Armstrong invited over 2,000 specifiers to judge a

Introducing New Era® Corlon®
commercial vinyl flooring.

We asked more than 2,000 architects and designers to judge 20 different design prototypes for the New Era line, the first commercial vinyl floor of its kind.

The winners were these innovative geometric patterns. They combine the popular designs of pattern-dyed commercial carpets with all the advantages of resilient flooring. And since these specifiers selected New Era’s 10 distinctive colorways as well, you can be sure the colors all coordinate with contemporary interior designs.

New Era’s wider widths give you fewer seams.

Available in rolls 12’ wide and up to 75’ long. New Era can be installed without seams in most rooms. And virtually seamless corridors are possible, too, with specially ordered 9’-wide rolls.
beauty contest. Here are the vinyl floors that won.

When you can't avoid seams, our chemical sealant can make it look as if you did, creating the impression of a continuous flooring surface.

The fewer seams and faster installations of New Era mean less labor in both new and remodeling jobs.

Good looks that stand up to the march of time.

New Era's high vinyl-resin content makes it more resistant to scuffing and damage than most other vinyl floors. Spills also wipe right up. And no special maintenance is needed.

So let these winning designs work for you. Contact your local Armstrong representative to see samples.

Or, for more information, write Armstrong, Dept. 04FPA Lancaster, Pa. 17604.
NOW A LOW-ENERGY SYSTEM GIVES YOU HIGH-QUALITY LIGHT.
Conventional ceiling systems can give you high-quality light. Furniture-mounted systems can give you low-energy light. Now Tascon™ task lighting gives you both. Here’s a dramatic improvement in lighting systems that can cut lighting costs by over 65% in either open plan or conventional offices. (See chart below.)

The principle behind Tascon lighting is simple. The lighting fixtures, because they’re moveable, can be positioned to provide light only in the areas where it’s needed. So a properly positioned Tascon fixture provides ESI values of 40 to 60 on the work surface. With one fixture for every 100 square feet, Tascon provides this high-quality lighting for less than one watt per square foot. And the 120-volt fixture with optional on/off capability can cut lighting costs another 15%.

Unlike some low-energy systems, Tascon provides comfortable light. Because the Tascon pendant fixture illuminates from both sides, as well as above and behind, it distributes high-quality light evenly without the glare, shadows, and reflections some furniture-mounted task lights create.

And Tascon directs 20% of its light upwards to create visual interest and ambient illumination.

Armstrong Tascon fixtures fit most types of ceiling grids. The tracks that support Tascon fit most ceiling grid systems. And you can relocate them to resposition the fixtures easily. So Tascon gives you the quality of ceiling-mounted lights and the energy savings of furniture-mounted lights along with flexibility that neither can offer.

For more illuminating information about Tascon lighting fixtures, write Armstrong, P.O. Box 3001, Dept. 04NPA, Lancaster, PA 17604.

<table>
<thead>
<tr>
<th>Performance Comparison—Conventional vs. Tascon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room size</td>
</tr>
<tr>
<td>Reflectances</td>
</tr>
<tr>
<td>Ceiling</td>
</tr>
<tr>
<td>Walls</td>
</tr>
<tr>
<td>Floor</td>
</tr>
<tr>
<td>Task</td>
</tr>
<tr>
<td>Lumens/Lamp</td>
</tr>
<tr>
<td>2'x4', 4-Lamp Recessed Troffer (prismatic lens)</td>
</tr>
<tr>
<td>No. of fixtures</td>
</tr>
<tr>
<td>No. of lamps</td>
</tr>
<tr>
<td>ESI (equivalent sphere illumination)</td>
</tr>
<tr>
<td>Classical footcandles (maintained)</td>
</tr>
<tr>
<td>Watts/work station 100 sq. ft.</td>
</tr>
<tr>
<td>Watts/sq. ft.</td>
</tr>
<tr>
<td>2-Lamp Moveable Tascon Fixture (prismatic lens)</td>
</tr>
<tr>
<td>No. of fixtures</td>
</tr>
<tr>
<td>No. of lamps</td>
</tr>
<tr>
<td>ESI (equivalent sphere illumination)</td>
</tr>
<tr>
<td>Classical footcandles (maintained)</td>
</tr>
<tr>
<td>Watts/work station 100 sq. ft.</td>
</tr>
<tr>
<td>Watts/sq. ft.</td>
</tr>
</tbody>
</table>
More awards feedback

The 27th P/A Awards issue depicts a segment of a profession gone looney—publicly illustrating a very distinct reason for avoiding the use of an architect where possible.

You and your staff can be excused only by admitting that the issue was prepared during the office Christmas party.

Conrad C. Jankowski, AIA
Jankowski Associates
Fort Wayne, In

Architecture by Appliqué dates back at least to the first primeate with a wad of mud in his hand and neoclassicism in his heart, so it is ironic to find a periodical devoted to eulogizing clumsy contemporary examples and calling itself "progressive." The sophistry of Venturi and his school is embarrassed by visual comparison to the conceptual force and invention evident in the eclectic work of Maybeck and Wright. It would seem that these predecessors were inspired by something transcending next month's issue. Cancel mine.

Bik Edmonds
Architect
Tampa, Fl

The P/A Design Awards program has become a self-serving and a predictable insidious recurrence. For many years it was Moore and clones, now it is Graves and clones, with the ethic clearly being, "the more eclectic, decorative, and unbuildable, the better." What a comment!

Charles Gwathmey
Gwathmey Siegel & Associates, Architects
New York, NY

Putting arguments concerning aesthetics to the side, the really shocking thing about the projects honored in this year's awards program is the narrowness. You yourselves acknowledge it. What a poor excuse, blaming it on the "disappointing quality" of the other submissions. Perhaps your jury selection process is so poor that the narrowness lies in it. Or, architects dealing with issues other than façades and formalism have given up submitting to your awards. Small wonder considering the standard you have been setting in recent years with the pink house, inaccessible voids, and the like. Either way, the responsibility is yours. P/A is painting itself into a decorated, stage-set corner.

As the cutting edge of the profession, which is where a progressive architecture magazine should be, there are more issues to be dealt with than just "aesthetic and formal aspects." One might hope twenty awards and citations for architectural design would reflect that. The saddest outcome of this year's awards will be their effect on the architects who might look to professional journals for direction. What if we come to believe that this is architecture? P/A has a responsibility to inform otherwise.

Philip Pijpal, Paula Kurkemeier, Kim Weller, Charles Craig, Lawrence Cheng, Laurie Putscher, John Freeman, Steven Inrich
M. Arch candidates, MIT
Cambridge, Ma

I was mildly bemused when I received the year-end and decade-end issues of the "Big Two" architectural periodicals. The theme of the magazine with "Progressive" in its name was a look backward over the past ten years, whereas the theme of "that other" magazine, the one with "Record" in its name, was a look forward.

Now arrives the January issue of P/A and "glory!," you managed to devote two whole pages to a look into the future.

And of course it is Awards time again. If one lesson can be learned from this year's collection it is that if you design and draw in the manner of Michael Graves you stand a much better chance of winning an award than otherwise might be the case.

It could even be argued that some publicity-hungry designers have learned how to manipulate not only color, form, and space, but also the press. One wonders if the Awards jury did not think in certain cases it was citing a Graves project when the project actually was done by one of Graves's imitators.

The cultural, philosophical, and emotional reasons which lie behind the phenomenon popularly named Post-Modernism are valid and should be addressed. Likewise, some of the responses to these social needs have been valid responses, even some of those by Graves. But the wholesale copying of his techniques without addressing the underlying issues in an objective way is the same kind of superficial quick-fix that lesser architects unfortunately have always been guilty of. To award such projects only compounds the problem.

P/A, you are infuriating. I know the jury made the awards selections and not the P/A editors. But, is it not possible that the selection of the jury, being an editorial function, undermines that claim for lack of involvement and responsibility?

Finally, you have changed the format and graphics of the magazine to something reminiscent of earlier years. When are you going to complete the change by renaming it Postprogressive Architecture?

Frank Orr, AIA
Orr/How & Associates Architects Inc.
Nashville, Tn

By coincidence today's mail included your January issue and the January 24th issue of Engineering News Record. As usual, I thumbed through P/A first and scanned a few jury comments.

It was a very short time before I picked up the Record as more productive reading and damned near died laughing when I read the article "Facade: Errors Can Be Expensive." The article includes the hypothesis that there are four basic causes of building façade failures: ignorance, carelessness, negligence, and greed and that ignorance is the only one we can hope to improve.

But that hope is slim as long as our schools of Architecture stress so-called "design" and as long as our major professional publications push out issues such as that of January 80.

William S. Oliver, Chairman
Architecture Department
Onondaga Community College
Syracuse, NY

Milan bank: correction

The capsule description of the Banque Bruxelles Lambert in Milan on the contents page of P/A, March 1980, could be interpreted as an adverse criticism of the work. Any such implication was purely inadvertent. P/A's actual viewpoint, as indicated in the article itself, was very favorable, and we regret any misunderstanding caused by the contents page wording.

Credit extended

Photographs in the February P/A, right-hand column, bottom of page 24 and three color photos, top of page 29, are the work of © Wolfgang Hoyt/ESTO.
For well designed interiors—a new look in Soundsoak™ acoustical walls

For interiors that should be quiet as well as elegant, Armstrong announces a wall panel with the same sound-absorbing efficiency as a good acoustical ceiling.

Soundsoak Supreme acoustical wall panels are faced with an attractive nylon fabric woven in a classic texture favored for contract furnishings. A complete palette features 15 neutral and accent colors.

For literature describing these fully assembled ready-to-install panels, write Armstrong, Dept. 04NPA, Lancaster, PA 17604.
9 Editorial: Energy balance

Energy-conscious design

81 Big problem, small world
Like the U.S., other countries face energy shortages, as these reports indicate, and each is trying to solve the problem in its own way.

90 Washington's commitment
The government's approach to energy efficiency is to encourage conservation by creating programs, offering incentives, and setting an example. By Sen. John H. Chafee.

92 Sticks not carrots
What effect will the proposed DOE standards for building energy performance have on construction and how will they be implemented? By Thomas Vonier.

98 Architectural energy analysis
Since design affects the energy performance of buildings, Dr. Vladimir Bazjanac uses a computer to analyze design options and approximate overall performance.

102 Rainbow's end
The Hooker Office Building, Niagara Falls, NY, by Cannon Design, uses a double skin and operable louvers to retain energy efficiency where there is substantial glazing.

113 Going solar in the city
Downtown areas offer a potential for energy conservation not available in sprawling developments: mass transportation, proximity to work, and retrofit capabilities.

117 More than just energy
Two government clients, the State of California and the Tennessee Valley Authority, are encouraging building design that reduces the use of energy. By Peter Calthorpe.

122 From Salk to SERI
Fred Dubin, in an interview with Richard Rush, discusses the importance of team effort by the architect and the engineer in planning an energy-conserving building.

126 Solar nexus
The headquarters for the Solar Energy Research Institute (SERI) in Golden, Co, designed by Table Mountain Architects & Engineers, applies solar energy in many forms.

130 Tomorrow's energy from yesterday
Case studies of retrofitted buildings indicate that energy savings may be greater than expected when the program is adapted to individual circumstances. By Don Klabin.

Cover:
Design by Elizabeth and Richard Rush.
Levels of conserving
Ponieroy, Lebduska Associates, with Fred W. Lyon, considers the energy already invested in a structure and incorporates it into the design for an energy-efficient library in New Rochelle, NY.

The two-legged thermostat
Adaptability to the environment is one of the capabilities of the human body and a great natural energy resource. By Jay L. McGrew.

This building is loaded
Richard Crowther's own living and working space used a central solar heated space and nine thermal zones to make the most efficient use of energy collected.

City under sod
A correctional facility planned for Oak Park Heights, Mn, designed by Gruzen & Partners and Winsor/Faricy, will be bermed on three sides to reduce heating and cooling needs.

A Georgia peach
Taylor & Williams have used sun for heating and cooling the Shenandoah Solar Recreation Center in Georgia, and also for making hockey rink ice.

Design dilemma
Two projects by Kelbaugh & Lee, the Milford Center and a group of townhouses, are designed for solar energy—one as a learning center, the other, urban infill housing.

Cool school
Saez/Pacetti architects expect solar energy to provide 70 percent of the cooling and 90 percent of the hot water for the Floyd Elementary School in Miami, Fl.

Energy: An expanding force for change
The turn to energy-conscious design is inevitable. How we use energy affects the environment: our transportation, our homes, our country, and eventually the world.

Technics

Specifications clinic: Energy-related specifications

Departments
4 Views
25 News report
26 In progress
68 Calendar
187 It's the law
191 Books
200 Products and literature
226 Building materials
228 Job mart
232 Directory of advertisers
235 Reader service card
Loose card in U.S. and Canadian editions
Flexible Architectural Tambour, in a wide selection of solid woods, wood veneers and metal laminates, offers unusual design possibilities for interior walls, columns and other architectural elements.

Forms & Surfaces  Box 5215  Santa Barbara, California 93108  (805) 969-4767

Circle No. 350, on Reader Service Card
When the Chairman of the Board has nothing to do but stare at the ceiling, give him something beautiful to stare at.

Celotex has just come up with a new line of prestige acoustical ceiling panels for executive suites. We call it Celotex Colortone. And we designed it to go over the heads of most of the heads of business.

Celotex Colortone is very special for several reasons. To start, it comes in five rich and luxurious colors. The names alone will probably make you want to get hold of a sample. Cattail, jute, reed, pampas and sage.

The colors of these high-quality panels go right through. From top to bottom. So if they chip or get cut, you'll never notice it.

And they have a "reveal edge" design. Giving the installation a handsome custom-designed three-dimensional look.

For more information about Celotex Colortone acoustical ceilings, contact your Celotex representative.

Celotex Colortone. They'll definitely make the suite smell of success.
We've earned the name: The Elevator Innovators.

Dover has done it with new ideas, and new applications of old ideas.

We were first to conceive the time and cost-saving pre-engineered elevators, and now have the broadest line in the industry (49 traction and Oildraulic® models) to serve low and mid-rise buildings. For high-rise buildings, our gearless traction elevators and sophisticated group supervisory control systems offer high speeds and the proper response to traffic.
demands, in order to meet the needs of the most severe building requirements.

Dover was first in the industry to put computer technology to work, using it to project a building's traffic volume and intensity, and to determine the elevator speed, capacity, and other characteristics needed to provide the desired level of service.

We have more solid state controlled elevators in operation throughout North America than any other company in the industry. But we also can, and do, utilize conventional hardware when we know it will deliver the proper level of performance to satisfy the individual building requirements.

We're proud to be known as the Elevator Innovators, but we won't ever use our customers' buildings as a test tower or let the urge to innovate override our customers' needs for safety, reliability, and performance. For literature write Dover Corporation, Elevator Division, Marketing Services—A665, P.O. Box 2177, Memphis, TN 38101.

DOVER
The elevator innovators.
Now, at every level of executive management you can create an image of success that gains the business edge.

True traditional by

KITTINGER

For complete information contact these franchised Georgian Collection Dealers

ARIZONA
Phoenix: Barrows Fine Furniture
CALIFORNIA
Los Angeles: Cannell & Chaffin Commercial Interiors, Inc.
San Francisco: Hogue & Associates
COLORADO
Denver: Howard Lorton, Inc.
Scott-Rice Co.
DISTRICT OF COLUMBIA
Washington: W&S Sloane, Inc.
GEORGIA
Atlanta: Ball Stalker Co.
ILLINOIS
Chicago: Marshall Field & Co., Contract Division
INDIANA
Indianapolis: Business Furniture Corp.
MASSACHUSETTS
Boston: Business Equipment Corp.
Peabody Office Furniture Corp.
MICHIGAN
Bloomfield: Lewis Furniture Co.
MINNESOTA
Minneapolis: Dayton's Contract Div.
General Office Products Co.
NEW YORK
Albany: Business Interiors, Inc.
New York: Bestype Office Furniture, Inc.
Colborn Associates
Empire Office Equipment, Inc.
OHIO
Cleveland: Ohio Desk Co.
Columbus: Thomas Ruff & Co.
PENNSYLVANIA
TENNESSEE
Knoxville: McQuiddy Office Designers, Inc.
Nashville: McQuiddy Office Designers, Inc.
TEXAS
Amarillo: Southern Furniture Co.
Dallas: Stewart Office Supply Co.
Houston: Suniland Office Furniture
UTAH
Salt Lake City: Salt Lake Desk
VIRGINIA
Lynchburg: Litton Office Products Centers
Norfolk: Litton Office Products Centers
Richmond: Litton Office Products Centers
Roanoke: Litton Office Products Centers
WISCONSIN
Milwaukee: Forrer Business Interiors, Inc.
CANADA
ALBERTA
Calgary: Contemporary Office Interiors, Inc.
RGO Office Furnishings, Ltd.
Edmonton: Donn Larsen Office Interiors, Ltd.

At franchised Georgian Collection Dealers listed to right.

Kittinger Company, Department PA, Railroad Street, Castile, New York 14427
Circle No. 371, on Reader Service Card
With Rmax Thermawall, it doesn't take a lot of energy to save a lot of energy.

The next time you specify energy efficient commercial wall insulation, take a minute to think about the energy required to put it up. Energy in the form of man hours, installing studs, batts and gypsum board. And the bottom line cost as a result. That kind of energy could be costing you a lot more than you think.

Which is why you need to think of Rmax Thermawall. It's a rigid isocyanurate core permanently bonded to gypsum board and wrapped by highly reflective aluminum foil. In a variety of thicknesses and "R" values (see the chart on the left). Together, it combines the efficiency of isocyanurate with a proven, time saving method of installing finished drywall. Which saves installation time and money. And a lot of energy.

The Thermawall Fastening System (patent pending) eliminates the need for common studs and batt insulation. A simple metal channel and clip system provides quick installation of Thermawall on masonry, concrete or metal perimeter walls. And because the system is thinner than conventional walls, you gain overall floor space, resulting in more square footage.

And think about this. Rmax Thermawall is perfect for residential basement insulation. For remodeling of old homes over existing walls. Even cathedral ceilings where maximum insulation is needed in a minimum space.

Call or write us for more information concerning Rmax Thermawall and your insulation needs. We'll be glad to help.

As a matter of fact, we really can't think of a nicer way to spend our energy.

Thermawall by Rmax

Rmax, Inc.
13524 Welch Road, Dallas, Texas 75240 214/387-4500
Route 8, Box 434, Greer, South Carolina 29651 802/297-1382

Note: Thickness includes 1/4" gypsum. Aged "R" values tested at 75° mean temperature.

Thermawall "R" Values

- Thermawall only
- Thermawall System

<table>
<thead>
<tr>
<th>Thickness</th>
<th>R Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/4&quot;</td>
<td>10</td>
</tr>
<tr>
<td>2&quot;</td>
<td>15</td>
</tr>
<tr>
<td>2 1/4&quot;</td>
<td>20</td>
</tr>
<tr>
<td>3&quot;</td>
<td>25</td>
</tr>
<tr>
<td>3 1/4&quot;</td>
<td>30</td>
</tr>
</tbody>
</table>

Thermawall Fastening System (patent pending)
The more you insulate, the

If you're going to insulate a building to its maximum cost-effectiveness, you ought to include quality windows, too. Andersen® Perma-Shield® windows, for instance, help insulate where heat loss might otherwise be the greatest—in the window area itself.

Compared to windows that only meet minimum industry air-infiltration standards, Perma-Shield windows allow you to increase the window area without increasing the building's heating and cooling costs. Low air infiltration is one reason. Andersen's snug-fitting design is two times more weathertight than industry standards require. The better to keep out drafts and keep in comfort. Andersen's use of double-pane insulating glass is another reason. It's two times more effective at reducing heat loss conducted through the glass.
more you need Andersen.

than old-fashioned single-pane glass.

Add triple glazing and the insulating value of Andersen windows climbs still higher.

And when properly sized, shaded and oriented toward the sun, Andersen windows help save more energy. In winter, they welcome in the warming sun, and in summer, they open to cooling breezes.

So specify as much insulation as is practical, but insist on quality Andersen Perma-Shield windows and gliding doors, too. See Sweet's file 8.16/An. Or ask your Andersen distributor to show you the many beautiful ways to insulate with a view.

Andersen Corporation, Bayport, MN 55003

The beautiful way to save fuel®

Circle No. 310, on Reader Service Card
Create your own energy-efficient environment with an Owens-Corning Fiberglas Fabric Structure.

This is the beautiful new Bullock's in San Jose, California. The world's first department store with a permanent fabric roof—made of rugged Owens-Corning Fiberglas yarn coated with Teflon.

The fabric roof gave the architects the freedom to create a unique environment—open, airy. A lot like a park.

Since the roof is translucent, it lets in soft daylight, thus cutting the need for daytime lighting and the use of energy. And Bullock's is projecting energy savings of $18,000 a year. (They're now planning a second store with a larger Fiberglas fabric roof.)

More savings.
An Owens-Corning Fiberglas fabric roof structure can cost less to build than a conventional roof. And generally, the longer the span, the greater the savings. Plus the fabric roof goes up in a fraction of the time, which can result in even more savings.

The Pontiac Silverdome, home of the Detroit Lions, could not have been built with a conventional roof without going over budget. Today, the Silverdome has a 10-acre Fiberglas fabric roof that cost a third the price of a steel-vault one.

Seven years of success stories.
Owens-Corning has been involved in every Fiberglas fabric structure project in the world. We've found there's practically no limit to what you can do with Fiberglas fabric structures.

You can use them to create exciting new environments for schools, malls, zoos, libraries, restaurants, hospitals, office buildings, and even airport terminals. (We're now working on the Haj Terminal in Saudi Arabia—larger than 80 football fields.)

One-stop shopping.
No one is better equipped to help you with your project than Owens-Corning Fiberglas. Call on us for assistance during preliminary design as well as for budget estimating. Count on us for materials, fabrication and construction. In short, depend on us for everything from A to Z. Don't hesitate to contact us at the earliest stages of your project.

For a free brochure, just send us this coupon.

Free brochure
Write to A.H.N. Meeks, Owens-Corning Fiberglas Corporation, Fiberglas Tower, Toledo, Ohio 43659

Name
Company
Address
City
State
Zip

© 0-C.F. Corp. 1980. Du Pont registered trademark.
Circle No. 380, on Reader Service Card
YOU SPECIFIED IT. BE SURE YOU GET IT.

There's only one STYROFOAM* brand insulation and The Dow Chemical Company stands squarely behind it. STYROFOAM, with thirty years of proven performance, keeps on delivering consistent energy savings for the life of a building.

Don't confuse STYROFOAM brand insulation with porous foam products made with today's throw-away technology, like molded foam cups and picnic coolers. This whole category of disposable foam products is made an entirely different way.

One product made with this same short-life, throw-away technology is "beadboard" insulation. Ever had a foam cup leak in your hand? That's exactly how these porous imitations can work in buildings. Think about it next time you specify insulation.

STYROFOAM brand insulation keeps the wet out. Moisture absorption is the most common cause of thermal resistance deterioration in perimeter, sidewall and roof insulation. Since water is a good conductor of heat, soggy insulation robs a building of the energy it's supposed to be saving. The unique closed cell structure of STYROFOAM repels water and retains R-value.

STYROFOAM brand insulation also meets many of the tough new building codes for demanding applications, like below grade. Because when
moisture gets in and freezes, porous imitations can crumble—along with their insulation value. STYROFOAM will continue to perform long after other materials fail.

STYROFOAM brand insulation can document long-term, high performance that doesn't let you down through manufacturing flaws, aging, or inferior product integrity. Ask for proof. We've got it.

Accept no substitutes. Specify STYROFOAM brand insulation and make sure it's actually applied. Then you can be confident that you and your clients have invested in the proven answer for energy savings from frostline to skyline.

For more information, write:
The Dow Chemical Company, STYROFOAM Brand Insulation, Dept. D58, Midland, MI 48640.

