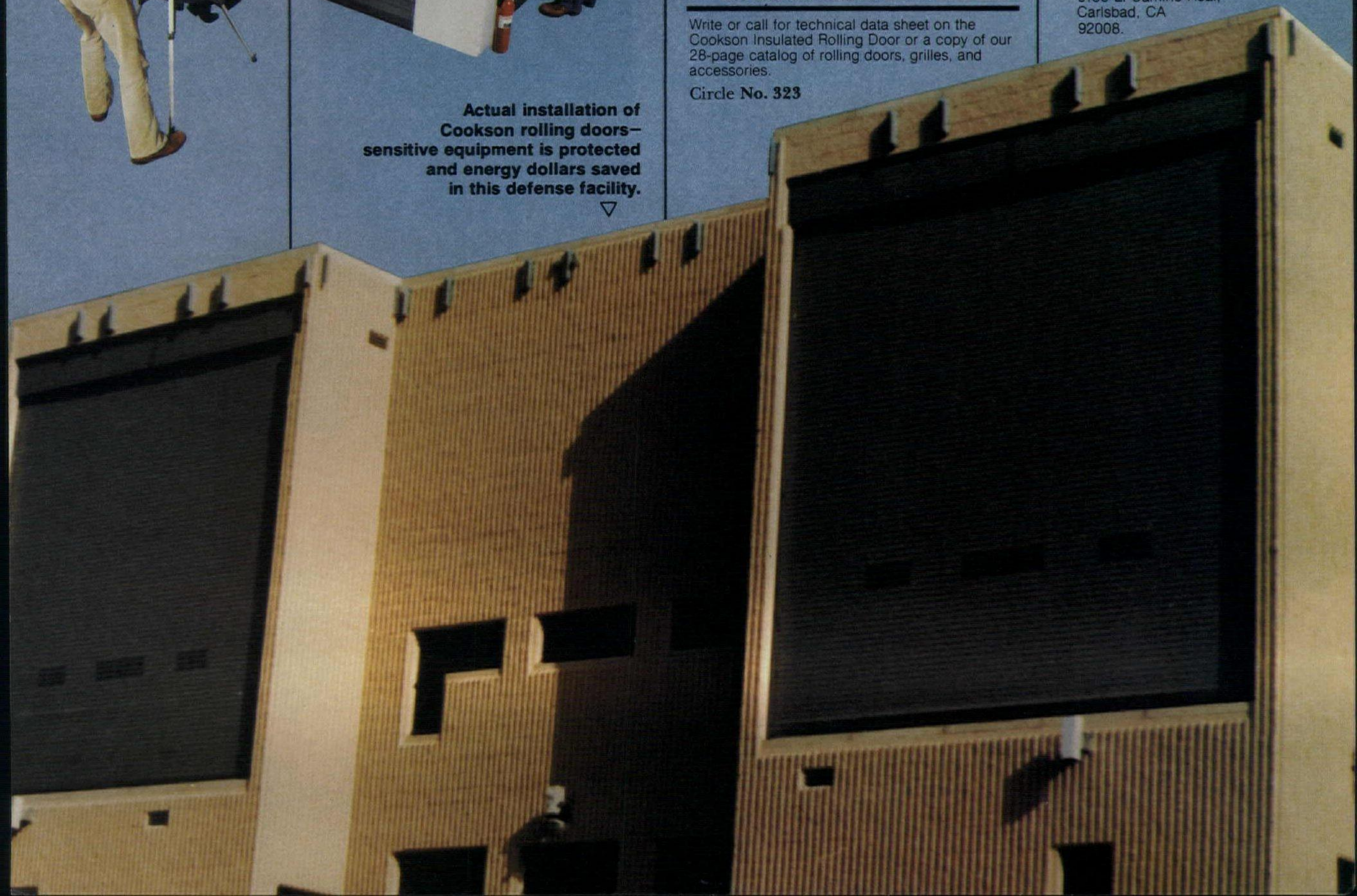


NON-INSULATED DOOR



Video images show a dramatic difference in heat loss between the two doors. White areas indicate excessive heat transfer. Only moderate loss occurs in red areas. And insulated walls, appearing blue, show no heat loss at all.

For information on the Hughes Probeye® Thermal Video System, write Hughes Aircraft Company, 6155 El Camino Real, Carlsbad, CA 92008.



Actual installation of Cookson rolling doors—sensitive equipment is protected and energy dollars saved in this defense facility. ▽

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Assistant Professor, Department of Architecture, North Dakota State University. 9 month basis beginning September 1982. Teaching architectural design and lectures/seminars in area of interest. First professional degree required; graduate degree desired; office and teaching experience considered. Application, resume and references by April 18, or when position filled: Search committee, Department of Architecture, North Dakota State University, Fargo ND 58105. NDSU is an Equal Opportunity Employer.

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UNCC's young and rapidly developing architectural program, which is dedicated to addressing our significant environmental design and planning issues, seeks faculty committed to an innovative, multi-disciplinary and rigorous architectural education. Desire persons to teach first/second, third/fourth or fifth year studios and conduct a related lecture or seminar course in an area such as: programming, environmental behavioral design, computer design graphics, preservation, design theory, building systems, or construction materials. Preference given to persons with prior teaching and practice experience. Long term, tenure track, and one-two year visiting faculty positions are available. Special Notice: In addition to the above, the College is seeking a person for 1–2 year term to serve in its newly organized Distinguished Visiting Professorship. Forward letter describing teaching and design attitudes with vitae to: Dean Charles C. Hight, College of Architecture, UNC-Charlotte, UNCC Station, Charlotte, NC 28223. Affirmative Action/Equal Opportunity Employer.

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