The Proven Answer

*Trademark of The Dow Chemical Company

WARNING: STYROFOAM brand insulation is combustible and should be properly installed. A gypsum board interior finish should be used in commercial construction. For roofing applications, STYROFOAM brand insulation should be provided with an adequate protection. For specific instructions see Dow literature available from your supplier or from Dow.
Oasis.
The water cooler that's built without shortcuts.

OASIS Ebco Manufacturing Co., Columbus, Ohio 43213

Circle No. 345, on Reader Service Card
Massachusetts energy code review program

The Massachusetts State Building Code Commission has established the Plan Review Assistance Program as an ongoing response to the need for community created by the Energy Code (the modified ASHRAE 90-75). The program provides technical assistance to building inspectors and educational assistance to the professional community; the plan-review process establishes a means to assess the levels of code awareness in both the enforcement and professional communities.

The dialogue between review staff and designers fills the continuing educational and technical assistance void, since there is currently no professional organization or registration board which directly addresses energy code requirements and the related technical issues. Pre-permit analysis averts potential problems of noncompliance. Finally, an outreach seminar program addresses specific areas of the professional community's needs.

David Miller, Energy Program Manager, believes the plan "has fulfilled a dual feedback role. It told us where new construction was not complying with present energy codes, and it enabled us to devise an educational program which would facilitate the transition to new, more stringent energy codes."

The Plan Review Program is composed of five sections. Section 1 deals with design conditions and shows how they should be included in the specifications or as plan notation. Section 2 on mechanical equipment establishes standards for HVAC performance which must be met and noted to show compliance. Section 3 on OTTV (Overall Thermal Transfer Value) Calculation indicates how such calculations should be distinguished from U, value calculations; the former indicates thermal performance in the cooling mode, the latter in the heating mode. Section 4 describes mechanical system sizing criteria. Finally, Section 5 describes ventilation calculations specifying, for example, that fan schedules should note the total number of people served by each unit, the CFM per person of ventilation air and outside air, and the total circulation and outside air requirements.

The program is dynamic in character and can identify issues of particular topical interest. The data base obtained in case review of individual projects will be utilized as an internal review of the code's technical value. From January 1979 to June 1979, 136 projects were analyzed with a response rate of 60 percent supplying data on new construction. The dollar value for projects reviewed ranged from $50,000 to $12 million. Such data are useful in evaluating how well codes are presently being met and what measures must be taken to improve compliance.

Where currently the onus resides on the designer to maintain contact with both the technology and terminology inherent in the energy code requirements, the Plan Review Assistance Program seeks to assist the professional by first, insuring a high level of code compliance and second, providing an educational assistance program to keep the design community aware of the new energy code. The program has the potential of adoption as a prototypical model and as an example for other states interested in establishing a similar assistance program. It provides a link between the component codes (ASHRAE 90-75) and the new second-generation energy codes (e.g., the Department of Energy Building Energy Performance Standards, BEPS), which prescribe overall energy budgets. It assists designers in using and feeling comfortable with the component codes prior to the implementation of the more complex BEPS computer-aided code. (Susan Gill)

Study proves preservation energy efficient

Old buildings save energy. That assumption, long a contention of the preservation movement, can now be documented, a federal agency reports. Booz, Allen & Hamilton prepared a study, "Assessing the Energy Conservation Benefits of Historic Preservation," for the Advisory Council on Historic Preservation, an independent federal panel that advises the president and Congress.

The study points out that approximately one-third of America's total energy consumption involves buildings, their use and operation. Five percent of the country's annual consumption is invested in the processing, transporting, and putting into place of construction materials. "Replacing all existing buildings in the United States would require the entire world's energy output for about a year just for materials and construction processes—approximately 200 quadrillion Btu of energy," the study notes.

In preparing the report, three dissimilar old buildings were used as case studies: the Grand Central Arcade in Seattle's Pioneer Square, a hotel converted to mixed use as shops and offices; Lockefield Gardens in Indianapolis, a 1935 WPA low-cost housing project—one of the federal government's first—now abandoned and threatened with demolition; Austin House, a two-story brick carriage house on Capitol Hill in Washington, DC, that was gutted, leaving only the shell, and then converted into three apartments.

The study notes that most people assume, correctly, that new buildings can be more energy efficient than old ones. In assessing whether to rehabilitate an old building or build a new one, however, there are other kinds of energy that must be taken into account. The first is demolition energy, the cost in energy terms of tearing down an old
building. Included would be the gasoline used by the wreckers to raze the structure and haul away the debris, for example.

The second, and even more important kind, is embodied energy—the energy already invested in a structure. Once used it is nonrecoverable. Thus, for example, the energy in eight bricks is equivalent to one gallon of gasoline, the study reports, but that energy cannot fuel a car. Included in embodied energy is the energy used to create the bricks, steel, concrete, glass, and myriad other materials.

It was determined that the abandoned Lockefield Gardens complex represents nearly 550 billion Btu of energy embodied in its construction, equivalent to approximately 4.5 million gallons of gasoline. Austin House has 1 billion Btu of energy embodied in its shell.

In determining how to document preservation's energy savings, the researchers developed three increasingly complex formulas—the Building Concept Model, the Building Survey Model, and the Building Inventory Model. Figures derived from a study of such elements as building materials, plans, climate, and occupancy standards can be plugged into the formulas to offer either general, refined, or precise results as to the amount of energy involved in a particular project. The work can range from a single calculation for each kind of energy—embodied, demolition, and operational—to several hundred that would require the use of a computer.

Through the use of the formulas, the study concluded that rehabilitation of the Grand Central Arcade used less than one-fifth of the energy that would have been required for a new building of similar size—a saving of 92 million Btu. Despite the fact that more energy is required to operate the Grand Central Arcade annually, the savings from rehabilitation would run the structure for more than 200 years, the study concludes. Over a 30-year period, enough energy would be saved at Austin House to heat and cool a similar-size apartment building for 10 years. And Lockefield Gardens offers a net energy advantage for 50 years.

Copies of the full report, including the complex formulas, are available for $2.75 from the U.S. Government Printing Office, Washington, D.C. 20402 (stock no. 024-000-008-56-8). An illustrated brochure that highlights the study is available free from the Advisory Council on Historic Preservation, 1522 K St., NW, Washington, D.C. 20005. [Carleton Knight, HI]

In progress

These buildings were chosen as representative of the vast body of effort known as Energy Conscious Design.

Civil/Mineral Engineering Building, University of Minnesota, Minneapolis. Architects: Myers & Bennett, Minneapolis. When the Minnesota state legislature mandated to the University of Minnesota that its proposed new Civil/Mineral Engineering building on the East Bank campus be an energy demonstration project, the architects dug in—way in. Currently under construction, the 142,000-sq-ft building will be 95 percent underground. A third of its volume, some 48,000 sq ft, will be mined space 110 ft below ground in a soft layer of sandstone beneath a layer of limestone.

The architects, who pioneered earth-sheltered architecture on the campus with the construction two years earlier of Williamson Hall, intend to demonstrate the potential use of mined spaces for a variety of human activities by introducing light to these spaces. Where Williamson Hall demonstrated that earth-sheltered spaces need not necessarily be cavernlike, the Civil/Mineral Engineering building goes further. It will demonstrate, according to project architect David Bennett, that daylight can be projected, not just naturally filtered, to deep spaces.

With research scientist Dr. Michael Dugay, now with Bell Laboratories in New Jersey, Bennett devised a demonstration solar optics system that collects sunlight and directs it through the building by means of an assembly of lenses and mirrors which reflect the light into deep interior spaces, including the mined space. The system optically compresses sunlight into narrow streams of light through a series of ten heliostats mounted on the roof of the building. The heliostats track the sun, reflecting it into a series of shafts which plunge into the main central space of the building, and then diffuse over targeted spaces in the structure. No transmission energy is used. When combined with conventional artificial lighting under controlled conditions, the system has the potential to reduce substantially the electrical demands for lighting interior spaces. As environmental design, it goes even further, illustrating the potential of enhancing earth-sheltered spaces as viable places for human habitation.

Solar optics aside, the new building will be a virtual energy park of passive and active energy systems working incrementally to reduce the building's energy demands; these include a system of plant screenings, called microclimatology, that turn the south-facing parts of the building into a kind of Babylonian gardens in reverse (the architects call this landscape microclimatology) and trombe walls. Active systems will include solar electricity generation, ice energy cooling, and planned solar heating, promising a grant from the U.S. Department of Energy.

Structural systems include cast concrete walls, columns, and floor slabs, and a structural-steel roof that will support a 15-ton traveling crane over the huge main structural lab. The exterior will be clad in oversized brick to match the surrounding buildings of the Institute of Technology.

Entrance to the building will be by means of a fan-shaped spiral of classrooms surrounding a rotunda. The spiral forms an entry court which begins at grade level and terminates in the main entry of the building. Because of its location near a proposed bus transfer station, the entry forms a symbolic center for this part of the campus, a focus not only for the Institute of Technology, but for the university as a whole as well. Construction costs are expected to be $12,500,000. [Joanna Baymiller]
"With REZ® Wood Stains we get a unique combination of color selection, service and technical support."

Waltan L. Bazemore, A.I.A.
Maddox and Associates, P.C.
Savannah, Georgia

The exterior of this striking home designed by Walt Bazemore is made entirely of cypress and stained with REZ Oil Type Semi-Transparent Wood Stain. A variety of Pittsburgh® Paints were also used throughout the interior.

"We knew from past experience that we would get a durable, quality product when we specified REZ Wood Stains for this home," says Mr. Walt Bazemore. He continued, "Other equally important factors in our decision to use REZ Wood Stains were color selection plus nearby service and technical support . . . from the Pittsburgh Paints distributor in Savannah. These add up to an economy of time that's difficult to measure in terms of dollars and cents."

If you're specifying or using stain on your next project, consider these plus benefits of REZ Wood Stains.

• "Now" colors — 145 REZ Wood Stain Colors or we'll match most any color you have in mind.
• Quality and durability that have been proven for over 30 years.
• Fast service from a nearby Pittsburgh Paints distributor — and a single source if you need both stain and paint.
• Technical support from one of the nation's leading paint and coatings manufacturers. Assistance on your specific project, if necessary, is available from your local PPG Representative.

See Sweets File 9.9/PPG or get our 8-page brochure by mailing the coupon.

PPG INDUSTRIES, Inc., One Gateway Center—3W, Pittsburgh, PA 15222

☐ Please send 8-page brochure regarding Rez Wood Stains.
☐ Please have representative call.

Name ____________________________
Title ____________________________
Company _________________________
City _____________________________
State ____________________________
Zip ______________________________

PPG: a Concern for the Future

PITTSBURGH PAINTS
Manufacturers of Rez® Wood Stains and Varnishes in U.S.A.

Circle No. 389, on Reader Service Card
In a World of Ordinary Windows,

**Double Hung.** It's been around long enough to have earned the title "Old Dependable." If you want to heat or cool the great outdoors, double hung should be your first choice. What the Packard was to the car, double hung is to windows. A good idea whose time has passed.

**Insulated Glass.** Sometimes the obvious answers aren't so obvious. Ask owners who've experienced seal fracture failures. They've found that insulated glass delivers improved shading coefficients when it clouds up. An unorthodox way to save energy. But tough on folks who want to look outside.

**Fixed.** The most popular commercial window system in the world today. The fixed window is simplicity itself. Non-separable, no emergency ventilation and no chance for easy repair. If your father-in-law is a window washer, be sure to specify fixed windows.

---

**A.** The DISCO T-2001 reduces the initial heating and air conditioning requirements. Provides the ultimate in heat and cold transfer reduction. Reduces noise pollution by as much as 50% and dramatically lowers cleaning and maintenance costs.

**B.** The first side hinged, in-swinging aluminum casement window featuring a poured-in-place polyurethane thermal barrier. A full ¾" separation is provided between the interior and exterior surface of the frame members. U value .47.

**C.** Wedge-glazing system provides a high compression seal between glass and aluminum, preventing air and water infiltration.

**D.** Heli-arc welded corners provide greater in-place frame stability.

**E.** Fully enclosed narrow slat venetian blinds help provide shading coefficients as low as 10 when set at 45 degrees. Virtually maintenance free.

© Copyright 1980, DISCO Aluminum Products Company, Inc.
Meet Disco...The Overachiever.

Slider. Try to wash this one from the inside. Better yet, try to keep it on track. Famous for easy air and water infiltration. They work best when accompanied by a repairman.

Pivoting. You don't have to be a fortune teller to predict the future of pivoting windows. Because they pivot across the weather stripping, they invite damage to the thermal seal. As they get older, pivoting windows let people inside know what's going on outside.

The Overachiever. The DISCO system. Operable, double or triple glazed. Inexpensive to clean and maintain. Side hinged, casement in-swing is our favorite. The DISCO T-2001 has a U value of .47 and a shading coefficient as low as .10. No other window does more to save energy and reduce life cycle cost.


Even good windows have a way of becoming mediocre when faced with the challenge of reducing energy and life cycle costs. What was right for the 1970's may not meet the needs and government regulations of the 1980's and beyond.

Enter the overachiever DISCO. A customized window system which assures maximum thermal efficiency and minimum air and water infiltration in an operable design. Perfect for combating energy waste and maintenance expense.

Our double and triple glazed systems are as malleable as you are imaginative. Each can be customized to meet your exacting specifications.

DISCO's ready for an age when good is no longer good enough...with windows that reflect the solid ideas of forward looking design.

Test us. If we don't have answers to your challenges, chances are they don't exist.

ALUMINUM PRODUCTS COMPANY, INC.
When outside temperatures permit, cooling will be done with fresh air. An air-conditioning compressor will be arranged for future conversion to a heat pump, providing flexibility to use the preset lower cost of natural gas with the option of converting to an electric heat pump, depending on the availability and cost of natural gas.

Upon completion of the project, approximately 70 percent of the heating requirements will be provided by solar energy.

**Indio Palms Park Center, Riverside County Parks Department, Rubidoux, Ca. Architects:**

Paula Solaris Associates, Scottsdale, Az. This exhibition and leisure facility for casual visitors and research facility for longer term users is designed to demonstrate an "environmental ethic as lifestyle." Situated in an unusually harsh desert climate subject to extreme temperature variations and near two earthquake faults, the building will reflect energy conservation and autonomy, using passive solar systems, waste and water recycling, and intensive greenhouse horticulture.

Takina in the form of a large solar greenhouse, the facility is sloped upward along a knoll. The main entrance to exhibit...
Some things will be around a long time . . .

and remain maintenance-free!

MICROZINC 70
factory-formed roofing systems

You'll never encounter call-back problems with Microzinc 70 roofing systems. Install them and forget them. And that includes coping, flashing, fascia and mansards!

Microzinc 70, widely specified for its beautiful pre-weathered patina, is even better known for its maintenance-free qualities—no leaks, no run-off stains and no rotted materials.

Whether you specify Batten-seam or Standing-seam, our LOK roofing systems are custom engineered, factory made and delivered directly to the job. Installation is so simple it greatly reduces labor costs. Other on-site savings include—no cleaning, no priming, no painting. And no soldering needed.

For further information, write or call Ed Pejsa at 615/639-8111.
How to get a round ceiling through a square client.

Talk sense to him. Donn Paraline linear metal ceiling system is a sensible, affordable way to turn a workaday building into a showcase. The dramatic, flowing design possibilities of Paraline are limited only by your imagination. Yet for all its visual impact, even your most skeptical client will see Paraline for the very practical solution it is. And — it's the only linear metal ceiling that's fire-rated!

Paraline adds flexibility to lighting and air return design while allowing easy access to the service area above. It's easy to install. Easy to maintain. Paraline is available in steel or aluminum with a wide variety of wipe-clean standard color finishes, chrome-like polished aluminum or nearly any custom finish. It's also available in a fire-rated version for nearly any application you can conceive. It's even available with an NRC sound control characteristic up to .90.

Ask your Donn representative for full details. Call us toll-free. Or write us. Donn makes access floors. Donn makes wall systems. And Donn makes ceiling systems. But most of all, Donn makes sense.

Paraline now available fire-rated!

Circle No. 335, on Reader Service Card
News report continued from page 30

distributed over a 24-hour period, greatly reducing peak period use and the resulting high demand charges. The implications of widespread use of this system, say the architects, would be considerable if substantial numbers of commercial and industrial buildings were converted to a similar system. Fewer power plants would be necessary, and expenditures by utilities would be reduced, resulting in fewer rate increases to consumers. [Joanna Baymiller]

Plan for the Relocation of Soldier's Grove, Soldier's Grove, WI. Architects and Planners: The Hawkweed Group, Chicago. Devastated by flooding several years ago, the entire town of Soldier's Grove (population 514) will soon relocate on higher ground away from the flood plain. Many town merchants and residents will move into the new town as the old one is demolished. When they do, it will be to a setting that—while not quite a complete haven from Wisconsin's harsh winters—may serve as a model of energy-conscious planning. Rodney Wright of Hawkweed says that the town fathers sought a plan that would emphasize energy as an issue for nonurban communities: "They want the town center to be rural in appearance. It was a small country town and the new town will be, too, right down to the building materials."

Hawkweed has done a planning scheme for the town center and has designed a number of public and private buildings for the site. A series of design guidelines and standards resulted from the planning effort, including a heat-loss standard of 4 Btu per square foot per degree day for building exterior surfaces and a restriction against flat roofs. The standards also call for a solar contribution of at least 50 percent of the total heating requirements of individual buildings, but, in fact, the buildings are emerging with a solar contribution closer to 90 percent. The plan calls for maximum use of renewable building materials, which, in Wisconsin, means wood. Even oak railroad ties are being used as columns in some of the town center buildings.

The site analysis for the town center involved examination of solar and wind movement, existing vegetation, and the microclimatic effects of terrain. A building area was defined by these considerations with solar access a key concern for the winter months.

Hawkweed's landscape design also involves relocation of trees. The 190-acre parcel now owned by the town—of which the town center involves 19 acres—will have large windbreaks to the north and northwest. Near-mature pines and other indigenous plantings will be moved for this purpose. Deciduous trees will serve to block summer sun, letting winter sun pass through as their leaves fall.

Concern with solar access is also evident in Hawkweed's suggested designs for buildings in the town center. Along the south side of the pedestrian thoroughfare, buildings will be limited to a single story, so as to ensure adequate sunlight for the street and for buildings on the north, which will be higher. Roof and balcony overhangs are also used, along with earth berms—some extending to roof level.

Although the initial scheme is for the town center only, two residential areas are planned for future development, and Hawkweed is now planning an industrial park that will be situated across a major road. The designers hope to see many of the same concepts applied to these neighboring developments. Sitework and landscaping will not be completed by spring, but there should be some completed buildings by then. [Thomas Vonier]

The Phoenix House, residence for Mr. & Mrs. Robert Kiefer, Phoenix, Az. Architect: Robert F. Augustine, Boston, Ma. In this design for a hybrid solar house, the goal was to avoid tacking on an energy system as an afterthought and instead to integrate art and technology in a self-sufficient, minimal...
Problem solver.

When you need on-the-roof technical assistance, your best source is a J-M District Engineer. For several reasons:

We have an unmatched team of 12 field engineers who devote full time to built-up roofing systems. Together they offer over 200 years of roofing experience, providing a technical resource unmatched in the industry.

Their expertise is available to you whenever the need arises. To assist with specifying, as part of J-M's guaranteed roof program. To provide on-site, technical advice on unusual roof situations. To help keep you advised on new practices in the industry. And to provide information on local climatic conditions as they affect roof design and construction.

Most of all, they're ready to help you eliminate your roofing problems before they happen.

Backing them are the full resources of one of the world's largest producers of built-up roofing materials. Plus knowledge gained in well over a century of solving roofing problems.

Find out more about our problem solvers and J-M single-source roofing systems. Consult Sweet's or contact George Constantin, Johns-Manville, Ken-Caryl Ranch, Denver, Colorado 80217, (303) 979-1000.

For single-source built-up roofing systems.

Johns-Manville
WE HAVE WALL TO WALL IDEAS.

Reed is the largest wallcoverings distributor in the United States. Our broad product line includes everything from the most exotic hand prints to good old tried-and-true. Papers, light and heavy-weight vinyls, metallics, mylars, strippables, pre-pasted, fabrics, whatever. You won’t believe so many choices could come from one source. (When you maintain a multi-million-roll inventory, it’s easy.) Moreover, our prices are competitive, and our delivery is simply beyond compare. (With 11 strategically located distribution centers across the country, it’s a snap.) We’re ready when you need us — for service, for advice, for selection, for help of any kind.

So next time you’re working out a wallcoverings plan — or specifying a wall-

- reception area
- senior vice president
- president
- corridor
- office manager
- restroom
coverings supplier—remember Reed. We have great wall to wall ideas for just about any wall you could suggest.


Sunworthy, W.H.S. Lloyd, Bolta, Dwoskin, UltraTex, Reed.
Now you can have the world’s finest roof on any building.

THE MR-24® ROOF.

The MR-24® roof—the only true, double-lock, standing seam metal roof system on the market—is now available for use on virtually any structure: conventional, pre-engineered or a combination.

That means you get design freedoms not associated with other metal roofs, plus quick installation with a minimum of labor.

And, because it is today’s finest roofing system, the MR-24 roof will change the way you measure the performance of all roofs.

Here’s why.

Unequalled energy efficiency.

No built-up or metal roof can come close to the MR-24 roof in energy efficiency.

Just 4 inches of insulation, plus special insulation blocks at the purlins, give the MR-24 roof an exceptional tested U value of .08. A fact that can mean lower utility bills, and savings for years to come. (See “Comparative U values” chart.)

Eliminates roof decay.

Built-up roofs use organic materials. But the MR-24 roof uses aluminum-coated or Galvalume® steel, which won’t crack, peel or decay.

To your client, that means virtually no maintenance...and big savings.

Energy-efficient, durable, weathertight, adaptable, easily installed and maintained.

Only one roof system can back all those claims with a record of proven performance: the MR-24 roof. Shouldn’t it be on the next building you design?

Comparative U values.

<table>
<thead>
<tr>
<th>Roof System</th>
<th>Calculated U value</th>
<th>Butler tested U value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Built-up roof with metal deck</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2” insulation</td>
<td>.15</td>
<td>.15</td>
</tr>
<tr>
<td>4” insulation</td>
<td>.07</td>
<td>.07</td>
</tr>
<tr>
<td>2. Industry standard metal roof</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2” insulation</td>
<td>.12</td>
<td>.19</td>
</tr>
<tr>
<td>4” insulation</td>
<td>.06</td>
<td>.12</td>
</tr>
<tr>
<td>3. Butler MR-24 Roof System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2” insulation</td>
<td>.12</td>
<td>.12</td>
</tr>
<tr>
<td>4” insulation</td>
<td>.06</td>
<td>.08</td>
</tr>
<tr>
<td>6” insulation</td>
<td>.04</td>
<td>.07</td>
</tr>
</tbody>
</table>

*No tested U values available.

To find out more about the MR-24 roof, contact your local Butler Builder®. He’s listed in the White Pages under “Butler Mfg. Co. Builder.” Or, write to us for our free MR-24 roof system brochure.
News report continued from page 34

Phoenix House.

aesthetic. The plan epitomizes both functional simplicity and formal elegance.

On the south side of the house the pool evokes the medieval imagery of moat and drawbridge, while serving as an energy reserve, stabilizing the house temperature by heat transfer in either direction. The southern living quarters are sheathed by a glass-enclosed "interstitial" space, the inner skin of which is made of etched glass which reflects and diffuses sunlight. Heat is trapped in this plenum during cold weather; at other times temperature variations are mediated by means of air circulated within this interstitial space. Adjustable awnings control the admission of daylight into this area.

A 432-sq-ft greenhouse constitutes the remainder of the southern exposure, serving both as a visually attractive transitional space and as a trap for passive solar heat gain. These southern layers of the house are aligned with the mechanical spine, which extends the length of the house. The northern exposure aligns service functions against this central, mechanical spine which services all spaces in the house. By designing this mechanical spine as an opaque barrier between the north and south functions of the house, the architect has missed an opportunity to establish a visual link between the greenhouse and the service spaces on the north side of the house: the bath, laundry, and kitchen. The dining room, which might have been more directly associated with the southern exposure of the living room, is also on the north side, separated from it by the mechanical spine.

The roof umbrella is half an array of water-filled solar collectors (1656 sq ft at 45-degree tilt) on a metal frame facing south and half a steel grid with translucent fiberglass panels, oriented north. This solar umbrella absorbs solar heat energy at the same time that it shields the house from unwanted insolation. The collector panels are used for domestic hot water, for space heating, and for an absorption chiller air-conditioning system. Electricity is supplied by a wind-powered electric generator. Beneath the solar umbrella, a roof deck with an outdoor sculpture court overlooks the valley from behind adjustable awnings. These movable sun screens control radiant energy at the exterior, while adjustable metal blinds, positioned in the interstitial space and greenhouse, control incoming energy. The house rests on a concrete pad base. The building skin is glass and aluminum with a structural metal frame and floor joint system used throughout.

To achieve this design subtlety in a project of 2304 sq ft conditioned floor area demanded careful integration of functions by the architect. The design is so tight that no space is wasted, and every element is used to both aesthetic and energy-conserving advantage. The house is scheduled for construction beginning in the spring of 1980 on a four-acre site in the Verde Valley near Phoenix. [Susan Gill]


The building was planned for a small, sloping urban site bounded on the south by a residential street in a moderate-income residential neighborhood in St. Paul.

Both the architects and the client shared economic and energy concerns. Those factors, and the site, led the architects to a low-profile building, a "nonbuilding," almost entirely underground. The plan puts classroom, commons areas, cafeterias, and lecture halls just below ground on the south side of the building, and administrative offices one level below, on the north. The triangular roofs which poke through the surface house skylights and solar collectors—16 banks of the latter, irregularly spaced, with the highest reaching 60 ft from the entry level at its highest point. Skylights [News report continued on page 42]
Carpeting of Antron® III resists dirt better, stays new-looking longer.

The secret: Unique hollow-filament fibers.

Antron® III nylon is the only carpet fiber with a rounded hollow-filament structure. So it resists dirt better than other nylon fibers. The smooth exterior shape of Antron® III minimizes dirt entrapment, and the hollow-filament structure scatters light to make dirt less apparent. So the carpet stays new-looking longer than ordinary nylon carpeting.

Antron® III is durable. Pile of Antron® III resists crushing and abrasion even in heavy-traffic areas. Keeps its fresh, new look.

Antron® III controls static shock. Gives you protection that won't wear out or shampoo out—because it’s built right into the fiber.

That’s why Northridge Fashion Center used carpeting of Antron® III nylon to cover over 135,000 square feet of one of Southern California’s busiest shopping malls (average of 250,000 shoppers per week). And why your next contract carpet should be Antron® III nylon.

Write for Specifiers’ Information Kit:
Du Pont Company
Room 37231
Wilmington, DE 19898

Installation: Northridge Shopping Mall, Northridge, Calif.
Flooring Contractor: Westwood Carpet, Los Angeles, Calif.

*Du Pont registered trademark for nylon fiber. Du Pont makes fibers, not carpets.

Antron® III is the leading contract carpet fiber brand.

Magnification 250X of Antron® III nylon showing hollow filaments and round, anti-static filament.

Circu No. 339, on Reader Service Card
bring light into classrooms and circulation spaces immediately below them; solar collectors are mounted above storage and mechanical spaces.

The terraced, sunken, south-facing play courts on the building's roof provide 4000 sq ft of controlled play area immediately accessible from every classroom, meeting the school's request for outside play space equal to or greater than indoor classroom space.

**SCAMP** sound masking helps keep your office door closed even if you don't have an office door.

Can improve worker efficiency and executive privacy in open office environments.

The incorporation of an unobtrusive SCAMP sound masking system into open office environments is essential to maintaining speech privacy. It reduces the effects of speech, business machine and other distracting noises exterior to an open office area. The background sound that SCAMP provides is electronically produced and specifically tuned to provide the degree of privacy required. For example, SCAMP units can be adjusted for the normal privacy office workers need to perform their assignments efficiently. And, as well, for the confidential privacy executives may require. SCAMP also provides a medium for voice paging, music or emergency tone bursts.

SCAMP is a lightweight, self-contained solid-state device that uses less than 3 watts of power and requires no maintenance. Available in exposed or plenum models, it's easy to install and its cost is quickly paid for in more productive man-hours.

That's why there are more than 10 million square feet of office space covered by SCAMP systems right now and more being installed every day.

Besides individually tunable SCAMP units we also offer centrally controlled systems. The best way to find out about your requirement is to send us a floor plan for a free analysis. We'll examine it and determine the best sound masking plan for you based on both the masking efficiency and cost effectiveness. Write today or call for further details.

The ultimate in speech privacy by the leader in sound masking.

Control Electronics Co., Inc.
1078 Allen Boulevard, Farmingdale, N.Y. 11735 • 516/694-0125

Sales Reps Wanted: Florida, Wisconsin, Illinois and all territories west of the Mississippi. Write or call Jack Leonard.

---

**Montessori School & Administration Building.**

The courts form an irregular grid of landscape and stone, breaking the expanse into a series of play courts and mazelike walkways. A greenhouse and an open, semicircular garden court have been designed to provide functional integration of the natural and man-made elements of the building.

After initial designs had been approved, the promised site was included in a major industrial development project planned by the city, leaving building plans temporarily suspended until an alternative site can be selected. [Joanna Baymiller]

**Central Pre-Mix Concrete Co., Spokane, Wa.** Architects: Walker McGough, Holtz, Eyler, Spokane, Wa. Electrically powered hydronic heat pumps are the basis of the energy-saving system for this earth-covered building. The conservation potential of the building envelope is enhanced through the maximum utilization of internally generated heat from people, lights, and equipment—mostly a computer—plus the solar energy from an exposed south-facing wall.

Wrapping the building with an earth berm on all but the south side answered the client's requests for a two-story structure with a daylighted basement and access to a major traffic artery along the south side of the site.

One floor is situated above grade on the north and the other slightly below, thereby providing both levels with generous amounts of natural light through continuous bands of south-facing windows. Exterior precast sunshades screen unwanted direct sunlight during the warmest months. Combining the building's structural mass with an earth cover insures minimum heat gain or loss through the building envelope. When outside temperatures exceed even 15°F, the occupant load will generate more heat than necessary. Only during periods when the building is unoccupied in the winter will heat loss through the south wall require use of the HVAC system to counteract reduced night temperatures.

To condition the usable 15,200-sq-ft floor area, the HVAC system will collect heat from the internal sources mentioned, including the lighting fixtures, the majority of which are extrusion fluorescent. The heat exchanger will direct the heat to the HVAC loop system, which in turn will supply it to the return air to the heat-pump units. If the total heat produced exceeds that needed to maintain a comfortable temperature, the heat-pump units will reject the heat into a water loop system that includes a 3000-gallon storage tank. The piping and storage tank will store enough heat to counteract the losses for approximately a 24-hour period during cold weather. Most of the time, the excess heat produced will be used at night and on weekends. When more heat is generated than can be used during unoccupied periods, outside air will be introduced into the ceiling plenum and into the heat-pump units. If the cooling effect of the outside air is inadequate, resulting in mechanical re-refrigeration within the heat-pump units, a tower fan will be actuated to reject the excess heat. When the temperature of the water in the storage system can accommodate additional rejected heat, introduction of outside air will be minimal.

If heat losses exceed available stored heat, [News report continued on page 44]
Introducing the StarTherm Energy Efficiency Analysis!

It won't cost YOU a penny, and it could save your clients thousands.

StarTherm insulated roof and wall systems are so remarkably energy efficient we think they'll out-perform almost any conventional construction materials. And we're willing to prove it with a free StarTherm Energy Efficiency Analysis.

Just give us the location and specifications of your proposed building project and your Star Builder will ask our computer to determine the energy savings you could realize with a StarTherm building of the same size. The results can be dramatic.

The StarTherm system's remarkable insulating properties will significantly reduce operating and maintenance costs, which account for about 50% of the total life cycle costs of any building. (The rest is initial construction and finance costs, plus improvements or building additions.)

You'll find it pays impressive dividends to build with StarTherm insulated panels.

Remarkable but not surprising.

StarTherm insulated panels offer some of the lowest U factors money can buy: 0.043 for roofs, an even lower 0.040 for walls. They have no through fasteners or compressed insulation points. Joints form a positive energy tight seal, and, according to ASTM-E-283 testing procedures, allow no detectable air infiltration.

Tax incentives. Reduced maintenance costs. Even lower insurance premiums.

The StarTherm system's low thermal transmission properties might qualify your structure for energy-related tax incentives.

Additional savings will occur through reduced maintenance costs. And our Class 1 low fire hazard rating and UL 30, 60, and 90 wind uplift ratings could lower insurance premiums. So over the life of your building StarTherm panels really pay off.

Ask for your energy efficiency analysis today.

Your Star Builder wants to help you design the building your client will thank you for—both today and in the future.

So ask for your free energy efficiency analysis today.

Call toll-free 800-654-3921. In Oklahoma call collect 405-636-2548. Or write Star Manufacturing Company, Box 94910, Oklahoma City, OK 73143.

$1,839 Annual Savings in Chicago.

In one example, the computer compared a 100' wide by 150' long by 20' high structure with 4" normal density blanket insulation in the roof and 12" corefilled concrete block walls, with a building of the same size equipped with StarTherm roof and wall panels.

Our energy savings calculations were based on heating loads only. We told the computer that our example buildings were located in Chicago, and we specified that each building had two 3'x7' walk doors, two 10'x10' insulated overhead doors and two 3'x6' thermal pane windows. We assumed gas heating at $3.50 MCF.

The results?
The StarTherm building consumed 68% less energy than the conventional building, resulting in an annual dollar savings of at least $1,839. And when you consider the current rapid inflation in energy costs, this savings will be even more significant to the building owner 20 years from now.

STAR BUILDING SYSTEMS

Circle No. 401
a supplemental gas-fired boiler will add heat to the loop. When the heat-pump units are mechanically cooling, heat will be rejected into a closed-loop water system via a water-cooled condenser subsequently to be redistributed or stored.

Compared to a similar, conventional above-grade building with a standard above-ground system, this structure has been calculated to reduce costs by about 50 percent. The payback period has been conservatively estimated at eight to ten years although the actual time should be less because of the gradual warming of the earth around the building. The

**Alabama Operations Center, South Central Bell Telephone Company, Jefferson County, Al. Architects: Crawford, Giattina & Associates; Joe Giattina, architect in charge, Birmingham, Al.** Although energy conservation was a strong design charge, many of the energy-conscious features of this 450,000-sq-ft headquarters building seem to be more a result of the owner's and architect's concerns for the attitude of the building toward its natural setting.

The winning solution in a statewide competition, this building is covered with insulating earth fill topped by native vegetation. Like other aspects of the project, this decision was not wholly the product of energy concerns. The ground level of the site is nearly 100 ft below the level of surrounding roadways. The building is mostly office space (or office warehousing, as Giattina describes it, referring to the client's need for large, flexible open areas). Internal stairs are a central element of the design, both formally and from an energy-saving standpoint. Use of elevators will be minimal. Since the building is only three stories high, stairs are emphasized as the major building transportation system.

The client's concern for environmental systems also led to development of a complete, self-contained waste-water treatment facility. Innovation in the project was extended beyond the mechanical, electrical, and plumbing systems. Faced with a requirement for large open spans, the architects and engineers devised a post-tensioned concrete frame and steel deck structural system, which, to the best of their knowledge, is the first such application in a building of this scale. Architect Joe Giattina explains, "it was really a problem of site-blending, as most of the major views of the building would be out over the roof level. The side benefits from an energy standpoint were substantial."

A man-made lake, in part a design gesture to the company's desired corporate image, serves several important environmental functions. In service as a thermal pond, its waters become a cooling medium when temperatures permit. Irrigation for the roof planting comes from the lake; as the water is recirculated, it is purified and oxygenated. The lake also serves as an area for storm-water retention and accommodates the building runoff.

The building form provides shading for all major glass areas. In the architect's words,
**bold cel**

**dramatic, luminous, functional**

**BOLD-CEL**

using low energy magic

**SPARKLE LAMPS**, 2½ Watts, 50 year life expectancy . . . Blend Form and Function to Keep You Comfortable and Complimented.

Showroom
LIGHTING UNLIMITED
12 East 37th Street,
New York City
537 Johnson Avenue, Brooklyn N.Y.
212-456-7400 11237

---

**The Loewenstein Silver.**

Brilliant.
Chrome chair for conference or dining upholstered in fine fabrics or vinyl.
From the Loewenstein contemporary collection of seating in metals and woods.
For corporate, commercial or institutional planning.
Loewenstein Catalog available by written request on professional stationery.
Loewenstein, Inc.
Post Office Box 22029
Fort Lauderdale, Florida 33334.
305/525-8453.
Telex: 514321

---

The Green Stuff: Tempchek.® It gives you the same high R values as Thermax, and is used on all types of decks, except directly over steel decks. Tempchek is reinforced with glass fibers to give it greater dimensional stability than other urethane foam insulations, so it resists “growth” and ridging. All of which makes Tempchek first choice for any application other than directly over steel. Talk to your Celotex representative about the stuff the best insulated roofs are wearing these days, or call Ed Levin at Celotex, Roofing Products Division: (813) 871-4545.
Tremco waterproofs your building a lot like your skin waterproofs you.

What we've learned from nature. You have five epidermal layers that protect the dermis (often called the true skin) from the elements and provide an efficient thermal barrier. A Tremco waterproofing system also has layers of liquid polymers, like epidermal layers, over the true structure of the building: concrete, wood, masonry or metal. The result is a flexible, seamless, waterproof "skin" that becomes an integral part of the structure.

Specialized systems give you more freedom of design. Just as your skin varies in thickness over your body, Tremco formulas vary to match the function and design of the building surface. That provides more freedom of design with the assurance that Tremco can give you the most efficient waterproofing system.

Whatever your waterproofing requirements, Tremco has a compatible system. Our systems include "Trempro®" fluid applied polymers.

Architectural systems for the life of your building. In addition, Tremco manufactures sealants, glazing and roofing systems that protect your building. We'll show you proven methods to solve old problems at the design stage because a good waterproofing system begins on the boards. And we'll follow through with on-site application instruction for the contractor.

For complete details on any Tremco weatherproofing system, call toll free 800-321-7906 (in Ohio call (216) 464-7994 collect). Or write Tremco, Cleveland, Ohio 44104; Tremco (Canada) Ltd., Toronto, Ontario M4H 1G7.

A building is a living thing.
“This is primarily a location where cooling is the problem; we’re exhausting heat 95 percent of the time.” A reclamation system uses that heat for domestic hot water in the bathrooms, kitchens, and cafeteria. Augmented by storage tanks and 6000 sq ft of solar collectors, the hot water system can also provide the building with adequate space heat, when needed, for brief holiday periods. This also saves considerably at “start-up” time when the staff returns.

One element seems to run against the conventional energy conservation wisdom: there are few provisions for task lighting. Constrained by the requirement to accommodate Southern Bell’s existing furnishings, which were not compatible with task lighting, the architects had to devise a flexible ambient illumination scheme in the ceiling. “The results are very nearly as good as those we’d see with task lighting,” says Giattina, noting that zoned switching and a perimeter photocell system helped greatly.

The firm compared the expected energy performance of its design against that of a 1970 office building of a similar size in a similar climate. The computer-assisted analysis put the Alabama Operations Center at 40 percent below its earlier counterpart in calculated annual energy use. Construction of the project is now about 30 percent finished with a projected completion date of October 1981. [Thomas Vonier]


California Farm Bureau Federation Headquarters, Sacramento. Architects: Pflueger Architects, San Francisco. Since the major problem in the Sacramento Valley is cooling, many of the energy-saving devices incorporated in this building address this problem. To reduce the energy input to the refrigeration chiller of the air-conditioning system, water is cooled in evaporative cooling towers at night and stored in four underground tanks for use the next day. On mild days the towers send water straight to the air-conditioning system, bypassing the re-

[News report continued from page 14]
When your next project calls for reflective glass, spec Rayflect™

Time and time again, glaziers and architects specify reflective glass that's energy efficient, durable and aesthetic. Time and again, they specify high performance Rayflect Silver from Advanced Coating Technology.

Color uniform Rayflect Silver reduces glare and provides more uniform daylighting. The solar efficiency designed into each pane of Rayflect glass reduces hourly interior temperature variations. Shading co-efficients, u-values and heat gain factors outperform other reflective glasses.

Annealed, heat strengthened and tempered, Rayflect Silver coatings are backed by a limited 10-year warranty against peeling, cracking or deterioration.

Best of all, Advanced Coating Technology provides complete service, from your initial specifications through a quick, efficient delivery. Our service professionals will examine your requirements and recommend the Rayflect Silver that's right, be it clear, gray, bronze or blue-green. Call us and see why the more you look, the better we look.

For more information, see Sweets #8.26, or write Advanced Coating Technology, Inc.
Rayflect Division
A subsidiary of Worthington Industries, Inc.
306 Beasley Drive
Franklin, Tennessee 37064
615-790-6001
Telex 55-5145

Circle No. 304, on Reader Service Card
AN ENERGY-EFFICIENT DESIGN isn't created by a committee on a one-dimensional blackboard. Rather, each design is born in the mind of an architect or engineer. A three-dimensional world where an idea can be developed. Shaped to an environment. Built in theory even before pencil has been put to paper.

Owens-Corning would like to honor those specific architects and engineers responsible for conceiving and creating the most energy-efficient designs of 1980.

Registered architects or professional engineers practicing in the United States may enter as individuals or in teams. The building entry must be a commissioned project: new or remodeled, in the design process, under construction, or completed.

A panel of proven professionals in architecture and engineering will act as jury. Entries must be submitted by August 29th, 1980. Winners will be notified in early October.

The Call for Entries has full details. For your copy, write today to Mary Reinbolt, Department 124, Owens-Corning Fiberglas Corporation, Fiberglas Tower, Toledo, Ohio 43659. Or call her at this number: (419) 248-7419.

©O.-C.F. Corp. 1980

Circle No. 381, on Reader Service Card
DELTA DASH. SAME DAY DELIVERY ON SMALL PACKAGES.

Delta is an airline run by professionals. Like normal business hours, we will package during normal business hours. Call (800) 638-7333 to U.

Up to 30 minutes before flight time. Delta cities in the U.S. and Mon­

3. Dryvit Primus/Adhesive: Dryvit's unique plaster material mixed with type I Portland Cement is used to adhere Dryvit Insulation Board to backup surface. It is also used to embed Dryvit Reinforcing Fabric on the face of the board.

4. Dryvit Quartzz Finish: one of four finishes available. This synthetic plaster material has high bond strength, permanent integral color and an applied texture that provides a weatherproof jointless exterior surface.

5. 4" x 16 ga. "C" stud of 16" O.C. 6. 1/4" exterior grade gypsum sheathing conforming to federal specification SS-l-30D, Type II, Grade W, Class 2 and ASTM C-79.

News report continued from page 48

California Farm Bureau Headquarters.

Delta DASH (Delta Airlines Special Handling) gives you same day delivery if we receive your small package during normal business hours. If your package arrives after normal business hours, we will deliver it the first thing next morning—generally no later than 10am. And DASH serves over 80 U.S. cities plus San Juan.

Packages (up to 60 lbs.) are accepted at airport ticket counters up to 30 minutes before flight time. Up to 60 minutes at cargo terminals. Size limit is 90 inches: width + length + height.

The airport-to-airport rate between any two of Delta's domestic cities is $35 ($25 between Dallas/ Ft. Worth and Los Angeles or San Diego or San Francisco). Pick-up and delivery is available at extra charge. Call (800) 638-7333, toll free. (In Baltimore, 269-6393.)

The building will require no heating or cooling for approximately 315 days of the year. Based on an interior design temperature range of 68 F to 78 F, it is estimated that the building will consume about 74 percent less heating and cooling energy than a comparable conventional structure.

The building is sheathed in Dryvit, a foam paneling with a cementlike appearance that has a number of advantages over stucco: reduced weight resulting in reduction of structural steel; simple, speedy construction; and no maintenance problems from cracks caused by expansion, as well as good insulating characteristics.

An energy-saving earth berm up to the second-floor level of the building on the west side minimizes its height and bulk from the point of view of the neighboring tract and provides a sunken terrace for the employees. The berm is well landscaped and the vegetation maintained by recycled or gray water. Parking is provided in an underground garage that also serves to transmit the cool night air under the building to the first-floor concrete slab where it is stored in the structural mass. [Sally Woodbridge]

Joanna Baymiller is a freelance journalist specializing in architectural subjects.

Susan Gill, M.Arch., Harvard, is a principal of the firm ABRI (Architecture, Building, Research, and Innovation) in Boston.

Barbara Goldstein, formerly of RIBA Jour­[News report continued on page 56]

Circle No. 338, on Reader Service Card
Massive insulation used as an integral skin creates a new perspective in energy saving.

ARCHITECT
Tom Hite
Denver, CO

The pyramid is ancient history. But in this Phoenix, Arizona building, the pyramid is a dichotomy. On one hand, its inverted shape creates a mood of modernity. On the other hand, it was erected by using some good old fashioned work methods. The building which houses the offices of Security Mortgage Corp. and its lessees, stands four floors high. Each floor carries an overhang of more than 10 feet. In all, a total overhang of 44 feet. A 30 foot tree could grow within its shelter.

Another remarkable feature about the structure is the time it took to build. Just two and a half months from start to finish.

Unique methods were used. The Dryvit System was prefabricated on steel stud panels which were constructed on an adjacent lot. The block and tackle method was used to hoist the panels into position. And it needed only a crew of 3 lathers, 2 plasterers and a plaster tender to put up the 16,500 square feet of walls. They made a mock-up of a single corner and adjusted it until it was correct. Then they built all the corners and put them in place first. They measured the distance between each corner and fabricated the exact size to fit each floor.

Obviously, Dryvit's lightweight and ease of application were two reasons why this structure went up so fast. And as Dryvit went up, it also provided Outsulation™, the massive insulation that saves energy while it looks beautiful.

The Dryvit System works in this inverted pyramid. Let us prove it can work for you. Call or write, stating your application: new construction or retrofit.
Presenting the five winning reinforced concrete structures in the CRSI Design Awards V Program.

This Fifth CRSI Design Awards Program honors an exceptionally diverse group of structures. This variety, ranging from the inspirational to the institutional, reflects the versatility of reinforced concrete itself.

All winners share equally in the Design Awards. There are no specific categories. In addition, for the first time in the Awards Program, the jurists presented a Special Award for energy conservation.

A CRSI Design Awards Program V brochure is now available. It details the structural systems and illustrates design features of all the Award winners. For your copy, write: Concrete Reinforcing Steel Institute. Attention: Victor A. Walther, Jr., Vice President, Marketing and Promotion.

CRSI Design Awards V Jury

Chairman
Ehrman B. Mitchell, Jr., FAIA, National President, American Institute of Architects, Washington, D.C.
Fred M. Briggs, AIA, Laguna Beach, CA
Harold Sandberg, President, Alfred Benesch Co., Chicago, IL
Mack Scogin, AIA, Vice President, Design, Heery and Heery, Architects, Atlanta, GA
Edward M. Cohen, Managing Partner, Ammann and Whitney Cons. Engineers, New York, NY
A.I.A. Representative
Mrs. Maria F. Murray, Director, Awards Program, The American Institute of Architects, Washington, D.C.

Watch for Call for Entries in CRSI Design Awards VI.

CONCRETE REINFORCING STEEL INSTITUTE
180 North LaSalle Street, Room 2113D, Chicago, IL 60601
For information on Professional Membership Program, write to Vice President, Marketing and Promotion.

Circle No. 333, on Reader Service Card
"Innovative, enthusiastic."
Reunion Tower. Dallas, TX.

Jury Comments:
A successful solution to a unique structural problem. An innovative structure that capitalizes on modern slip-forming methods to provide both speed and economy. This enthusiastic reinforced concrete structure should have high appeal to the patrons of the observation decks and the revolving restaurant at the top.

Owner: Woodbine Development Co. (subsidiary of Hunt Investment Corp.), Dallas, TX.
General Contractor: Henry C. Beck, Dallas, TX.

"Functional, practical, overall economy."
Mecklenburg County Courthouse, Charlotte, NC.

Jury Comments:
A very functional, practical, and distinguished solution for a government building. Everything is done with a purpose. Reinforced concrete was an excellent example of a very natural material for a high-quality building. The unique glass façade provides visual penetration both in and out of the building. One feels comfortable in this environment. The straightforward design provided overall economy for the client.

Owner: Mecklenburg County, Charlotte, NC.
Structural Engineer: King-Hudson Associates, Charlotte, NC.
General Contractor: Larke Construction Company, Charlotte, NC.

"An exciting place to be."
Chapel of Thanks-Giving Square, Dallas, TX.

Jury Comments:
A fun place for people. A real surprise in a busy, congested downtown area. A multi-leveled, well-ordered, exciting place to be. A tribute to the dedication of open space for use by people.

Owner: Thanks-Giving Square Foundation, Dallas, TX.
Structural Engineer: Datum Structures Engineering, Inc., Dallas and Austin, TX.
General Contractor: Manhattan Construction Co., Muskogee, OK.
WASHROOM DIRECTIONS are reference manuals designed to guide specifiers in selecting the right equipment for use in each of a wide variety of washroom categories. The stainless steel units in this washroom were taken from a WASHROOM DIRECTIONS checklist of essential and optional space-saving units for use in a men’s washroom in an office building. They include:

- MULTI-PURPOSE UNIT (paper towel dispenser, mirror, shelf, soap dispenser) — No. 614
- WASTE RECEPTACLE — No. 656
- TISSUE DISPENSER — No. 611

If space-saving units are not required, WASHROOM DIRECTIONS also provides checklists for recessed, surface-mounted, barrier-free and concea lwall washroom designs. Send for your WASHROOM DIRECTIONS also provides checklists for recessed, surface-mounted, barrier-free and concealed washroom designs. Send for your WASHROOM DIRECTIONS and find out how easy specifying Parker units can be, whatever direction your washroom plans are taking.

News report continued from page 52

N and Architectural Design in London, now teaches at the University of Southern California, Los Angeles, and is a West Coast correspondent for PIA.

Thomas Vonier, AIA, is president of Thomas Vonier Associates, Washington, DC.

Building Stone Institute architectural awards

The 1980 Tucker Awards for architectural excellence in the use of natural stone have been announced by the Building Stone Institute. Presented at BSI’s annual convention in San Francisco in February, these awards recognize outstanding concept, design, and construction in several categories.

Cornithian capital, First Church, Boston

Singled out among contemporary nonresidential buildings was the new portico of the First Church of Christ Scientist in Boston, completed in 1975 under direction of project designer Araldo Cossutta, then a member of I.M. Pei & Partners of New York (now principal of Cossutta & Ponte, New York). Among the several applications of stone in this addition to a monumental 1906 structure, the most striking are ten 42-ft columns of Indiana limestone with six-ton Corinthian capitals—each of which required 500-700 man-hours to carve (P/A, Mar. 1976, p. 81).

In the category of residential design, a single award was presented for a residence in Armonk, NY, by architects Robert A.M. Stern and John S. Haggman of New York (P/A, Feb. 1977, p. 58). Among the notable features of the house are the fieldstone retaining walls of its terraces, which extend into the landscape, and the bluestone terrace paving, which continues into the interior.

Recognition for use of stone in buildings 25 or more years old was shared by two landmark structures designed by [News report continued on page 61]
Texture and color as subtle as that of an everlasting bouquet can be found in the 37 patterns of 366 color selections of Tower Contract Vinyl Wallcovering. Featuring textures in deep dimension for fabrics, wood, grass, masonry, leather, etc., Tower Contract Vinyl Wallcoverings can be found in buildings of distinction from coast to coast in the United States and Canada. Consult the distributor directory for catalogue and samples. Material is supplied in 30 yard bolts of 54 inch width. Custom colors and emboss effects are also available.
A 10-acre roof of TEFCON...and air
fabric coated with supports the load.

An air-supported dome of lightweight Fiberglas® coated with DuPont TEFLON® fluorocarbon resin completely roofs Pontiac Silverdome, home of the Detroit Lions, Detroit Pistons and Detroit Express. The 10-acre area is the largest permanent structure roofed with architectural fabric to date—and the stadium cost far less to build than comparable stadiums using other dome approaches.

Although the roof weighs 200 tons, the spectators inside never notice the slight increase in air pressure that supports it.

Tension structures with steel cables carrying the load, such as this LaVerne College drama lab and campus center, offer an attractive alternative to air-supported structures.

In addition to low construction costs, fabric structures coated with TEFLON offer easy and economical maintenance. The coated fabric resists sunlight, dirt and aging, and rain helps keep it clean because of the non-stick surface of TEFLON.

Fabrics coated with TEFLON have high reflectivity, which helps minimize energy expenditures for cooling in summer. They also provide relatively high solar transmission for natural illumination and can be insulated to minimize heat loss in winter.

Architectural fabric structures are strong. When properly specified, they easily withstand the stresses of wind and snow. And Fiberglas® coated with TEFLON does not support combustion—exhibiting exceptionally low values for flame spread and smoke generation.

Send for free booklet

Find out more about the advantages of architectural fabrics coated with TEFLON for permanent buildings. For a free 16-page full-color brochure, write: DuPont Company, Room 37050A, Wilmington, DE 19898.
97 years of craftsmanship.

The Heltons of Terre Haute, Indiana. Three generations of craftsmen, and proud of it.

Elza Helton is on the left. He's been laying brick since 1919. Jim, on the right, has been a mason since the late 1940s. Rick is a relative newcomer with five years of journeyman experience on top of his three-year apprenticeship. Every time he lays a brick, Rick brings to the task the accumulated skills, experience and pride of three generations; and every wall he builds reflects those attributes.

Masonry is a unique building system. The inherent quality of the materials—of brick, block, stone, or tile—is one reason. Men like the Heltons are the other.

Their craftsmanship is what gives a masonry wall its beauty, permanence, and durability. Their skill is what makes a masonry wall air-tight, watertight, sound-resistant and fire-safe. Masonry craftsmen build walls that save money, cut heating and cooling bills, and need virtually no maintenance.

It's a winning combination—the best building materials ever devised, and human skill and pride in using them well.

INTERNATIONAL MASONRY INSTITUTE
(The Bricklayers' International Union and the Mason Contractors in the U.S. and Canada)
823 Fifteenth St., N.W.
Washington, D.C. 20005
202/783-3908

Circle No. 364, on Reader Service Card
the Detroit firm of Smith, Hinchman & Grylls; the 42-story Penobscot Building in Downtown Detroit, a limestone-and-granite-clad exemplar of 1920s skyscraper form and the Rackham School of Graduate Studies at Ann Arbor, also of granite and limestone, with other fine materials.

Awards for landscape architecture went to two contemporary works by Robert Murase of EDAW, Inc., Portland, Or., for two projects in Japan—the Myodo Kyo Kai and the Aichi Green Center—completed when the designer was resident there.

The jury for this year's Tucker Awards included: Harry C. Wolf, FAIA, principal of Wolf Associates, Charlotte, NC; Gerald Allen, architect with Peter L. Gluck & Associates, New York, contributing editor of Architectural Record, and coauthor of The Place of Houses and Dimension: Space, Shape and Scale in Architecture; Charles G. Hilgenhurst, architect, of Boston (see obituary, P/A, March 1980, p. 50); William H. Livingston, Jr., AIA, of the firm of H2L2, Philadelphia; E. Thomas Schmitt, AIA, principal of his own firm in New York, until recently an associate of I.M. Pei & Partners, where he was Project Designer for the East Building of the National Gallery (P/A, Oct. 1978). [JMD]

Architectural awards for steel structures

The Architectural Awards of Excellence Competition, sponsored by the American Institute of Steel Construction, granted 14 awards for architectural excellence in its 19th annual competition. The jury also cited two other structures for "Special Mention." A total of 103 designs were entered in the competition.

Although clear, sharp details demonstrating design control are important, increasing emphasis is being placed upon energy utilization as an essential criterion in developing an award-winning structure. In addition, the jurors looked for an inviting environment for those using the building.

The following AAE award winners are listed alphabetically by architect:


[News report continued on page 64]
Now, the name that offers you more in exclusive insulating sheathing systems is first to fill another important architectural need. It's a 1-hour fire-rated commercial system for rigid insulating sheathing—with load-bearing steel framing (see schematic above).

This unique new system employs high performance FOAMULAR insulation—the remarkable polystyrene produced by a patented vacuum/hydrostatic process. Remarkable because of a closed-cell core structure, continuous skin surface, good flexural and compressive strength, minimized wicking, plus resistance to water, vapor and decay. FOAMULAR insulation scores and snaps clean to expedite installation. Meets Federal Specification HH-I-524B and major building codes. Call your U.S.G. Representative. Mail coupon now!

The higher the R-value the greater the insulating power. Ask your seller for the fact sheet on R-values.
Exclusive new tongue and groove configuration reduces air infiltration, permits joints to meet between framing members.

Extruded Polystyrene Insulation

Only UNITED STATES GYPSUM brings you this

1-HOUR FIRE-RATED SYSTEM!

(A joint venture between subsidiaries of UNITED STATES GYPSUM COMPANY and CONDEC CORPORATION)

United States Gypsum, 301 S. Wacker Dr., Chicago, Ill. 60606, Dept. PA-480

Send complete product information on FOAMULAR® Polystyrene Insulation Systems to:

Name __________________________ Title ________________

Firm __________________________ Address ______________

City __________________________ State _______ Zip ______

Phone __________________________

Product currently not available in Western U.S.

Circle No. 412, on Reader Service Card
The Co-Ray-Vac Heating System Can Cut Fuel Usage 20%-50%

The 17 year old vented radiant heating system that a lot of people don't know about.

Co-Ray-Vac is a gas fired, fully vented, low intensity, infrared heating system.

Low Intensity. Unlike glowing red "high intensity" infrared heaters, our system is a series of enclosed burners connected by radiant tubes or pipes. This unique design efficiently heats not only large areas like factories and airplane hangars but also offices, stores and restaurants.

Infrared. Heats like the sun. Radiant heat is emitted from overhead tubes but not released until it strikes people or objects at floor level. Air temperature is raised when these objects give off heat. Heat is not wasted at roof level. Comfort is dramatically increased because the system provides draft free heat. It bathes an entire area in warmth.

Gas-Fired. Does not use oil. Operates on natural or LP gas. Extremely high combustion efficiency; in the range of 90%, coupled with infrared heating principals, slashes fuel consumption. Users report fuel savings up to 50% over conventional heating systems.

Fully Vented. No fumes. Saves fuel because extra ventilation is not required to expel condensation caused by combustion.

Ask the Man Who Owns One. Designed for new or retrofit installations in industrial or commercial buildings. Write or phone for information and names of users in your area.

Roberts Gordon
44 Central Ave.
Buffalo, NY 14240
Phone 716 / 892-8400

Hickory Hollow Mall, Nashville, Tn.


The two buildings that received "Special Mention" are: Pavillion for Pope John Paul II, Boston, Ma; architect: Glaser/de Castro Associates, Boston, Ma. Sixty State Street, Boston, Ma; architect: Skidmore, Owings & Merrill, Chicago, Il.

The six jurors praised AISC for again sponsoring the awards as an effective means of promoting steel-framed buildings and steel as a construction material. Citing the institute for its promotion of fine architectural design, the jury noted that such a competition encourages designers to create buildings that not only have an aesthetic value but also fit the needs of the owners and relate effectively to their environment.


Paddock®
Pool Equipment Co., Inc.
P.O. Box 511
Rock Hill, S.C. 29730
803-324-1111

Circle No. 386, on Reader Service Card
BLIND AMBITION.

How you design with Bali one-inch blinds depends, of course, entirely on your point of view. That's our point, though. It only depends on you. Because with Bali, you can be as ambitious as you want to be. No matter what shape your imagination is in. And regardless of your colors.

Here, a little Blind Imagination helped establish a very imaginative beachhead. An office built inside a geodesic dome structure, featuring triangular windows and custom cut Bali blinds.

It's clearly a case of applied geometry. While this office may also be a special case, we've always been especially good at figuring all the angles.

We've also added some new optional features to make your finished jobs look better. One-position cord lock, limited tilter and clutch tilter are all available.

We've even specified our blinds in a simple CSI format to permit ready reference for procurement packages. And we'll make these specs readily available to you.

So, specify Bali. We'll help your ambition soar.

BLIND IMAGINATION.

Bali BLINDS

19198, Marathon Carey-McFall, Loyalsk Avenue, Mertensville, Pennsylvania 17754. Division of Marathon Manufacturing Company.

I'm ambitious. Send me your free brochure, The Tricks of the Trade.

Bali BLINDS

Bali IS Blind Imagination.
PPG SETS THE GOLD STANDARD IN GLASS.
The Midland Life Insurance Building, Sioux Falls, South Dakota. The centerpiece of a far-reaching urban renewal program. And a triumph in modern center city architecture.

One reason for the building's success is 26,000 square feet of energy-conserving PPG Solarban® Gold Twindow® reflective glass. A breathtaking building skin that, literally, has earned its way into this design.

**THE STANDARD FOR BEAUTY.**

Perhaps the most striking characteristic of Solarban Gold is its true color. It isn't brassy or greenish like many other gold reflective glasses. Instead, its rich golden tone is distinctive and elegant. An excellent way to bring out the best in any innovative design.

Yet Solarban Gold never looks out of place. Its reflective qualities allow it to blend easily and naturally into practically any surroundings.

**THE STANDARD FOR ENERGY EFFICIENCY.**

But beauty is only half the story. Solarban Gold is also the most energy effective of all PPG's high performance glasses. Each panel boasts a U-value of .30. And spandrel units are available with even more impressive U-values of .08.

That kind of insulating efficiency is coupled with other energy-saving features to meet the design goal of a building that needs no heat until the outside temperature dips below 10 degrees Fahrenheit.

Solarban Gold is effective during the summer, too. By reflecting the sun's heat, it reduces solar heat gain as well as the need for air-conditioning.

There's much more to learn about PPG's spectacular gold standard in glass. For more details, see Sweet's 8.26 Pp, or write PPG Industries, Inc., One Gateway Center, Pittsburgh, PA 15222.

PPG: a Concern for the Future

Architect:
Henningson, Durham & Richardson, Inc.,
Omaha, Nebraska.

Owner:
Midland National Life Insurance Company,
Sioux Falls, South Dakota.

Circle No. 388, on Reader Service Card
Promotions on P/A staff: McCarthy, Desimone, Rose

Three key members of the P/A organization have assumed greater responsibilities as part of a program to expand and strengthen the magazine's staff.

Barbara McCarthy, previously Administrative Editor, has been named Managing Editor, with broad responsibilities for planning of editorial subjects and management of editorial expenses. A graduate of Sacred Heart University, she joined P/A in 1971 as an editorial assistant.

Daniel Desimone, who joined the P/A Production Department in 1960, has been promoted from Managing Editor to Business Manager of P/A. In this newly established position, he will work closely with the Publisher in all areas affecting the magazine's revenues and costs.

Harrington A. Rose, who has been associated with P/A since 1962, has been appointed to the new position of National Accounts Manager. Until recently P/A's Eastern Sales Manager, he will represent P/A with major producers and trade associations nationwide and at building industry conventions.

Calendar

Workshops

Conferences


Conventions
June 1-4. American Institute of Architects convention, Cincinnati, OH.


Deadline April 11. Registration for May 12-16 study tour to Helsinki, Finland, sponsored by Institute for Urban Design, State University of New York at Purchase.
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.

Schindler Haughton
ELEVATOR CORPORATION
Toledo, Ohio 43609
Announcing the downfall of the built-up roof.

Coreroof.

In a survey of 1,000 bonded, built-up roofs, one-third were in trouble within a year or so after completion.* Today there is a better answer. Coreroof.

Coreroof is a new, complete, one-step roof system that does everything the built-up roof does. Except give you trouble.

A factory-finished insulated panel 2 1/2 inches thick, Coreroof is so lightweight (only 2 1/2 pounds per square foot), that primary and secondary structuralists can be lighter.

Yet Coreroof gives you insulation so effective that it exceeds the ASHRAE 90-75 energy code (already adopted in most states).

*The Manual of Built-Up Roof Systems C.W. Griffin for the A.I.A.

One-step installation.

Best of all, Coreroof ends all the problems of the built-up. No steel decking, no poured or rigid insulation, no layer after layer of tar and felt. No dealing through several trades for one roof.

Each 40-inch wide panel is simply placed and clipped to the structural frame. And panels are machine-clipped together along a 2 1/2" standing seam. Saves many, many expensive man-hours.

And Coreroof has passed U.L. 90 uplift tests and qualifies for the lowest wind-storm insurance rates.

Lowers your overhead.

Coreroof has a tested "U" value of 0.050, which is just about the lowest available today. Thanks to just 2 1/2" of urethane foam bonded between exterior and interior steel facings.

And the exterior facing of aluminum coated or aluminum-zinc coated steel is so effective in resisting corrosion that we provide an extended warranty. In addition, its bright surface reflects 85% of the solar heat. Inside, the galvanized steel facing is factory-painted to provide a highly reflective (65%) ceiling.

We beat the system.

The built-up roof system has been one of the most complex field-assembled sub systems of a building. Thus it presents a long list of exacting requirements to succeed.

Requirements that are often difficult, if not impossible, to meet under jobsite conditions.

Manufactured under controlled conditions, field-assembled Coreroof is vastly simpler. Yet results are vastly superior.

Granco Building products that perform

Whether you're building or replacing, find out more. Write, or send the coupon for complete information.

National Steel Products Company
Dept. PA-40, P.O. Box 40526, Houston, Texas 77204
Phone 713-466-2300

National Steel Corporation

Circle No. 357, on Reader Service Card
Energy Analysis. CYBERNET® Services Makes It Easier.

Energy analysis is still a job for professionals. Our service, support and state-of-the-art programs can help them make cost-effective conservation decisions.

Energy costs are now the number one expense of operating a building. But Control Data's CYBERNET Services can help you reduce those costs through analysis of new building designs, and retrofit analysis of existing buildings.

You get a wide variety of easy-to-use programs
We know how important it is to have the right tools for the job. And we continually make improvements to our comprehensive offering of proprietary and public domain programs. Interactive access to many of our programs allows you to converse with the computer in a question-and-answer manner to help you make the best use of your valuable time.

You get the training you need
We provide comprehensive step-by-step training for our energy analysis customers. Bring a sample problem to one of our workshops. We'll help you use an appropriate program and give you “hands-on” experience on our equipment. We'll show you the way to solve your problem using the powerful computing resources of CYBERNET Services.

You get people devoted to helping you succeed
As one of the world's leading suppliers of data services, we know the value of support and service. Should you run into a problem, our professional services staff is trained and ready to answer your questions. Trained energy specialists are available throughout the country to provide the technical assistance you need.

We're only a phone call away
We'd like to show you what we can do for you. Call your local Control Data sales office. Or contact Energy Industry Marketing, Control Data Corporation, HQW09A, P.O. Box 0, Minneapolis, MN 55440.

Addressing society's major needs

Circle No. 343, on Reader Service Card
Who protects the Picasso after the museum closes?

Kinnear does.

Any art gallery or museum which has one or more works by Pablo Picasso is rightfully proud . . . and not a little apprehensive. Which may be why specifiers choose Kinnear metal rolling doors to keep weather and possible vandalism at bay where such valuable art is shown.

For over 80 years, Kinnear has been recognized as the opening handling company for commerce and industry, agriculture and government agencies. Our complete line includes steel rolling and sectional doors (some in aluminum, fiberglass or wood) . . . grilles, shutters and fire doors. Plus dock seals, power operators and other accessories.

A nationwide network of plants and sales/service representatives assures you prompt delivery to meet tight budgets, specs and deadlines. Write or call for literature . . . or see our catalog in Sweet's. Also listed in Yellow Pages under "Doors."

Kinnear makes it easy for you to put it all together.

KINNEAR

A DIVISION OF harsco CORPORATION

Box 598 • Columbus, Ohio 43216 • (614) 294-4451

Circle No. 369, on Reader Service Card
Task/Ambient lighting by Keene.
Because nothing helps you create the right environment like the right lighting.

Keene Task/Ambient lighting systems create atmospheres people find comfortable to work in. And use less than 2 watts per square foot to do it. For your free copy of our complete Task/Ambient lighting catalog of portable lighting fixtures, write c/o Task Lighting, Keene Corporation, Lighting Division, Industrial Way, Wilmington, Mass. 01887.
Bilco horizontal doors.

Your assurance of value and satisfaction for your clients.

When you specify Bilco horizontal doors or automatic fire vents you're specifying the quality that is uniquely Bilco. You're calling for the design, materials and workmanship that add up to long, trouble-free service. And you're calling for products that will operate properly. Proper operation is the most important requirement of a horizontal door or vent.

Bilco. Your assurance of value and satisfaction for your clients. Roof scuttles, automatic fire vents, sidewalk, floor and pit doors, ceiling access doors. Performance proven products by the leader in design and quality.

See our catalog in Sweet's General Building, Industrial Construction and Engineering Files, or write for a copy.

The Bilco Company, Dept. PA 40, New Haven, CT 06505

Circle No. 318, on Reader Service Card
When we say CONSTANT INSULATING VALUE we mean constant.

FOAMGLAS® Insulation.
Case in Point: 26 years of thermal performance.

In 1952, FOAMGLAS insulation was installed in the roofs of a 20-story, cruciform-shaped office building in Gateway Center, Pittsburgh, Pennsylvania. The installation was over a concrete deck and consisted of 2-inches of FOAMGLAS insulation, a coal tar, four-ply built-up roof with a gravel surface.

In 1978, Pittsburgh Corning removed a piece of that FOAMGLAS insulation for testing. The test results show that the FOAMGLAS insulation had almost the same thermal conductivity value in 1978 as it did in 1952. Twenty-six years of constant thermal efficiency.

From 1952 to 1978 the insulation had withstood, without deterioration, ambient temperatures ranging from highs in the 90's (99°F, July, 1974) to lows in the minus teens (-18°F, January, 1963). Actual roof surface temperature reached as high as 160°F and as low as -38°F.

And, since 1952 the thermal conductivity and density of FOAMGLAS insulation have been improved.

Performance is built-in
The closed cellular glass structure of FOAMGLAS insulation is impermeable, it will not absorb moisture which penetrates other insulations and destroys their thermal efficiency. FOAMGLAS insulation is also dimensionally stable, strong, rigid and totally noncombustible.

Now Pittsburgh Corning offers the TOTAL ROOFING SYSTEM GUARANTEE
Performance like this makes it possible for Pittsburgh Corning to offer a no-leak, no-thermal-loss guarantee that includes everything from the deck up. Call or write for details.

So when you're specifying roof insulation, specify FOAMGLAS cellular glass insulation and get a roof with constant thermal efficiency. Guaranteed. Call or write Marketing Department PA0480, Pittsburgh Corning Corporation, 800 Presque Isle Drive, Pittsburgh, PA 15239. (412) 327-6100.

Results of Independently Conducted Tests*

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>Published Rating 1952</th>
<th>Test Result 1978*</th>
<th>A.S.T.M. Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Conductivity (k)</td>
<td>0.40</td>
<td>0.42</td>
<td>C 177</td>
</tr>
<tr>
<td>Density (lbs/cu ft)</td>
<td>9.0</td>
<td>9.52</td>
<td>C 303</td>
</tr>
</tbody>
</table>

*Tests conducted by Pittsburgh Testing Laboratory, an independent testing laboratory located in Pittsburgh, Pennsylvania. Copies of the test results may be obtained by a written request to our Marketing Department.
Join the discoverers. Let the sunshine in on energy problems.

EXOLITE™ double skinned acrylic sheet provides outstanding thermal insulation in skylights, window walls and swimming pool enclosures... large and small area applications... new construction and renovations. Longitudinal air cells between the ribs give EXOLITE sheet a U factor equal to insulated glass, at substantially lower cost. Buildings can open up high, wide and handsome to daylight, because EXOLITE sheet combines visual excitement with cost efficiency, in construction and long term fuel savings. And that’s not all.

A remarkably versatile high performer, EXOLITE sheet also offers high rigidity and load strength, excellent impact resistance, and weatherability, easy workability and high light transmission. Designers gain increased freedom for tailoring daylight to the application, adding drama and distinction—with savings on construction as well as in heating and lighting costs.

Especially well suited for passive solar applications and large area glazing, EXOLITE sheet and its special mounting system, consisting of EXOLITE double skinned sheet in 47⅝" width and lengths graduated to 20', and specially designed aluminum fittings, provide fast, efficient glazing on 48" modules. EXOLITE sheet is equally efficient in custom designed units. Light weight, high strength and workability permit extensive pre-fabrication, and easy handling and transportation.

Non-yellowing EXOLITE acrylic sheet is available in clear, translucent white and solar tints. There's a polycarbonate version, too. Both have properties geared to expand the range of architectural possibility. EXOLITE sheet presents a superior alternative to glass in many situations. For practicality, economy and visual excitement—join the discoverers of EXOLITE double skinned acrylic sheet, and design in daylight.


Circle No. 327, on Reader Service Card
Keep energy bills down with a Clark 4-second* door!

It's fast-moving, power-operated, insulated with urethane foam, and neoprene-sealed around the perimeter to prevent energy waste.

Ask the Clark Door man in your area to show you how energy-saving discipline is built-in to every Clark power-operated industrial door. Or write for more information. Today.

* 8' wide door opens in 4 seconds.
Hope's invents the steel window that gives you a break

The revolutionary 2000T combines the performance of steel with the advantages of the thermal break

STRENGTH / DURABILITY / THERMAL PERFORMANCE / AESTHETICS / ECONOMY

Now there is a steel thermal break window for architectural assignments. A product of two year's research and development, the 2000T represents Hope's on-going commitment to window innovation.

Why invent a steel thermal break window? Because steel is three times stronger than aluminum with far greater resistance to thermal transfer. That means enhanced structural integrity, maximized envelope performance and larger glass lites. And 2000T windows can be created for just about any application calling for projected, casement, combination or fixed-frame configurations.

Like all Hope's products, 2000T windows are good looking but tough. They're assembled from special roll formed, hot-dipped galvanized steel sections, fitted with PVC thermal separators and will accommodate up to 1" thick insulating glass. Unique vinyl weatherstripping defeats air infiltration at ventilator perimeters.

A modified Ultracoat acrylic enamel is the standard finish, but when rugged environments demand all-out surface protection, Hope's answer is Ultrathane, its the same type of urethane finish in wide use where resistance to heavy abrasion and chemical action is a must: aircraft surfaces, pipe lines, municipal transportation, even cement trucks. For more information on the window that can give you the break you've been waiting for, contact the people at Hope's. Steel windows make a building what a building should be. Hope's can make the windows.
YOU MIGHT CHOOSE 8000 SERIES PANELS FOR THEIR WIRING OPTIONS ALONE.

It's a thought certainly worth considering. For here, within a highly versatile office system, is a wide variety of cost saving wiring options. You buy only what you need now—add on or rearrange as later needs for power and communications require. This same freedom of choice is apparent throughout the 8000 Series System concept—a concept that offers design compatibility with free-standing furniture...and also offers all the components needed for open plan offices.

Call Wayne Wilkins at 312-859-2600, or write for our new 8000 Series Systems Furniture brochure.
Our energy problems originate from having ignored our environment for too long. Buildings must recognize the context in which they exist. Energy ideas must relate to the world context of thought.

As individuals, we realize that our bonds to the energy problem per se are voluntary. We can within a matter of hours fly to another country where oil and the inflation it causes are quite remote. We can ride a horse, chop wood, barter or farm for food, and live a quiet if lonely life.

In rural India, for example, it is rare for people to have the forms of commercial energy to which Americans have become enslaved. Humans and animals provide the work; wood, crops, and dung supply the fuel. In some African bush locations commercial energy is not only unused, it is unknown. In large portions of Africa, South America, and the Far East, people still rely on wood for fuel, and the stove may literally be a placement of stones on the ground. In such remote corners of the earth where the roads are still too narrow for cars, the people probably inhabit a strikingly "energy efficient" home.

Ten years ago, I served in the Peace Corps in such a place, the Korhogo region of the Ivory Coast. The village was called Fakaha. To the Senufo inhabitants of that village, a bicycle was high technology. The mud houses were clustered together like mushrooms in an open field, the thick walls keeping the heat out in the day and warming the house at night. The rounded house exteriors reflected the heat and presented minimal areas to the sun. The conical thatched roofs miraculously kept rain from coming in but let the heat escape. There was no energy crisis in Fakaha in 1970 and there is probably none there today.

Modern society not only bit from the energy apple in the garden of Eden, it supplies that apple 25,000 feet in the air wrapped in cellophane in coach class. Some people who have never lived in a village setting worship the simplicity and oneness of place which can be found there. They might even question whether this complex organism which we call civilization is worth the trouble.

The Senufo village pays a price for its self-sufficiency. It may be a different price, but so will we. In a sense the modern world is desperately seeking what Fakaha has never been without (and doesn't know it has).

The energy crisis in this country is heavily rooted in faraway places. Some of them have been the cause of the problem, others have found good solutions. Our purpose in the pages that follow is to provide an overview of what energy problems other countries face and to explore some of the directions which they have found fruitful.
Energy overview

Israel
The energy news from the Middle East has not been all bad. The Israelis have set a solar example and possess a blossoming solar-collector business that exports to two dozen other countries. Its precarious position in the region militarily and its dependence on oil of course make development of alternative energy sources vital. Today, 20 percent of all the homes in Israel have incorporated solar water heating, a savings of about 100,000 barrels of oil per day. As impressive as that sounds it constitutes only 2 percent of the country's energy consumption. Israel's goal is to reach between 8 percent and 15 percent total consumption by solar by the 1990s.

The man most responsible for Israeli solar progress is Dr. Harry Zvi Tabor, head of the Scientific Research Foundation in Jerusalem. His work in solar dates back to the mid-1950s, and he is in the forefront with the emerging technology of the "solar pond" which holds so much promise for the future electrical needs of Israel.

Solar ponds: A normal body of fresh water which is acted upon by wind and surface irregularities underwater is not a very efficient collector of solar heat. The underwater turbulence tends to even out water temperature. Tabor's solar pond contains salt water which is left undisturbed and stratifies, with the hottest, most saline solution at the greatest depth. Working with Dr. Rudolf Bloch, Tabor built a black-surfaced water container filled with a saline solution and recorded near boiling temperatures at its depths. When this solar heat energy is passed through heat exchangers, power turbines can then be linked into the system to produce electricity.

The Dead Sea region of Israel offers a particularly abundant natural resource of relatively tranquil salt water. Israeli energy experts have been busy trying to improve the economics of electrical generation using solar ponds in the Dead Sea region. One 150-kilowatt power plant has been constructed for experimental purposes adjacent to the Dead Sea. Within three years, a five-megawatt power station will be built in the region, using a one-square-kilometer pool. Still larger projects are intended by 1985. At the moment the cost of solar electricity is between 25 and 30 times that of fossil fuels. By 1985 the large installations are expected to compete with expensive hydroelectrical energy. If progress and technology improve normally, it is conceivable that the Dead Sea region could meet all of Israel's electrical needs by the end of the century.

Japan
A full 90 percent of Japan's energy resources must be imported. Three-quarters of that imported energy is foreign oil and 15 percent is imported coal. To make matters worse, over half the electrical power is oil generated. Another unique energy factor is that kerosene, a refined petro-product, is the primary home heating fuel. What are the Japanese doing about it?

At the moment, long range plans include nuclear energy supplying 30 percent of Japan's power requirements by 1990. Three Mile Island has had its effect on the Japanese, however, and it is expected that energy supply volumes for both nuclear and oil will be revised downward in favor of importing more coal. This means business for such trading partners as Australia, the U.S., and Canada. Japan is actively investigating alternative energy sources. Although the goals are much higher, it is estimated that solar energy will comprise little more than 1.6 percent of the total energy consumption by 1990.

There are two long-term government projects which have been underway in Japan since the beginning of the energy crisis: the Sunshine Project and the Moonlight Project. The Sunshine Project is for the development of new energy sources, and the Moonlight is for energy saving technologies.

Project Sunshine was begun in 1974 and has the goal of developing technologies for making use of solar and geothermal energy as well as coal liquefaction and gasification and hydrogen production. The goal of the program has been to supply 10 percent of Japan's energy using such methods by the year 2000.

Geothermal energy has great promise in Japan. Underground steam and hot water have already been put to use producing electrical power. Six geothermal power stations are operative today in Japan with an output of 168,000 kw. Three times that output is expected in the next decade.

Two 1000 kW solar power towers are now under construction. A field of mirrors surrounding the tower will focus solar heat to a point and eventually drive a turbine generator of electricity. The Japanese Science and Technology Agency is also constructing series of eight small wind-powered generating plants.

The Moonlight Project has three areas of concentration: 1) development of large-scale technologies for energy conservation; 2) development of pioneering, basic technologies for energy conservation; and 3) development of energy-saving technologies for devices used in the household and commercial sectors. Part of the conservation program is voluntary. Television stations close down earlier, gasoline stations close on holidays, and entertainment establishments shut doors early.

Japan's historic sensitivity to nature and the natural processes will no doubt turn up some ingenious technological solutions. Solar access is at the other end of the scale, but the Japanese can traditionally serve as an example to the Western world. A recent article by Gail Feingold Takagi in Volume 10:123 of the Connecticut Law Review traces the history of solar access in Japan back nearly 400 years. Property owners were expected to compensate a neighbor when a new house shaded his property. Most recently, The

1 Solar water heaters have become an integral part of the roofscape in Israel. 2 The solar pond is an Israeli invention and holds great promise for electrical generation in the Dead Sea region. 3 A SERI project for Saudi Arabia uses a photovoltaic field to power two villages. 4 Researchers at the Australian National University in Canberra are experimenting with ammonia-filled chemical heat pipes.
Building Standards Law (BSL) in Japan prescribes a strict procedure for assuring solar access. At one point Takagi describes the standards process for Tokyo: “The developer or contractor shoulders the burden of conformity with the BSL by obtaining a permit of construction from the building review council of the appropriate governmental authority. In Tokyo, the developer must in addition provide notice to the residents of the site vicinity by erecting a sign the dimensions of which sets forth the dimensions of the proposed structure, the anticipated date of commencement of construction, and the name of the developer. The posted notice also directs any residents with complaints to file their objections with either the local administrative unit or the developer. As evidence of compliance with the notice requirement, a photograph of the sign must be appended to the architect’s drawings at the time they are submitted to the building review council of the administrative unit.”

Australia

Like the United States, Australia has rich coal resources. Unlike the U.S., Australia generates most of its electricity from coal. In addition, about 70 percent of the country’s oil requirements are met with domestic crude oil resources. Although it actually exports energy, it must still rely on imported oil for the remaining 30 percent of its oil needs. Uranium, steam, and liquefied natural gas are abundant enough to export. The major thrust for Australia’s energy future is to increase the use of its coal. At this time about 47 percent of its energy needs are met by oil and 37 percent by coal. By 1990, coal is expected to top 41 percent and oil will be reduced to 39 percent.

Solar energy is not given much near-term potential in Australia, although non-oil fuel space-heating appliances including solar devices are exempt from sales tax. Solar has been found to be competitive in powering microwave radio systems in Australia and replacing diesel-fueled generating systems.

Heat pipes: A team of researchers at the Australian National University in Canberra has pioneered in high-pressure and two-phase chemical heat pipes. By using high-temperature parabolic tracking solar collectors, the sun’s heat can be concentrated on a small container of ammonia to decompose it into nitrogen and hydrogen. The gas then is transferred to a cold pipe where it reforms ammonia. On a large scale, the energy released in the process can be used to make steam and power an electrical generator. Because of Australia’s large expanse of bush country, such devices hold great promise for providing electricity to remote areas.

SERI's international programs

In addition to second-hand international experience, there have been formalized programs of cooperation between the U.S. and other countries. At the center of many of these cooperative programs is DOE's Solar Energy Research Institute located in Golden, Co (see p. 126). SERI is currently involved in millions of dollars of research with numerous countries. Here are just three examples:

Mexico: In February of 1979, the presidents of the United States and Mexico signed a Memorandum of Understanding of Science and Technology Co-operation. In that context, SERI is participating in seven joint projects: 1) Mexican information specialists will be given training in the use of SERI’s Solar Energy Information Data Base (SEIDB). 2) Cooperative work will attempt to establish a comprehensive network of instrumented stations in Mexico to map insolation availability throughout the country as well as formulate accurate solar prediction models. 3) Following a series of information exchange meetings, the two countries will perform a detailed study of passive heating and cooling principles which will culminate in the construction, instrumentation, and monitoring of two passive solar buildings, one in each country. 4) A cooperative program between the University of Delaware and the University of Mexico will center on the optimal usage and testing of photovoltaic devices. 5) The two countries will jointly participate in the preparation and characterization of “selective surfaces,” i.e., coatings and chemical treatments which improve surface solar properties of materials. 6) Laboratory testing of solar refrigeration components and subsystems will be followed by field testing in both the U.S. and Mexico. 7) The village of Ajuchitlan, near Cuernavaca, Mexico, will be made energy self-sufficient through uses of energy-conserving technology. Italy: SERI will play a role in a three-pronged program of joint energy research with Italy involving coal, electric power transmission, and solar energy. A $4.5-million sponsored multiyear project will involve R&D, design and construction, and information exchange on a broad range of solar technologies, both passive and active. Solar systems will be installed near Catania, Sicily, varying from photovoltaics to concentrating liquid collectors. Further projects will be sponsored which will involve designing, building, and monitoring passive solar buildings.

Saudi Arabia: Late in 1979, SERI signed a $16.4-million agreement with Martin-Marietta for that company to design, build, construct, and operate the world’s largest photovoltaic power system for the villages of Al Uwaynah and Al Jubailah, 30 miles northwest of Riyadh, Saudi Arabia. The 350 kW system will provide the complete electricity needs for nearly 3500 people. The photovoltaic system will be situated on a hilltop between the two villages. It is part of a five-year, jointly funded project under the auspices of the United States-Saudi Arabian Joint Commission on Economic Cooperation, which is expected to cost over $100 million. The purpose ultimately is to demonstrate the economic and technical feasibility of solar technology in both the U.S. and Saudi Arabia. [Richard Rush]
United Kingdom

George Kasabov

For an American to understand the context of energy-conscious design in the U.K., he has to remember that Britain is a small, densely populated, damp island situated at the same latitude as central Canada. While it is not subject to extremes of either hot or cold, comfort standards have been traditionally lower than in the U.S. United Kingdom buildings consume just over 50 percent of all U.K. energy, 35 percent going to housing, and it is important to remember that 32 percent of housing is publicly owned. Also, most housing is made of masonry not timber as it is in the U.S. The damp climate produces major problems of condensation. The high latitude means that solar-energy schemes are only marginally successful. Given these conditions, what has been achieved?

**Government action:** First, a reduction of temperature standards in public buildings has lowered thermostats to 68 F, and the proposal is to reduce them further to 66; second, financial incentives cover two-thirds of the cost of insulating dwellings, up to a maximum of £50, which is $110; third, there is an energy survey scheme which allows £75 for a one-day energy survey of buildings in order to evaluate what can be done. Eighteen thousand buildings have been surveyed so far and the program can be extended with more money for half the fees for a more extensive energy audit. The fourth program is conservation in industrial buildings. So far, $12 million has been spent out of a total of $25 million which has been earmarked for the four-year period from 1976. There is also a demonstration scheme, again started in 1976, which allows 25 percent reductions toward demonstrations of new technology, and here a lot of work has gone into heat recovery, some into heat pumps, and a lot into energy management and automated energy control. The total, however, is only $2 million spent so far out of the $20 million for the purpose. Funding for this sort of work is also available through the European Economic Community (EEC). This source has not been used extensively as the loan of up to 49 percent is to be paid back out of the savings made.

New building regulations were also instituted in 1976, but these really are dealing only with insulation levels and window sizes. The 1976 regulations which are for houses were extended in 1979 for other buildings.

**Education:** Some money has been made available by the government for courses in energy management and also in design. The design courses have been implemented by the RIBA Energy Group, which was formed in 1976 specifically intended to 1) initiate the training of practitioners and students in energy management and also in design. The test SHED consists of a highly insulated room with a conservatory running the full length of the south side. Three types of vertical air solar collectors are being tested: a natural thermosiphoning collector, trombe wall, and 'hypocaust' heat store (containing sealed bottles of water). It was designed by Cedric Green and a project team from the University of Sheffield.
energy-conscious design; 2) provide information and tools of the profession; and 3) collect examples for the profession. This group operates throughout about a dozen regional groups scattered around the U.K. and is also sponsored by industry and the profession.

With respect to training, the first point, so far over 3000 practitioners—that is about one-eighth of the profession—have already attended courses throughout the U.K., and 22 courses are planned for the next few months. These generally take the form of 2-5 day seminars with the initial run-through of theory and materials, followed by a number of case studies, and culminating in a choice of design exercises.

The second point, information, is provided both for the public and for professionals, the former through home energy advice centers which have been pioneered by the gas industry, and the latter by the building centers which are an organization devoted to collecting and comparing building materials. The committee created an energy conservation handbook and library of materials and components that are particularly related to energy conservation. The library has been sent to each architectural school in the U.K., and product information has also been filed in a computer for further access. An energy center is planned in London in the next few months and will serve to inform the architectural profession.

The other point, information and tools, relates to a programmable calculator program which has been developed and is being widely used. Another aim of the group is to provide examples of what has been achieved by holding exhibitions and conferences such as the Building for Energy Conservation conference last year.

Research: Projects are being sponsored partly through the government department of energy, and partly through the Science Research Council, the Department of the Environment and again the EEC, as well as the building materials industry and, very important, the fuel supply industry. Projects in this category can cover large comparative programs to evaluate changes in construction methods such as the Better Insulated Housing Program, or the Liverpool Energy Study. Then it proceeds from passive and active solar heating to monitoring of heat-pumps.

Government buildings: Surprisingly, the largest, longest-running and best-documented program of energy conservation in buildings has been that of the Property Services Agency of the Department of the Environment. It has achieved a 30 percent saving of energy in its existing building stock since 1972. Principally this has been achieved by improvement in plant management, but also by material improvement in buildings.

Office buildings: The building type which has shown the most spectacular changes is the office building, governmental as well as private. Not only were easy savings made by reducing environmental standards from unnecessarily high ones, but also its regular pattern of occupation makes the office building particularly susceptible to automated mechanical controls. Moreover, the projects are large enough to justify the high fees involved in producing a sophisticated design analysis. The most interesting examples combine natural and artificial ventilation with careful design of the envelope and the thermal mass of the building to optimize seasonal variations.

Commercial: In the commercial sector, the most successful involvement of conservation is shown by a firm called Marx and Spencer, a chain of clothes and food stores. In the past seven years they have spent £1.5 million and saved £9 million by a simple mixture of good housekeeping and attention to critically wasteful equipment. This company, together with only a handful of other firms, stands apart from the general run of industry and commerce. Most have done very little because of the low priority energy conservation gets through the use of normal accounting procedures involving very short payback periods. Retrofitting pales in significance in terms of effectiveness when compared to more careful management, and that idea is starting to get around. People realize that if they just fire the pump at the right time, they're going to get tremendous savings for very little extra money. And obviously that's the first thing they're going to do.

Housing: In housing the picture is much more diverse, for the greatest interest is in designing for passive solar collection. Active solar heating is generally considered too expensive in this climate even though there are a number of houses built with active systems and even some proponents who claim that they will become cost effective within the next five years. Solar water heating, by contrast, is slowly gaining ground through lower interest rates for borrowed money of between 15 and 20 percent. The cost equation is still not encouraging, and there are no financial incentives for grants for such installations as in the U.S. There are also a small number of heat-pump systems, but not nearly as many as in France, Germany, Holland, and Scandinavia, all of which had extensive monitoring programs to test in-use reliability of heat pumps.

Summary: Significant developments for the future will reflect energy conservation in both the building stock nationally and the individual building. Production of total energy will, to a large extent, depend on more careful use by a better educated population, and on a much better system of monitoring and control. We can also expect a much larger proportion of new buildings to be designed for energy efficiency. Up to now, several thousand architects have developed some expertise in the field. As energy-conscious design becomes the norm, more careful matching of energy strategies to buildings will help to obtain the maximum efficiency in the use of fuel.
Although Denmark enjoys one of the highest standards of living in the world, it is almost totally dependent on imported oil and coal for its energy needs. This fact, coupled with the country’s northern location (at a latitude of 56 degrees, about the same as Juneau, Ak) and cool temperate climate (winter temperatures 20-40 F, summers 50-70 F), has made the Danes habitually energy-conscious.

Space heating accounts for nearly half of Denmark’s energy consumption, with 59 percent of the nation’s dwellings utilizing central heating, generally oil-fired. Another 29 percent use direct heating, which makes Denmark the world’s highest per capita user of district heating systems. These systems, used in subdivisions as well as in urban areas, carry water by underground pipes to individual dwellings to supply domestic hot water and radiator systems. One-third of Denmark’s district heating systems operate on waste heat from electric power plants; major efforts are currently underway to increase such cogeneration of electricity and heat—an energy-conserving measure that is still in its infancy in the United States.

Of the approximately two million dwellings in Denmark, about 60 percent are single- or two-family houses, with the average size of a dwelling being about 1345 sq ft. Because Denmark is only sparsely forested, the traditional building material has been brick. Cavity walls came into use around the turn of this century, mainly to save brick, although it did not become common practice to fill the cavity with insulating material until the 1950s, when the Danish government began formulating insulation requirements for new construction. The latest of these government building regulations, BR 77, which was enacted in 1977 and went into effect in February 1979, represents an appreciable amelioration over the previous requirements of 1972, with specified R-factors of 14 for heavy-wall construction, 19 for light-wall construction, 29 for ceiling and roof, 19 for floors over basement or ground, and 2 for windows.

The new building regulations are only part of an overall government energy plan which calls for a reduction in the growth of energy consumption, and for the development of alternative resources. The large space-heating sector is receiving special attention, with the government aiming to hold energy consumption for space heating in the year 1995 to the same level as in 1975—a reduction of over 30 percent as compared with projections based on traditional trends.

The Danish Ministry of Commerce is sponsoring an energy research and development program which includes the promotion of energy savings in buildings, as well as the testing of active solar components and systems and the development of renewable energy sources such as geothermal and wind energy. The government is further encouraging conservation by offering subsidies and tax incentives for all sorts of energy-saving measures in new and existing buildings. Energy consultants, recruited from the engineering and building professions and licensed by the government after completion of a special course, provide required consultation services to those wishing to qualify for certain of these subsidies.

Low energy houses: Hjortekaer

In a research and development project sponsored by the Danish Ministry of Commerce under the direction of the Thermal Insulation Laboratory of the Technical University of Denmark, six prototype “low energy houses” were constructed in 1978 in suburban Hjortekaer outside of Copenhagen. Each house was built by a private development group, who assumed fiscal responsibility for its own project, with additional funding provided through a government grant.

The purpose of the Hjortekaer project was to demonstrate that it is possible to build a single-family model house of about 1300 sq ft whose energy requirements for space heating, ventilation, and hot water were about 500 kWh per year—less than a third of the energy consumption of buildings conforming to BR 77. Energy use in these houses is being monitored during two heating seasons, to end in spring of 1980: they are sealed from public access, and habitation of the buildings is being simulated while detailed measurements are taken. The houses will later be sold, with monitoring to continue under conditions of actual human habitation.

The low energy consumption of the houses is achieved through a combination of technical solutions, including super-insulation, tight construction, insulating shutters, solar heat, heat pumps with ground heat exchange pipes, thermal storage mass in the building construction, controlled fresh-air injection systems with recuperation of waste heat from exhaust air, and utilization of the heat emitted by persons, lighting, and appliances, as well as solar heat gain through the windows.

1 The apartment building shown was part of “Low Energy 1979” at Skive, Denmark. The citywide exhibit provided a tour of energy-saving dwellings of all kinds. Brick cavity walls are 16 in. thick with 4 in. of mineral wool insulation. The heating system is solar hot water (1377 sq ft of collectors), water-to-water heat pumps, air-to-air heat recovery, and district heating back-up. Architect: Børge Kjaer.

2 Low Energy House C: The Hjortekaer project was designed to demonstrate that it is possible to build a single-family model house of about 1300 sq ft whose energy requirements for space heating, ventilation, and hot water were about 5000 kWh per year. House C uses heavy insulation and triple glazing. The heating system, consisting of plastic tubes in the concrete floor, is supplied by a combination of solar and electric heat. Architect: Vibe-Hansen & Lombreg Ltd.

3 Sambo Low Energy House is also located in Skive. The heavy part of the house uses a 15%-in. brick cavity wall insulated with 5 in. of mineral wool. The light construction utilizes prefabricated load-bearing building material consisting of ¾-in. waterpoof plywood and ¾-in. tempered hardboard inner membrane sandwiched around a core of glass fiber that is cut into blocks and stacked with the fiber perpendicular to the membranes. Insulation can be varied to R 40. Architect: Erik Berg.

4 Roslev Houses, Inc., is a manufacturer of prefabricated building systems who supplies turnkey housing projects ranging from a single house to a whole town. The row-house version is shown here. 140 sq ft of solar collector is built into the south-facing roof surface on each dwelling. The heating system is a combination of solar and district heating. Designer: Roslev Houses Inc.

Kathy Goss is a free-lance writer and editor, specializing in scientific subjects. Per Madsen is an engineer, born and educated in Denmark, who is working in solar product development and manufacturing in California. They are married and live in San Francisco.

Progressive Architecture 1980
and a number of research organizations, the event was the second of its kind in Skive, and was accompanied by a supplementary exhibit of energy-saving building components, materials, and equipment. The participating contractor/design groups were required to hold the energy consumption of the houses to within 60 percent of the maximum permitted by BR 77, and the use of oil for heating was discouraged. The buildings, integrated into a subdivision in Skive, were to be sold or rented after the exhibit. Although they utilize the same kinds of energy systems as those at Hjortekær, the buildings at Skive represent a wider range of design choices.

**Roslev Houses, Inc.** A manufacturer of prefabricated building systems supplies turnkey housing projects ranging from a single house to a whole town; it also has community and regional planning capabilities. The nine single-level Roslev houses are arranged in a row-house layout, attached by the carports. The exterior walls are of brick veneer anchored to a load-bearing back wall with a 2 1/2-in. ventilated cavity. The highly insulated back wall is constructed of special rock-wool insulated studs covered on both sides with chip board, and the complete wall is insulated with a total of 8 in. of mineral wool (R-29). The floor is 4-in. concrete slab on an insulating layer of 2 in. of hard mineral-wool batts and 10 in. of loose slag clinkers (R-23-26). All windows are triple glazed (R-3). Ceilings are insulated with 12 in. of mineral wool (R-40) and the roof is covered with corrugated fiber shingles and pitched 15 degrees towards the north and 56 degrees (equal to latitude) towards the south, with 140 sq ft of solar collectors built into the south-facing roof surface. The heating system is a combination of solar and district heating. The controlled fresh-air injection system is equipped with a recuperator which transfers 76 percent of the heat from the exhaust air to the fresh intake air. In comparison with construction conforming to BR 77, these low-energy versions of the Roslev homes realize a net energy saving of about 43 percent.

**Conclusion:** Denmark's continued prosperity hangs by the slender thread of energy conservation. The Danish government, as well as the private sector, early recognized the urgency of the situation and is well on the way toward implementing sophisticated measures to improve the energy efficiency of buildings. Besides the obvious use of passive design elements—heavy walls for thermal mass, the orientation of the buildings along an east-west axis, the minimal use of glass on all but the south sides—Denmark's experimental low-energy houses demonstrate the importance of tight construction, added insulation, and state-of-the-art energy systems whose present relative costliness will be more than offset by the resultant energy savings in the years to come.
France

France's energy resources or, more accurately, her lack of them, place her in a rather precarious position. The nation depends upon imported energy for 70 percent of its energy needs. The French get their oil from OPEC and their coal from Poland, the U.S., and developing countries in Asia and Latin America. Although France's Energy Policy aims to cut its imported energy figure to 60 percent by 1985, it is clear that other measures must be taken. The near-term answer is nuclear energy.

France's objective is to produce more than half its electricity and 20 percent of its total energy requirements with nuclear energy within ten years. This program is the largest nuclear energy project in the world. Instead of buying enriched uranium from the U.S. or the Soviet Union, the French are attempting to produce it themselves.

The French government has great plans for solar energy, but not in the immediate future. It is hoped that 5 percent of the energy supply by the year 2000 will be solar. As modest as the goal sounds, over $100 million has been spent by the French in the last two years on solar research and development.

The government is conducting a competition for the design of solar houses, with the objective of 5000 units in three years. It is expected that within the next 10 years nearly 200,000 solar water heaters will be installed; France now allows homeowners a $230 grant towards the cost of installing them.

France is also currently the second largest (after the U.S.) manufacturer of silicon photovoltaic cells. Experiments with photovoltaic generators in the early 1960s produced a 100-watt experimental photovoltaic generator at La Turbie in Southern France. As much as 90 percent of France's photovoltaic output is exported. Over 100 French generators have been constructed in the Third World.

Recent interviews in France—one with a pioneer in the area of solar-heated buildings, one with a young team of designers—reveal some of the more promising accomplishments in energy-conscious architecture now emerging with French government support.

From his office on the outskirts of Paris, architect Jacques Michel maintains contact with numerous solar energy building projects in France, in Italy, and as far away as Chandigarh and Ahmedabad. In 1958, Michel was impressed by the potentials of energy-conscious design while working on projects in Chandigarh and Ahmedabad. In 1960, he began working with physicist Felix Trombe, of the Centre National de la Recherche Scientifique, on development of the Trombe-Michel collector wall. (After referring to the system by its dual name, Michel himself lapses into the more familiar term "Trombe wall.")

Most of Michel's practice involves the application of ever more refined collector wall systems. At the latitudes of France, he points out, vertical collectors are almost as efficient during the heating season as canted ones and offer great advantages in structural simplicity and compatibility with interior requirements. In most of his numerous houses, collector walls are combined with windows in the south wall, while more solid north wall recalls local traditions (as in houses at Odeillo, opposite).

Michel points out the particular suitability of collector walls for larger-scaled buildings without precise heating demands. At the new technical school at Beziers, a sunny location in the far south of France, Michel has designed 11 workshop structures (shown here) with 1600 sq m of collector wall serving all heating needs for a total floor area of 4000 sq m. In this classic version of the Trombe wall, air is heated in a narrow vertical gap between dark-painted concrete block wall and an outer layer of sliding sash.

The government is conducting a competition for the heating of a gymnasium at St.-Peray, in Eastern France. Michel has installed a more sophisticated version of the Trombe wall (patented by Michel-Diamant-Durafour) designed to minimize loss of stored heat by transmission back out through the glass skin. Here, incoming sunlight strikes a honeycombed wall of black, expanded-aggregate concrete, which is backed up by a storage wall of more massive concrete. A current of air rises by convection between this inner layer and an interior baffle to heat the gym itself. Using strictly the solar source, the temperature inside the gym is maintained at a minimum of 12 °C except for an estimated 10 days per winter, when it may fall to 9 °C—when the outside temperature is −6 °C.

One of Michel's innovative current projects is a window-wall system now being designed for a retrofit installation on 450 sq m of façade on buildings of the Milan Fair. Tentative plans call for installation of three-layer glass sandwich panels. Using the outer layer of glass and the void behind it primarily for insulation, he plans a combination of reflective (catadioptric) plastic sheet and fluid in the inner void. The faceted plastic will be almost totally reflective when dry, almost completely transparent when fluid fills its cavity. Thus injection or withdrawal of fluid can control transmission of sunlight. Backing the panel assembly with a dark, absorptive surface can convert it from a window to a solar collector, similarly controllable with fluid. The potential of such a device for mass-produced window-wall systems is obvious.
Three attached houses at Odeillo in southern France, by architect Jacques Michel, have vernacular forms, closed north fronts (photo left), and arrays of windows and Trombe walls to the south (drawing below). Completed in 1974 (one for Felix Trombe), they have yielded fuel savings of 60-70 percent compared to conventional houses.

Michel looks forward to the industrialization of collector wall systems, using licensed manufacturers. Mass production, he hopes, will finance the testing required to make such walls acceptable for widespread use. He is particularly concerned about answering the doubts of insurance and building code authorities regarding performance of assemblages under unusual thermal stress. Without standards that such authorities can depend upon, says Michel, the market for collector walls will remain limited.

At the very beginning of their practice in Paris, the young international team of Baczko, Jann, Jordan, Taponier, and Zakrzewski has taken one of the four top prizes in the “HOT 5” residential design competition, held in 1979 by the French Ministry of Environment. Their proposal is based on a duplex dwelling unit that can be lined up in rows and/or stacked in four-story structures to meet urban or suburban planning needs. Its combination of a south-facing greenhouse with a central two-story void and massive thermal storage walls is estimated to reduce demand on the conventional heating system (oil- or gas-fired) by 40-50 percent; roof-mounted solar collectors would provide 77 percent of water-heating demand. Interior spaces surrounding the thermal core could be laid out in a variety of ways. Showing a rare combination of simplicity and sophistication, their design was said in the jury report to “demonstrate that it is possible to reconcile architecture of quality with thermal preoccupations.” [John Morris Dixon]
As architects develop energy-efficient designs, the government will approach the energy crisis in three ways: by creating effective programs, providing financial incentives, and setting a good example.

The Energy Policy and Conservation Act was signed into law in December 1975. It was designed to help states develop and direct state energy conservation programs, and called for $50 million a year in grants for three years, 1977-1979. The act required them to set standards for lighting efficiency, restrict the open hours of public buildings, and set insulation requirements. Federal agencies were required to develop ten-year programs along the same guidelines.

The Energy Conservation and Production Act, signed in August 1976, calls for enactment of building performance standards, state-level information programs for homeowners, a $200-million grant program to aid low-income people in weatherizing their homes, and a $200-million demonstration program to educate homeowners about the benefits and techniques of energy conservation programs. The act authorizes $105 million to be allocated to states which have education programs, foster energy audits, and coordinate local, state, and federal programs. The act also calls for federal energy standards which the Department of Energy and Department of Housing and Urban Development have been working to develop.

The Energy Tax Act, signed into law in November 1978, encourages homeowners to install energy-saving items in their homes by offering a 15 percent tax credit up to $300. The act also provides for income tax credits of up to $2200 for installation of solar and geothermal energy devices and increases by 10 percent the investment tax credit for businesses which purchase this equipment.

The National Energy Conservation Act is the most comprehensive law promoting conservation thus far. It increases funding for low-income weatherization programs, and requires utility companies to offer energy audits to consumers and to advise them of loans for energy-saving devices. It authorizes $100 million for solar equipment in federal buildings and $98 million over three years to purchase photovoltaic devices for them. It requires existing federal buildings to retrofit a percentage of their total space for maximum efficiency and requires new buildings to be designed to minimize life-cycle energy costs.

Congress passed legislation creating a solar bank to provide subsidies for below-market loans for purchase and installation of solar devices. The consumers' savings could be significant. And by encouraging consumer demand, the solar bank is expected to stimulate growth of the solar industry.

De-regulation
There is one factor which alone may induce more energy savings than any government program: the price of oil. Since 1973, the price of oil has been subject to controls. While well-intentioned, artificially low prices encouraged consumption and discouraged conservation. Alternate sources of energy remained uncompetitive. And U.S. companies were less inclined to look for new oil supplies.

In June 1979, we took a significant step: decontrol of oil prices, with controls to be phased out until eliminated in October 1981. Congress also has agreed to phase out price controls on natural gas by 1985.

Oil price decontrol will result in domestic oil costing many times what it did previously. In order to redirect some of the revenues, Congress passed a "windfall profits tax." A portion of the price increase will be collected by the government and used for purposes such as development of alternate energy sources. Revenues will also be used to fund a near doubling of the existing credit for homeowners who make use of solar and other renewable resources, raising the maximum from $2200 to $4000. The 10 percent energy investment tax credit for business owners will be increased to 15 percent. Though these efforts are worth while, I personally believe that a greater portion of the revenues should be dedicated to development of alternate sources and conservation.

The bottom line
The statistics so far reveal that American energy consumption, if not tumbling, is at least dropping slightly despite some population growth. Americans used 10,302.93 trillion BTUs in 1973, the peak year.
Direct subsidies for weatherization are called for to help those who are most hurt by the rising price of energy and least able to undertake measures themselves: people with low incomes. The Department of Energy and Community Services Administration programs which provide weatherization assistance are vital to the 14 million households with incomes below $9800. Almost half of all low-income households are in the Northeast and North Central regions, where winters are especially severe. Of the approximately 10 million lower-income homes, only 590,000, or 5 percent, have been weatherized. With 9.4 million houses to go, there is a clear need for a concerted, aggressive effort.

**Lending policies**
The federal government must also do more work with existing institutions which generally have not encouraged conservation measures. For example, revision of lending policies of banks could encourage the American public to conserve energy and to consider life-cycle costs more than initial costs. A statement concerning the energy efficiency of a particular building, either through a comprehensive listing of utility costs or through a listing of energy-saving devices in the home, might be required in a transaction involving a financial institution. It is reasonable to assume that a building that is energy efficient would command a higher price than one which is less energy efficient.

By working closely with banks, the federal government could help assuage the fears of normally conservative lending institutions. Some banks, for example, find lending money to people who want to buy homes that are built partially underground. Such homes can be extremely energy efficient, and yet because the idea is new and the market untested, many banks balk at financial backing.

The Department of Energy has worked to convince banks that such investments are wise, that underground homes can be both attractive and efficient, and that as a result, they are bound to increase in value.

The government's contribution to winning the energy battle must include strong incentives for conservation, research, and development of alternate energy sources, and energy-efficient building design and construction. In the long term, research and efficient design will produce the energy sources and energy-efficient buildings needed to make the United States an energy-independent country.

There is a great energy future in solar power, synthetic fuels, and alternate energy sources. But the harsh truth of the energy crisis is that, in the 1980s, we are not likely to find a meaningful replacement for oil and natural gas. Those new sources may be refined in the latter part of the decade. But with government incentives and energy-efficient design, conservation will provide the light at the end of the tunnel.

**Incentives**
The federal government can do a great deal to influence energy-conscious design through tax incentives and direct subsidies. The Energy Tax Act represents a step in the right direction, but the relatively low level of response indicates that greater incentives should be seriously considered. In a time when initial costs are of greater concern to building owners than life-cycle costs, significant incentives are required to encourage investment. The Report of the National Energy Project of the Harvard Business School argues: "The speed with which retrofit can deliver substantial savings argues for a much more stimulative public policy, with tax credits up to 50 percent. Such a policy would signal the importance of retrofit and would encourage homeowners, entrepreneurs, and manufacturers. It would make retrofit economically attractive for homeowners, and not only attractive but possible for others."

Another way to encourage investment in energy-saving items is to accelerate depreciation. The current laws allow write-offs of machinery over an average of 11 years and buildings over 20 or more. A bill halving these times would allow businesses to write off major changes to buildings in ten years and install energy-saving equipment such as solar heating devices in five years. The point of depreciation is to encourage businesses to replace old equipment and buildings with new, more efficient pieces. It is an incentive that entrepreneurs understand well.

**Conserve by example**
Numerous federal programs have been devised to reduce energy consumed by the federal government. The Federal Energy Management Program, started in 1973, sought to reduce projected federal energy use by five percent, and the General Services Administration devised guidelines for federal office buildings. Since 1976, HUD has installed solar heating systems in approximately 23,000 apartments and houses at a cost of $26 million. The department also has developed its Minimum Performance Standards for federally funded housing and published a host of fact sheets for consumers. Its Solar Heating and Cooling Information Center can be reached by telephone toll free.

By working closely with banks, the federal government could help assuage the fears of normally conservative lending institutions. Some banks, for example, fear lending money to people who want to buy homes that are built partially underground. Such homes can be extremely energy efficient, and yet because the idea is new and the market untested, many banks balk at financial backing. The Department of Energy has worked to convince banks that such investments are wise, that underground homes can be both attractive and efficient, and that as a result, they are bound to increase in value.

The government's contribution to winning the energy battle must include strong incentives for conservation, research, and development of alternate energy sources, and energy-efficient building design and construction. In the long term, research and efficient design will produce the energy sources and energy-efficient buildings needed to make the United States an energy-independent country.

There is a great energy future in solar power, synthetic fuels, and alternate energy sources. But the harsh truth of the energy crisis is that, in the 1980s, we are not likely to find a meaningful replacement for oil and natural gas. Those new sources may be refined in the latter part of the decade. But with government incentives and energy-efficient design, conservation will provide the light at the end of the tunnel.

**Pondering the dollar drain.**

Progressive Architecture 4/80
With release of the Notice of Proposed Rulemaking, DOE signaled that—after months of delay and heated internal debate—it was at last ready to unveil proposed standards that it saw as technically sound, legally sufficient and correct in policy terms. Departing significantly in certain areas from what had been laid out in DOE's advance notice (issued in November 1978), the recent NOPR provides the complete framework for the standards themselves and discusses ways in which they may be implemented.

The proposed standards, comprising only a few pages out of the hundreds contained in the NOPR, establish “energy budget levels” that building designs would have to meet before construction could commence. All new commercial and residential buildings would be subject to the standards and, if made “mandatory” through imposition of Federal sanctions against noncomplying states and localities, the standards or their equivalent will become a major part of the codes that every practitioner must follow.

The law passed by the 94th Congress calls for the standards to become final by 1980 and effective at the state and local level one year thereafter. DOE has used half—and will probably use all—of a six-month extension left in the law to the discretion of the secretary of energy. If the question of sanctions fulfills its promise for controversy and is argued during the election, it’s likely that a delay in this schedule may result. Maxine Savitz, DOE Assistant Secretary for Conservation and Solar Energy, has been quoted as saying that a delay in the final standards until January of 1981 “may be acceptable.”

By DOE’s account, the standards are the most significant mid- to long-term energy-conservation effort to emerge from the Federal regulatory process. Unquestionably there are major, unresolved issues associated with the standards DOE has proposed. The technical and policy dilemmas usually faced by a Federal agency assigned a responsibility of this magnitude were magnified initially for these standards by the almost total absence of any data upon which to base decisions. Four years and millions of research dollars later, the data problem now seems mostly to have been solved. The AIA Research Corporation led a massive effort to obtain useful information on the energy performance characteristics of recent buildings and went on to tackle the questions of how much better buildings might do in the future and what impact existing standards might have.

The proposed standards
The standards are directed at designs of new buildings and involve three interrelated concepts:

- **DEB:** Design energy budgets, setting the maximum allowable energy consumption, in MBtu/sq ft/yr, without regard to the methods, materials or processes to be employed.

- **DEC:** Design energy consumption, which is the calculated annual energy use, in MBtu/sq ft/yr, determined by applying the standard evaluation technique or approved alternate.

The standard evaluation technique specifies weather data, operating conditions, and other variables for the location and building type in question, and sets forth detailed instructions and procedures to be used in calculating design energy consumption based on building design characteristics.

The standards require, simply, that a building's designed energy consumption not exceed its design energy budget. The standard evaluation technique is the measurement tool used in making that determination. How much will the design use? The standard evaluation technique consists of a set of public-domain computer programs, each especially suited to a particular area of building energy analysis. DOE-2, a complex program developed for DOE at Lawrence Berkeley Laboratory, is at the core of the standard evaluation technique. Other programs, including DEROB and TNSYs, augment for passive and active solar analyses. DOE expects to improve the standard evaluation technique and will establish procedures for having other, presumably simpler, techniques—approved as alternates.

It is not contemplated that many people would actually use the standard evaluation technique to demonstrate compliance with the standards. In addition to the simpler evaluation techniques that would be approved as alternates, DOE has said that the manuals of accepted practice will be developed, embodying design prescriptions suited to specific locales and buildings types. If the provisions contained in these manuals are followed, a design would automatically comply with the standards.
This approach is seen as a way of helping designers, builders and others to know that their projects are "on budget" from the outset, obviating the need for a complex analysis (and possible bad news) once the project design is complete.

The design energy budgets are set at present for 18 residential and commercial building types in 78 Standard Metropolitan Statistical Areas (SMSA). The SMSAs listed were chosen for the availability of weather data in a format suitable for use with the standard evaluation technique. The NOPR contains a procedure to be employed in extrapolating for climate areas outside the locations listed, making use of heating and cooling degree-day figures. DOE hopes to work with the National Oceanic and Atmospheric Administration to produce many more computer weather tapes - Alaska and Hawaii are not represented on the list in the NOPR, and many states have only one or two locations listed.

For commercial buildings, the energy end-uses covered by the standards are heating, cooling, lights, fans, domestic hot water, auxiliaries, escalators, and elevators. For single-family residences, a fixed domestic hot water budget is given, and lights are not included, on the theory that most residential lighting is owner-installed, not designed in. The standards do not specify what proportion of the total budget is to be used for what purpose, except in the case of residential hot water. If any portion of the building's energy requirements is provided by a renewable resource (active solar, for example) the energy involved is "credited" against the total design energy consumption.

**Consider the source:** The energy budget levels are "weighted" according to energy source. Separate budgets are given for single-family residences heated by, respectively, gas, oil, and electricity. The budgets for commercial buildings are based on average fuel-mix characteristics of designs in the research sample. The weighting factors (set at 1.0 for natural gas, at about 1.2 for oil, and at about 3.0 for electricity) were used in setting the budgets. Based on average national energy prices, the weighting factors are also used in arriving at the design energy consumption for a given building.

In a program plagued by delays and policy dilemmas, many of which seem now to have been overcome, the source energy issue has stood out as perhaps the most difficult aspect of the standards. DOE's advance notice drew heavy and most vehement public comment on this subject. While opinion was about evenly divided on the appropriateness of DOE's intent in suggesting the "resource impact" and "resource utilization" factors (or RIFs and RUFs, as they became known), nearly all comments questioned practical aspects of the concept.

Some DOE program officials have never
DOE's Energy Performance Standards

The process of creating the Building Energy Performance Standards has been long and controversial. The flow chart above demonstrates the scale of endeavor which is currently underway.

The proposed rule leaves "space reserved" for restaurants, industrial buildings, and mobile homes. DOE's research into these building types is incomplete—in the case of industrial facilities, it has yet to begin. The Department's lawyers have constructed the law as calling for regulation of all buildings, so plans for additional work are underway.

Implementation: In comparison with determination of what the standards should be, in itself a complex and arduous undertaking, the question of how they should be implemented may prove to be even more taxing. Responsibility for implementation remained with the Department of Housing and Urban Development when DOE was formed in 1976 and received responsibility for development of the standards. The separation of the standards from implementation has been a major problem for the program. Just prior to release of the NOPR, after much haggling, the two agencies signed a memorandum of understanding that places...
responsibility for developing implementation regulations with DOE. Legislative action may be required to make this arrangement official, and a bill transferring authority has languished on the Hill since late 1979.

One result of wrangling between the HUD and DOE staffs has been a delay in research and planning for implementation. The NOPR, at the insistence of HUD lawyers, contains only a "discussion" of implementation issues and strategies, watered down considerably from a draft section that had been circulating within DOE. Uncertainty over sanctions, too, has created difficulty, ostensibly because an implementation program for mandatory standards would probably differ markedly from a program designed for voluntary standards. Current plans call for DOE to issue proposed implementation regulations in conjunction with the final standards. At the same time, DOE would submit recommendations to Congress on the entire question of whether the standards should become mandatory and, if so, how and when.

The NOPR does contain the framework of an implementation strategy and probably signals basic elements of the more detailed rules that will follow. Three possible approaches are outlined and DOE suggests that all, in combination, will be necessary.

"State certification," would involve a determination that Federal criteria had been met for a building code equivalent to or exceeding the requirements of the DOE standards, and for adequate implementation programs in local jurisdictions. DOE intends to develop model codes based on the standards, which could be adopted by states and local jurisdictions. It also plans to provide a method for evaluating local codes that are not based on the DOE standards.

The "alternate approval process" would permit building designs to be approved in jurisdictions where adequate codes or implementation programs did not exist. It would involve a determination—by a code official or a private design professional—that the design meets or exceeds the requirements of the standards. The local jurisdiction would then declare (presumably to DOE or HUD; it is not clear) that the requirements of the standards had been met.

"Exemption" is the third possible approach, reserved for areas where the "volume of construction is so low and building regulatory mechanisms so underdeveloped" that costs of implementation would exceed any expected benefits. DOE suggests that areas seeking exemption would need to provide data suitable for a detailed cost-benefit analysis. In any case, exemptions would be subject to review and granted only for limited periods of time.

Major issues of interest to architects

With this brief background on the proposed standards and the plans to date for implementation, let us consider some of the major issues likely to be of interest to architects, their clients, and colleagues.

Sanctions: Are the standards necessary? Should they be mandatory? Will the costs of implementation be outweighed by the benefits produced? DOE's findings, as contained in the economic and environmental impact analyses that accompany the NOPR, suggest that all of these questions can be answered affirmatively. By DOE's reckoning, residential buildings would be designed to

The cities shown on the map above will serve as the weather models for their respective states. Buildings in other cities and states will be required to use the data of an SMSA which is climatologically similar.
use between 22 and 51 percent less energy than in present practice, while commercial buildings would see reductions of between 17 and 32 percent, depending on location and building type. (These figures are based on comparison of the standards' proposed design energy budgets against data for 1975-76 practice; the budgets would call for design energy consumption below the base, within the ranges stated.) As a result of reduced fossil fuel consumption, major reductions in atmospheric pollutants could also be expected. And all of this, in DOE's view, can be accomplished at little or no increase in initial building costs, with major dollar savings to individuals and the nation over the longer term.

Congress will have the final say when it acts on DOE's recommendations for implementation. A senior DOE official, speaking freely in a late-night working session during preparation of the NOPR, may have summed up the Administration's present position: "My attitude is pragmatic. If it appears that there may be a need for regulation, if it appears that the benefits of the regulation far outweigh its costs, and if nobody is seriously injured in the process, then I think it's a 'good' regulation and we should have it—the sooner the better."

Even if no sanctions are imposed, DOE's Energy Performance Standards are likely to have an impact on all building design and construction. A DOE lawyer has interpreted the law as specifying that the standards will, when final, apply to all Federally subsidized and insured construction. In addition, the heads of all agencies and departments of the U.S. government must assure that their organizations are in compliance with the final standards. DOE has determined that, even without sanctions, the standards might apply to 65 percent of all construction.

Effects on practice

It is probably too soon to say much on this subject, because the details of implementation are largely unresolved. In general, though, it is clear that—if it has not already made major inroads to the mainstream of professional practice—energy analysis of some kind will become an absolute requirement. The NOPR alone may prompt some clients to question how designs prepared for them compare with DOE's standards, thus "implementing" them in an unanticipated way.

DOE has said repeatedly that much of its future research and development spending will be in the area of simple, low-cost design and analysis tools. The Department already supports educational programs for faculty in architectural and engineering schools. These efforts, coupled with planned manuals of recommended practice, should help architects considerably in understanding and meeting the requirements of the standards.

Liability: Liability is also an issue. Suppose a design has been certified by an architect or engineer as being in compliance with the standards and, after using the building for some period of time, the owner discovers that actual energy use far exceeds that called for in the standards. As a result the owner sues the designer. A DOE lawyer responded to this question by saying that "the standards will look only as far as the building design." As to whether or not a client might look further, the attorney acknowledged that it was a "fascinating" issue. "I put the question back to you," he told the questioner. "If I were the client, would it be reasonable to expect the building to perform in accordance with representations made about its design?"

The matter is complicated. It is unlikely that all of the assumptions about climate, occupancy patterns, and building design features used in making the compliance evaluations would ever be duplicated exactly in practice. Thus, one might argue, it is not reasonable to expect that the building would achieve the exact performance suggested by the standard evaluation technique. DOE has been careful to assert that the evaluation technique is designed to serve as a common basis for comparison, not necessarily as an ac-

An office building in Denver, Colorado under DOE's Proposed Standards

What would happen to an office building in Denver under the standards? Assuming that the building is greater than 50,000 gross square feet, the energy budget is 109 MBtu/sq ft/yr, in 'weighted' terms. Here's an example of how this energy budget works out for various heating fuels, expressed in terms of site energy:

<table>
<thead>
<tr>
<th>Heating Fuel</th>
<th>Energy Budget</th>
<th>Weighting Factor</th>
<th>Total Energy Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>65.4 MBtu/sq ft/yr</td>
<td>1.00</td>
<td>65.4 MBtu/sq ft/yr</td>
</tr>
<tr>
<td>Oil</td>
<td>54.5 MBtu/sq ft/yr</td>
<td>1.20</td>
<td>66.65 MBtu/sq ft/yr</td>
</tr>
</tbody>
</table>

These figures compare with 68 MBtu/sq ft/yr established as the mean of "existing practice" in 1975-76, and with 64 MBtu/sq ft/yr from the Phase 2 research into the impacts of ASHRAE Standard 90-75R. The mean of the Phase 2 "redesigns" was 40 MBtu/sq ft/yr for large office buildings. Some observers have argued that the weighting factors are unduly hard on all-electric buildings. This example shows that all-electric buildings would have much more stringent energy budgets.
The deadline for written comments on the proposed standards is 30 April 1980. Comments should be submitted to the address below, and DOE asks that 15 copies be provided: Energy Performance Standards, Docket Number CAS-RM-79-112, Office of Conservation and Solar Energy, 20 Massachusetts Ave. NW, Washington, DC 20583.

The following is a table showing the State SMSA, Single-Family Attached Gas, Oil, Electric, and Single-Family Detached Gas, Oil, Electric for Illinois:

<table>
<thead>
<tr>
<th>State</th>
<th>SMSA</th>
<th>Single-Family Attached Gas</th>
<th>Single-Family Attached Oil</th>
<th>Single-Family Attached Electric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illinois</td>
<td>Chicago</td>
<td>39.1</td>
<td>46.5</td>
<td>46.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>29.2</td>
<td>34.8</td>
<td>36.0</td>
</tr>
</tbody>
</table>

What the Standards Would Mean in Chicago, Illinois

Taking the hypothetical case of a single-family detached gas-heated residence in Chicago, which will heat domestic hot water with gas, the design energy budget is taken from tables in DOE's proposed standards. For space heating and cooling in Chicago, the energy budget level is 39.1 MBtu/sq ft/yr. To this figure must be added the energy budget level for domestic hot water, obtained by dividing the budget for gas water heating by the total gross area of the dwelling design (we've assumed a 1500 square foot residence):

Energy budget level for heating and cooling = 39.1 MBtu/sq ft/yr
(Single-family detached, gas space heat, Chicago)

Energy budget level for domestic hot water = 19.6 MBtu/sq ft/yr
(Gas: divide 29,500,000 by gross area, 1500 sq ft)

39.1 MBtu/sq ft/yr + 19.6 MBtu/sq ft/yr = 58.7 MBtu/sq ft/yr

Total design energy budget = 58.7 MBtu/sq ft/yr

It is important to note that the budgets are "weighted" by fuel type and the figures are not measures of energy used at the building site.

Now assume that a building design has been developed and has been evaluated by DOE's standard evaluation technique, which provides a computation of annual energy use measured at the building boundary. These hypothetical "site" energy figures must now be multiplied by the appropriate weighting factors. We'll assume that the design provides for some space cooling. As shown in the computation below, the designer and client are fortunate, because the design meets the requirements of the standards—its design energy consumption does not exceed its design energy budget.

Design energy consumption for space heating
20.0 MBtu/sq ft/yr at the site X 1.0, the gas weighting factor = 20.0 MBtu/sq ft/yr

Design energy consumption for space cooling
6.5 MBtu/sq ft/yr at the site X 2.79, the electricity weighting factor = 18.1 MBtu/sq ft/yr

Total design energy consumption = 52 MBtu/sq ft/yr

A more accurate prediction of actual performance. Whatever the case, it seems likely that the matter will eventually be litigated and this prospect has many practitioners worried.

Higher costs? DOE's data show that initial building costs would rise only moderately, if at all, as a result of the standards: about $1 per square foot in residences and between three and five percent in commercial structures. (The estimates are based on cost analyses of the redesigns produced in Phase 2 of the research effort and on more rigorous examination of costs for conservation measures in single-family residential buildings.) Little attention has been paid to the cost of design services, however, and it seems clear that additional analyses will lead to requirements for higher fees.

Stringency: The design energy budgets are very stringent. Writing in the Progressive Architecture energy conscious design issue a year ago, John Eberhard and Senator Charles Percy suggested that, to be useful, the standards would need to be very rigorous indeed, posing a genuine challenge. Designers, they stated, have demonstrated that it is technically possible to meet such a challenge.

Their statement might better have read "some designers." The proposed budgets are set at levels that were not reached by a large majority of the architects and engineers who redesigned buildings for "maximum technically feasible" energy conservation as part of DOE's research effort. This kind of stringency may lead to serious difficulty for many designers who are not familiar with energy-conserving strategies (not necessarily a bad result).

Monitoring and updating: The law calls for the administrating agency to review, evaluate, and update the standards periodically. With changes coming so quickly and dramatically in the energy situation, and with the promise of emerging energy conservation technologies, this is an especially key element of the program. Some DOE policy staff members have considered the possibility of "racheted" standards, rules that would—like the EPA mileage objectives—call for progressively stricter standards over time.

The use of price weighting factors would seem to indicate that some method is needed for periodic revision of the energy budget levels, based on new information about energy supplies and costs. Other parts of DOE's research effort provide for periodic revision of the energy budget levels, based on new information about energy supplies and costs. Other parts of DOE's research effort provide for periodic revision of the energy budget levels, based on new information about energy supplies and costs. Other parts of DOE's research effort provide for periodic revision of the energy budget levels, based on new information about energy supplies and costs. Other parts of DOE's research effort provide for periodic revision of the energy budget levels, based on new information about energy supplies and costs.
Architecture energy analysis

Dr. Vladimir Bazjanac

The dynamic action of buildings in the heat exchange process is difficult to predict. Designing to optimize heat exchange needs approximation, but if we ask the right questions, a computer can help us find good answers.

Architectural design is the primary force which sets the energy performance of buildings. The demand for heating and cooling and the use of lighting fixtures are determined by the layout and the orientation of the building, by its "envelope," fenestration, shading, and other design parameters. Mechanical systems are designed and operated in response to this demand. Each design decision has an effect on the ultimate energy performance of the building. This is true especially of the earliest design decisions, which often determine the extent to which the consumption of energy in the building can be minimized. If the architect fails to consider this, any energy-conserving design decision made later (including even the design of the most energy-efficient mechanical system) will merely constitute "retrofitting" of the building.

The planned design of an energy-conserving building requires the architect's understanding of the effects of design decisions on energy performance. Some effects (for example, of the orientation) are more or less obvious; others are more subtle and require rather complex analysis of many factors which may be unfamiliar or completely unknown to the architect at the time. This analysis, which assesses the effects of architectural design decisions on the overall energy performance of buildings, I call "architectural energy analysis."

Quantitative models of energy performance

Architectural energy analyses rely on the use of models which describe the energy performance of buildings. They are representations of buildings as energy systems and include only those characteristics and relationships which determine their energy performance. Other characteristics, perhaps important to the design but not important for buildings' energy behavior, are left out.

Quantitative models used in energy analysis are mathematical representations of complex thermodynamic or luminous behavior of buildings. Everything is described numerically: the weather, the building and its operation, the consumed energy. The behavior of buildings is simplified in models and only approximates what is happening in reality. Some are descriptions of only an individual factor and are quite simple. Others attempt to describe a multitude of factors which determine energy performance and are much more complex. Correspondingly, some models require only limited computation, while others cannot be operated without the use of sophisticated computer systems.

Quantitative models offer convenient "parametric" analysis of energy performance: the effect of planned change in a single energy parameter of a building. Properties of buildings or the characteristics of their use are changed by modifying values which represent them. Long-term change (e.g., performance over a whole year) can be simulated and analyzed in a short time. Modeling of environmental conditions is virtually perfect: any weather or environmental condition can theoretically be described at will.

Architectural or mechanical: It is important to understand the distinction between the "architectural" analysis of thermal behavior of buildings and the simulation of performance of mechanical systems. Many well-known models were designed specifically to simulate the performance of mechanical systems. Such models can be used to calculate heating and cooling loads of buildings only to the extent needed for the simulation of mechanical systems and typically ignore sensitive architectural design parameters (such as shading and daylighting). Only models that deal with architectural design parameters of energy performance in detail are discussed here.

Static or dynamic: Models of thermodynamic behavior can be static or dynamic. Static anal-
ysis considers thermal performance independently of time. Typical of this group are simple models which consider only a single factor of energy performance. A good example is the model of conduction through external surfaces (heat loss or gain is a function of surface area, resistance, and the temperature difference between the outside and the inside). The analysis in single-factor models is free of influence from other factors.

Dynamic models by contrast consider change in thermal conditions as a function of time. All models which simulate performance on hourly, daily, monthly, or yearly bases are of this type. Models which consider multiple factors in relation to each other (such as direct and diffused solar gain, reflectance and roughness of surfaces, thermal mass, etc.) are by necessity of this type. Dynamic models of thermal performance have another important distinction: some consider thermal mass of the building and the "delay" effect it causes, some do not.

Zones: Each area of the building with unique thermal characteristics is considered a thermal zone. Buildings are usually zoned by floor. A floor may have more than one zone to account for the difference in thermal behavior between the floor perimeter and the interior. Thermal zoning is an important issue in the use of complex dynamic models—insensitive zoning results in inappropriate description of the building.

Shading: Models used in architectural energy analysis must be able to simulate the effect of external shading. Simple models take shading into account only as percentages of glass shaded. It is more appropriate to "track" the sun and determine the position of shadow caused by the shading system. Most complex models of thermal performance use the latter method. Shading surfaces are treated as external walls and overhangs. Some models allow for simple configurations only, while more sophisticated models can analyze complex shading systems with many surfaces and different tilts, and can include shading from trees and surrounding buildings. Some can even simulate the performance of movable shades and thermal shutters.

Infiltration: Simulation of infiltration is a troublesome proposition as is the simulation of natural ventilation, and few models consider natural ventilation in their calculation of heating and cooling loads. Three methods of infiltration calculations are found in models of energy performance: air-change method, crack method, and the Achenbach-Coblenz method. None describes actual infiltration under different circumstances accurately. It is almost impossible to predict actual infiltration because it depends so much on details and quality of construction.

Function: Energy performance changes with the use of the building. Some dynamic models allow the simulation of different patterns of use. This is accomplished through the "scheduling" of occupancy, of the use of lighting fixtures and user-operated equipment, and of the operation of shades and shutters. Schedules determine when occupants are using various devices in the course of simulation. Such use options as thermostat settings and night setbacks can also be scheduled in some models.

Weather: Energy performance of buildings is weather dependent and can be simulated in a number of ways, depending on the type of model and the purpose of simulation. For this purpose, National Oceanographic and Atmospheric Administration (NOAA) has compiled weather data on magnetic tapes. These tapes provide weather information for a full year for most major cities in the United States. They are used by complex dynamic models to simulate a full year of buildings' energy performance. When simulation of a full year is not needed, "design day" approach can be used. "Design day" represents a "typical" day of the year (typical for the intent of analysis) and contains weather data representative of the local climate which is condensed into one day.

Some models need very elaborate data for their calculations, ranging from dry-bulb and wet-bulb temperatures, to wind velocity and direction, to cloud type and coverage. Most of them calculate both total and peak heating and cooling loads. In contrast, simple models may need only very limited weather data. For example, the previously mentioned model of conduction through external surfaces requires only outside dry-bulb temperature.

Combining thermal and daylighting analysis: Models for daylighting analysis require sky illumination data. Consequently the best analysis is obtained from the use of scale models which can be placed and studied in the actual location of the building. Difficulties arise when repetitive or comparative measurements are needed over extended periods of time—weather and natural illumination sometimes change too rapidly.

Most quantitative models of daylighting are complex. Only extreme sky conditions are considered: clear or overcast. Illumination from natural light is analyzed in a single room for a specific moment in time. Architectural design parameters, important in daylighting analysis and typically required by these models, are room size and shape, finishes of interior surfaces, design of windows, and shading devices.

Models which effectively link thermal and daylighting analyses are not yet available for public use although work on such models is now in progress. Currently, an architect can link thermal and daylighting analyses only indirectly by reducing artificial lighting loads in thermal simulation as a function of use of natural light.

Enter the computer: Models which require
Architect-machine relationship in ECD

elaborate data typically demand the use of very powerful computers. The manipulation of large data bases in some of the complex models requires very fast computers with large memories. The use of weather tapes from NOAA requires tape drives. Such models generate so much information that fast printers are needed. A large computer usually has many users and "turn around time" (time between the submission of input and the getting of results) can be substantial. The use of large, fast computers can be expensive.

Using complex models can be very time consuming. Information must be prepared in a form acceptable to the model and the computer and takes time to understand in detail—and that information is often vast. The user must be familiar with the documentation which describes the model, its logic and assumptions, and the operation on a particular computer system.

Simpler models which require only the use of programmable pocket calculators offer distinct advantages to an architect. They are much less expensive to use. They can be used at the drafting board; they require much simpler input; and they permit much faster analysis. There are, however, penalties for their use. Models are smaller and information from NOAA weather tapes cannot be used directly. There are severe restrictions on the size and complexity of buildings in analysis. As a result, complete analysis of buildings using programmable calculators often requires the use of several different models.

Limitations of analysis

Limitations of architectural energy analysis are inherent in the methods of analysis used. Quantitative models of buildings are representations of reality as seen by the models' designers. If a building or the objective of analysis does not fit this view, useful results can be obtained only when the model is modified. The performance of a passive solar house, for example, cannot be properly simulated with a model designed specifically for the analysis of high-rise office buildings.

As in any design, each model has explicit and implicit assumptions. Assumptions are the only means of dealing with aspects of reality which are not understood, cannot be controlled, or cannot be modeled. They are always made about the simulated weather, the zoning of the building, the use of the building, and the performance of lighting control systems. Explicit assumptions are usually stated in very general terms. It is sometimes difficult to interpret how they specifically affect the simulation of a particular building. Implicit assumptions are even worse. It is often necessary to understand physics or computer science to become aware of them. Difficulties in dealing with assumptions increase with the complexity of the model.

The accuracy of results is of course affected by our ignorance. Our understanding of processes and relationships which determine energy performance of buildings is limited. Their descriptions are incomplete, imperfect, and sometimes inaccurate. For example, sensitivity analysis with the DOE-2 program indicates that the simulation of infiltration may cause a 30 percent error in the computation of heating and cooling loads. Even when the theoretical understanding of a phenomenon is appropriate, its mathematical complexity may be of such magnitude that it can be modeled in usable form only if it is simplified.

Some limitations of analysis are due to the design process itself. A building is much better defined at the end of its design than at its beginning. Detailed information about the building, required by some complex models of energy performance, must be estimated early in the design process. As the architect designs the building in more detail, some of his guesses prove to be wrong. What is finally built quite often differs substantially in its energy performance characteristics from the building described for architectural energy analysis.

Architectural energy analysis is a tool for use in the design process. Its primary goal is to gain the understanding of the impact of design decisions on energy performance of the building. Expectations of predicting the exact energy consumption of the completed building result only in disappointment.

Architects and architectural energy analysis

What can an architect expect from architectural energy analysis? A better understanding of the what, the where, the when, and the how much of energy conservation, as well as advice about design. Specifically, energy analysis can assist in the following: 1 Determining the energy performance characteristics of individual design elements. This, for example, may mean to discover whether a certain element has the desired energy-conserving effect. It may also indicate the best position and orientation of the element, its optimal size, and the conditions under which it is most effective. 2 Establishing energy performance of the whole building. The overall performance is the sum of performances of individual components of the building. The components interact with each other and affect each other's performance. Each contributes differently to the sum, and the effect of a single component of energy performance is sometimes lost in the overall performance of the building. Energy analysis can provide the comprehensive understanding of how much is contributed by which component. 3 Making trade-offs. Architects, for various reasons, often cannot select the most energy-conserving materials or solutions. One material may be chosen at the expense of another. The most obvious example is the case when the high first cost of one energy-conserving solution forces the exclusion of another. Comparative estimates of the extent to which each choice affects the building's energy performance are important in the making of

The section above shows components of heating and cooling loads for a building as percentage of combined loads. Below is a checklist of features characteristic of computer programs. Of the 6 samples, the first 3 are for programmable calculators; the last 3 are large computer systems.
energy conservation issues may avoid problems and embarrassment later in the design process. Architectural energy analysis brings the consideration of these issues to the beginning of the design.

Confirming intuitive design decisions. Architects often make design decisions without the explicit consideration of energy performance. They may deal with energy performance intuitively (perhaps relying on "conventional wisdom"), without the explicit understanding of energy aspects of their decisions. Architects may believe they are energy conscious—energy analysis will show if their design decisions are indeed energy conserving.

Understanding how different conditions of use affect the building’s energy performance. Energy consumption in a building is a function of its use and the changing weather. Architectural energy analysis allows the architect to understand how to deal most effectively with the peculiarities of weather. It can also demonstrate which patterns of use of the building consume more energy. This may lead the architect to deliberately design control systems which will prevent such occupant behavior.

**What is the necessary background for architectural energy analysis?** There is a myth that, with so many calculator and computer programs available for energy analysis, the architect does not need to know much about energy analysis; it is enough to use a program and obtain information about the energy performance of the building. Such “analysis” can lead only to distorted, incomplete understanding of the building’s performance. Output from quantitative models must be interpreted in view of the models’ limitations. Without interpretation, numbers are often misleading.

To engage in architectural energy analysis, the architect must have a basic understanding of thermal behavior of buildings and daylighting. He or she must also have at least some understanding of the particular models used in analysis, their logic, and the basic assumptions and conditions of use. Without that, the preparation of the building for analysis and the meaningful interpretation of results are not possible.

Besides access to appropriate equipment for computation, the architect should have access to full support documentation and prompt consultation. Good advice can save a lot of time when unusual issues or problems arise in analysis. Finally, the architect has to allocate enough time—architectural energy analysis, like design, tends always to take more time than planned.

---

**Ground rules: Architectural Energy Analysis**

This project is directed by Dr. Vladimir Basijanac, Center for Planning and Development Research, College of Environmental Design, University of California, Berkeley. Project staff includes Harvey Bryan (daylighting) and research assistants Peter Brock, Robert Engelsen, and Patrick Mervin. This undertaking would not be possible without the cooperation of the owners, designers, and engineers in the preparation of analyses of their buildings, the assistance of the Building Energy Analysis Group at the Lawrence Berkeley Laboratory in modifying DOE-2, and the help provided by special consultants on difficult aspects of analyses.

The work at the University of California is supported by a research grant from the U.S. Department of Energy, office of John Cable, Director, Buildings Division, Office of Buildings and Community Systems.

Progressive Architecture wishes to invite its readers to comment freely on the value of this program. Suggestions and feedback are important to its future direction. Letters should be addressed to: Progressive Architecture, Architectural Energy Analysis, Richard Rush, Senior Editor, 600 Summer St., Stamford, Ct 06904.

This issue marks the beginning of architectural energy analysis of selected buildings published in *Progressive Architecture*. Our main objective is to introduce energy conservation into the earliest stages of architectural design. By making energy conservation part of the continuous learning process of architects, we hope to: provide an understanding of how early design decisions affect energy performance of buildings; establish the methodology for evaluation of energy performance of buildings from architects’ points of view; disseminate knowledge contained in the DOE-2 computer simulation model to the design community; and encourage a tradition of energy evaluation as an integral part of architectural evaluation of buildings. The title of this project is "Architectural Energy Analysis of Trend Setting Buildings." Its scope of work includes detailed analysis of energy performance of selected buildings, the publication of results simultaneously with the publication of the design, and the recommendation of possible areas of improvement in energy performance.

Architectural energy analysis is the analysis of heating and cooling loads and of the demand for energy from lighting fixtures and occupant-operated equipment (at the building location). It does not include the performance and demand for energy from any mechanical systems. It includes the understanding of energy conservation in buildings, and the quantitative simulation with DOE-2 and daylighting simulation models. Daylighting and thermal analyses are linked whenever possible, although other models are used when appropriate. When available, special studies, reports, and measurements are used to make the analysis as realistic as possible.

A summary of results of analyses will be published in conjunction with the publication of buildings in *Progressive Architecture*. Summaries will follow a standard format (see page 105) as much as possible, highlighting a) energy performance data on the entire building at the stage of design development as published; b) architectural features identified as characteristic for the building, with energy performance data for each feature; c) analysis of compliance with BEPS (after public hearings on BEPS are over and Technical Support Documents are finalized). Quantitative information from analyses will be published without any value judgments. Detailed information from analyses will be published in full. Reports and recommendations for improving energy performance of analyzed buildings will be available with the consent of buildings’ designers.

Limitations of analyses and reliability of results are those of the methodology and tools used (see page 100). Summary reports will provide information about the magnitude of energy consumption as a function of architectural design. The first four reports are experimental in contents and format, and are intended to begin a dialogue with readers.
At the south end of the famed Rainbow Bridge on the Niagara River, a new focal point is to greet travelers from Canada.

On a very prominent site in a prominent city now fighting to rebuild an almost hopelessly eroded urban core, a new office building will join the effort. The corporate office structure for Hooker Chemicals & Plastics Corporation, designed by Cannon Design Incorporated, is far more than first glance might indicate. The unpretentious square plan, diagonally right on axis with the Rainbow Bridge, expresses its flexible office space function in a largely conventional way—albeit column-free between outer structure and core.

That first glance might not even indicate that an observer is confronted with anything much more ambitious than an admittedly handsome orthogonal, subdivided cube. But the second looks which should be triggered by the building's élan will reveal a whole other layer—literally—of content. The building has two skins, and sophisticated controlling features.
Along with the client's desire to consolidate disparate company facilities, and the intended expression of commitment to Downtown Niagara Falls, both client and architect wanted to do everything possible to promote energy efficiency. Mark Mendell, Cannon's principal-in-charge, describes the initial intent as one of incorporating simple solutions representing current abilities to conserve energy. If possible, off-the-shelf hardware, as opposed to highly technical devices, was sought—with the exception of the control and monitoring equipment, discussed later.

It bothered Mendell and his team that the pat answer to conservation was often to cut glazing areas out, or at least down. In order to both supplement artificial light with natural (reducing power demand) and allow maximum vision areas for the occupants, an extraordinary exterior membrane was needed. Since standard glazing, even double glazing, did not meet the design needs, the architects came up with an inner skin and an outer one, four feet apart. This arrangement, which admittedly will come at something of a cost premium, virtually eliminates air infiltration through the inner layer.

Of HVAC lineage
Between the membranes is possibly the biggest-scale set of Venetian blinds ever, and off-the-shelf, no less. Casting about for an efficient yet inexpensive method of installing operable louvers, the designers discovered the system chosen, an assembly of airfoil-shaped louvers long used for HVAC applications. These assemblies will cover all glazed areas of the building envelope except the recessed lobby entry. Motorized screw-shaft rods will provide the power drive for each segment, activated by sensors for each building face.

All façades thus will be controlled separately, and sensors on the louver blades will, when shaded, stop movement. The system will allow horizontal fin alignment for elevations in shade, down to 45 degrees in full sun, or in between. At night when the building is unoccupied, the louvers will close up completely, retaining conditioned air from sunny sides to cooler, shaded exposures. The precise flow of this air is more difficult to predict, but the effect should be beneficial.

More than skin deep
Immediately inside the skin is a 15-ft perimeter lighting zone with two-stage lighting controls to allow for maximum daylighting benefits to reduce power use. The controls will allow for dimming artificial lights in accordance with light levels from outside. Elsewhere on each floor, localized task/ambient lighting will be employed. The designers expect to keep lighting energy use down under 1W/sq ft, taking daylighting into account.

In addition, a comprehensive central computer control center will oversee most building functions. Some of its duties will be to monitor security points, fire safety information, and HVAC dampers, fans, and the variable air volume system. It will also provide for data reduction, allowing precise pinpointing of operating conditions.

Scheduled for completion in 1981, the Hooker building should be interesting to observe "in action." Mendell points out that, from Rainbow Bridge for instance, the building will change from transparent on the left half to largely opaque on the right at certain times. The sides will vary constantly, depending on weather, time of year, and time of day. It may not be a pot of gold, but the Rainbow should end well, anyway. [Jim Murphy]
Data

Project: Hooker Office Building, Niagara Falls, NY.
Client: Hooker Chemicals & Plastics Corporation.
Site: 2.3 acres of open urban renewal land, on axis with Rainbow Bridge linking U.S. and Canada, overlooking Niagara River gorge.
Program: corporate office space of 180,000 sq ft and 20,000 sq ft of commercial and office rental space.
Structural system: steel frame, metal deck.
Mechanical system: electrically driven centrifugal chillers (from which heat is recovered all year), gas-fired boiler, low-pressure variable air volume distribution; all building systems (solar shielding, HVAC, fire alarm, security, etc.) are integrated through a computerized automation system.
Consultants: structural, Gillam Colaco; energy, Professor John Yellott, Professor Richard Levine, Burt Hill, Kosar, Rittelman Associates; acoustics, Bolt, Beranek & Newman; early planning, Hellmuth, Obata & Kassabaum.
Building Energy Performance/Design Energy Budget: 114,000 Btu/sq ft yr.
Photography: Barbara Martin.
City planning and energy

Harnessing solar energy for heating and natural lighting need not be reserved for new developments, nor for sunbelt areas, nor for residential units, contend researchers studying existing cities.

Few of us need to be reminded of the steadfast connection between dispersed growth, characteristic of 20th-Century urban settlements, and high energy consumption. Cars, single-family dwellings, highway commercial strips, downtown office buildings, and suburban industrial parks all are manifestations of an expansion pattern based on a confident presumptuousness about fuel resources. Now with the fuel shortages and high prices upon us, we look for dramatic planning solutions.

The 20th-Century trend toward dispersed development and other reflects the character of the economic institutions that govern our society, a connection that has generated different urban forms in past centuries. The mercantile-based cities of the 17th and 18th Centuries, the industrial ones of the 18th and 19th Centuries, and finally the present-day corporate versions spawned distinct urban typologies. Older manufacturing cities show a concentration of workers' housing near factories, which in turn often lie at the edge of older, mercantile-based downtowns. Both urban types gradually gave way to the current version typifying our corporate society: new office towers are erected in downtown areas, far from the executive "bedroom" suburbs, and far from the places of manufacture. These in turn lie at some distance from workers' residences, which also are dispersed in relation to services.

The best new towns

As urban studies professor Jon van Til argues in his article "Spatial Form and Structure in a Possible Future" (APA Journal, July 1979), older cities represent models of energy efficiency. The mercantile/industrial form corresponds closely to the ideal urban settlement for an energy-conscious society. This concept, called by van Til a "diversified-integrated model," embodies the proposal that people settle in small nodes of concentration where they would live close to work, shopping, and other services. The nodes, 2000 to 3000 in all, scattered throughout the U.S., would mean new urban centers would not have to be built. Existing towns and cities could provide the shells.

The megacity or concentrated supercity that captured the imagination of many architects and planners in the 1960s doesn't meet the demands as well as the smaller nodal urban form. While the concentrated supercity poses the most dramatic alternative to dispersed growth, it would now be too expensive to build in terms of the energy it consumes—a "cruel paradox," van Til adds.

Not just climate

The advantage for the older Northeastern cities with an inherited infrastructure of support services and transit needs little explanation. Climate notwithstanding, a city like Boston has an irrefutable edge over a city like Houston.

Because of its climate, Boston clearly bears the brunt of higher space-heating bills. On the other hand, mass transit is plentiful and corporations are now building inner-city industrial parks in South Boston and Roxbury. The high cost of heating homes can be offset somewhat by the strong "retrofit" activity, and because of its planning advantages, Boston maintains an edge over Houston in energy efficiency.

Back to downtown with DOE

Compact planning of medium-density building configurations does not solve the whole problem. Energy-conscious planners presently are trying to figure out how existing cities can harness alternate sources of renewable energy with old and new construction. Using the major source of renewable energy, the sun, increases the challenge.

Government agencies like the Department of Energy are trying to rise to the occasion. DOE has initiated the Solar Cities program, which, along with all sorts of other government-aid projects, it hopes will reduce consumption of nonrenewable energy sources by 20 percent in the next 20 years. Individual and multiple buildings or complexes qualify for the solar cities program, which is researching means of providing energy through the sun, as well as wind conversion, photovoltaic cells, and so forth. All sorts of design and planning efforts come under the purview of the program including building, designing and siting, land uses and street patterns, solar access protection, and historic preservation.

Frank de Serio, program manager for DOE's Passive/Hybrid System Branch, reports that the program applies to the 150
City planning and energy

cities with the highest population centers. But, de Serio estimates, four buildings must be converted to solar energy to displace the equivalent of one building's consumption of nonrenewable energy. To meet the U.S. Government's goal by the year 2000, 80 percent of the existing building stock will have to rely on alternate energy sources.

Demonstration projects and conferences form a basic component of the DOE program. In addition, the Department offers free advice, technical assistance, and financial aid. The program has been broadened to include such endeavors as funding the drafting of zoning ordinances related to solar accessibility or harnessing other renewable energy sources. The design and construction of prototypical energy-saving projects, generated by private as well as public initiative, would also come under the purview of the program. Furthermore, a partnership between DOE and the National Bureau of Standards is now developing methods by which building owners, architects, planners, and government officials can analyze buildings and urban design complexes for site orientation, configuration, materials, and energy-load characteristics. The financial aspect of spurring energy-conserving measures for retrofit, through tax incentives, grants, etc., is being given due attention.

Solar in the city

Two energy researchers from the National Bureau of Standards' Center for Building Technology, Robert Hastings and Kalev Ruberg, have been studying developed urban areas to uncover potentials for solar energy applications. Too often, Hastings and Ruberg point out, current research is being carried out for single buildings, particularly single-family houses. Since much rehabilitation and recycling is now being conducted in cities, these pockets of development provide new opportunities for solar technology.

The main thrust of Hastings and Ruberg's research is directed at commercial or mixed-use buildings. Generally, they explain, it is assumed that energy demands for commercial buildings are higher for lighting than for heating, and therefore solar heating would not be practical. Actually, however, they find more energy is used for space heating in commercial buildings than for any other kind of use: space-heating needs are proportionately higher in smaller, older buildings than in newer office buildings that require cooling and heating. Hastings and Ruberg hypothesize that a greater dependence on natural lighting would mean that new office buildings would also need to use less energy for cooling and proportionately more for space heating. Solar energy, with the added advantage of including natural light in its "energy package," could be very persuasive.

The time schedule of energy use is critical. Fortunately business hours coincide nicely with the use of the sun for heating and lighting. But commercial buildings need to warm up quickly early in the morning, particularly after a cold night. Thus nighttime thermal storage capabilities and orientation of the building to the southeast would most effectively harness solar heating and make use of natural light.

Access to sun

Access to the sun, plus its intensity, vary of course, depending on the development. In the urban context obviously not every building can face south-southeast. Access to the sun becomes even more of an issue when it is jeopardized with the increasing density of urban development. Thus it is not surprising to see right-to-light laws being proposed or explored in Japan and California (see p. 82 and P/A, April 1979, p. 76).

For their part, Hastings and Ruberg, again looking at a low-density block in a settled Northeastern city, note the portion of solar gain is surprisingly high. A south-facing surface in Columbus, Oh, for example, will receive on a January day 80 percent of its daily solar gain between 10:30 a.m. and 1:30 p.m. Furthermore, they have found if the surfaces receive shade both before and after these times, the building will still get 60 percent of the sun's radiation. Not only does most of the radiation occur in these hours, but solar gain can result from both diffuse radiation and direct sunlight. In urban environments such indirect radiation comes from the pavement or even from particulate pollution in the atmosphere. In fact one study Hastings and Ruberg uncovered showed that at noon about 22 percent of the solar radiation available in

The above drawings have been executed by S. Robert Hastings and Kalev Ruberg. The drawings form part of a National Bureau of Standards study on urban solar applications, passive solar heating methods, and preliminary thermal performance data for a prototypical neighborhood commercial strip.
an Eastern seaboard city is diffuse radiation, compared with 8 percent in a California desert site. (Desert sites still receive 20 percent more solar radiation.)

Interestingly, Hastings and Ruberg add, while not every grouping of buildings can have the ideal conditions of south façades in blocks oriented east-west, other areas of solar absorption exist. The street, for example, can act as a prime solar collector, and the two argued strongly that this advantage should be considered for its implications.

**Commercial uses and solar energy**

In working on a small computer program to calculate solar availability for various types of urban geometries, Hastings and Ruberg decided to pursue retrofitting existing neighborhoods rather than emphasize hypothetical urban forms. They chose a neighborhood in the Northeastern city of Baltimore, Md., to amass data that would be applicable elsewhere. They also decided that an older commercial strip, much like the main streets of many older downtowns, would offer a representative study area of a less than ideal solar situation. This kind of urban agglomeration is generally composed of brick row-house buildings, two to three stories high, with commercial space on the ground floor and residential or storage space above. Generally the buildings range in width from 10 to 40 ft and vary in floor area from 500 to 5000 sq ft. Everyone is familiar with the architectural styles—usually watered-down Federal over laid with "contemporary" retail store fronts.

**Testing alternatives**

The two researchers found Baltimore's Cross Street revitalization area near the city's Downtown business district the proper prototypical situation. In this quarter, 42 percent of the retail businesses are small stores. Isolating one building out of the grouping, they decided to try three different solar design approaches, then compare the performance of each. The first approach called for just insulating the exterior walls and roofs of the building and adding double glazing. Another alternative to be explored involved the installation of active solar air collectors on the upper stories of the south-facing wall. A third alternative they investigated projected the construction of a solar canopy over the street to absorb and store solar energy falling on and between the buildings.

The team found a typical building on which to base their calculations, an 800-sq-ft, three-story building with double brick walls. The ground floor was devoted to commercial space, with the two floors above unoccupied. Of the various kinds of energy needed, the building, like others in the neighborhood, uses about 58 percent for space heating. For purposes of analysis, Hastings and Ruberg established a 70 F temperature setting for business hours, with the temperature reduced to 56 F at night.

As part of the background for their calculations they had to figure out peak loads of energy use, detect pathways through which heat would be lost, and estimate the amount of internal heat gain.

To weigh the effectiveness of these three approaches against each other, a heating-demand profile was calculated for three days in January. Such profiles must take into account early morning heating demands and their peaks, plus the drop in heating requirements in the afternoon resulting from internal heat build-up, and the limited nighttime requirements. Since more heat is needed by these commercial spaces in the early morning, heating needs peak during the time when the stores just open.

An hour-by-hour examination of solar availability showed that the south-facing wall reaches a peak of solar intensity later than the peak heat needed for a commercial building. Since the amount of solar gain at noon on clear days exceeds the heating loads, excess solar energy could be stored in thermal-mass areas to be used as low, direct irradiated heat the next morning. With the case study building, Hastings and Ruberg also found that the upper floors received 72 percent of the total insolation in January on the south face.

**Insulation on one alternative**

In analyzing the data compiled on the three approaches investigated, Hastings and Ruberg hesitate to rank one method over the others, be it insulation, use of solar collectors, or the installation of a street canopy. Present rehabilitation plans for this kind of construction call for 3½ in. of insulation on a stud wall and the interior surfaces of masonry walls, plus 6 in. of loose fill between ceiling and floors. Double glazing and perimeter insulation at the edge of the floor slab help too. Given these conditions for the month of January, thermal data show that heating requirements would drop from 62 million Btu per year to 19 million Btu. However cooling and ventilating requirements in the warm months would mount considerably since the added insulation would also keep the heat within the building from escaping. Since internal build-up would cause overheating much of the year, these disadvantages have to be met: the auxiliary heating demand would in winter heating requirements.

**Solar collectors on city blocks**

The second strategy the team investigated was the installation of solar collectors on the upper walls of the building. Even though this method showed some advantages—such as a reduced heat loss—the disadvantages of collectors for heating this kind of building outnumber the benefits. Only a small part of the building envelope can be used for solar collectors, and thus only a limited percentage of the energy requirements for the building can be met: the auxiliary heating demand would be cut to 47 million Btu annually.

Cloudy conditions during the January test days didn't help: the collectors' yearly solar fraction (determined by the solar load ratio method) was calculated at 25 percent. The disadvantages spread out over the whole...
City planning and energy

block of long, narrow buildings pointed to the main problem of adapting this method to this building configuration: "If the near walls of the north-facing buildings are shadowed, the cost of the south wall collector applications must then be amortized over the entire block," points out Ruberg, "and the energy savings become even smaller."

Street canopies as a third method

The third energy-saving approach investigated suggests enclosing the neighborhood commercial street with a canopy. After exploring this passive heating system with a semiconditioned environment, Hastings and Ruberg concluded that a closed canopy spanning a north-south oriented street with a serrated profile, south-facing glazing, and overhanging sloped roofs would provide the most efficient kind of heat gain in the winter and shade in the summer.

High internal heat gains in commercial buildings during business hours with the absence of nighttime gain plus the thermal mass of the brick would keep temperature swings down to a reasonable range in the winter. The large thermal mass of the street and sidewalk pavement enclosed by the canopy effectively stores heat, and the area of building surface that loses heat is considerably reduced. (Fifty percent of the total heat generally is lost from the front face of the case study building, largely due to shoppers going in and out.)

With this canopy design, the yearly solar fraction would amount to 57 percent for the case study building. Annual heating needs of this building would be lowered to 43 percent of the standard, a reduction to 27 million Btu annually. In addition, the closed canopy would offer 370 sq ft of semiconditioned retail space for each of the 48 commercial businesses in this study area, the two researchers estimate. In warm weather, natural light, particularly that which could be directed on the commercial and residential settings, an energy-conserving future might be easier to attain.

And elsewhere

In PAA's special issue on energy last April, the need for planning and development for energy conservation was urged by Peter Calthorpe and Susan Benson. They argued, in fact, that the "form and density of housing, the land use patterns and resulting transportation systems have a greater potential for energy savings than any solar applications."

If patterns of growth and development are not addressed along with specific architectural measures, then the use of alternative energy sources will mean little. As many observers contend, the current experiments in solar technology have been implicitly reinforcing suburbanization patterns by concentrating on the single-family house. While to some degree this small-scale effort is understandable, solar experimentation will have to move to an urban scale to begin to solve the nation's energy needs.

Ralph Knowles, whose efforts were also discussed in last year's issue (p. 74), is addressing the forms that new urban development should take with regard to solar energy sources. This kind of effort, along with that concentrating on existing commercial and residential low- and medium-rise buildings in urban areas, is where the attention is needed. The implications are irrefutable: the two- to four-story row house must be retained, not torn down for redevelopment. This kind of construction offers dramatic savings: with the modifications that Hastings, Ruberg, and colleagues are pointing to on the commercial and residential settings, an energy-conserving future might be easier to attain. This possibility is rooted in the past—in the way cities developed and urban form took shape in previous eras. [Suzanne Stephens]
More than just energy

Peter Calthorpe

Two giant public institutions, the State of California and the Tennessee Valley Authority, are aggressively blending architecture and energy. The unique aspects of these programs are expansions of two classic government responsibilities. The first is its role as coordinator, integrating the various social and technical goals of society into cohesive programs which few private clients can duplicate. The second role is that of social and technical experimenter, taking risks the private sector generally avoids.

Having been a project designer for the California State Office Building, Site One A, and a design team member on the TVA complex, I would suggest there is much more than economics and energy motivating these projects. The programs came to represent a social philosophy and a political will. The new designs therefore take on a symbolic role, marking an emerging attitude toward diminishing resources, and satisfying government's need for a meaningful identity. In some cases, ironically, it became more important that the building look "solar" than actually reduce energy consumption.

The State of California, under Jerry Brown's era-of-limits philosophy, devised a major building program to provide the state with one-and-a-half million square feet of energy-efficient office space. Started in 1976 when Sim Van der Ryn became State Architect, the project involved resource policy and land use planning as well as architectural programming. The results have been: a master plan for downtown Sacramento (The Capital Area Plan or CAP), a major architectural competition (Site Three), one office building designed by the Office of the State Architect (Site One), and six projects designed by private firms.

TVA, with the recently appointed chairman David Freeman in charge, has also taken an active stance on energy issues in building design. Its first project, directed by Withers Atkins of TVA's architectural branch, is a 1 million-sq-ft office complex in Chattanooga. As in the California projects, its wide range of goals—satisfying user needs, employing infrastructure efficiently, and keeping cost as well as energy use down—has produced a bold political and architectural statement.

The State of California, in a publication called "Building Values: Energy Guidelines for State Buildings," set forth four performance measures for its new buildings. The first, a real estate investment measurement, incorporated the standard life cycle cost analysis and showed that the State's current leasing policy was costing 20 percent more than an owner-operator policy. The second criterion, energy investment, admitted the unpredictable nature of energy futures and took account of its ambiguous but central political realities. The third, cost of operation, was found to be far more tied to worker performance than construction or energy considerations. A standard building's cost breakdown is two percent for acquisition, six percent for maintenance, and 92 percent for personnel. The State publication emphasizes this point: "A better work environment that improved worker effectiveness by only six and one-half percent would be cost effective even if it quadrupled building costs."

This set in motion a new programming department in the State of California, headed by Bobbie Sue Hood, to solicit user participation and articulate user needs in the new building program. Its recommendations included crystal clear circulation; maximum views for work stations; individual control of lights, heating, and cooling; stairs (to reduce elevator requirements); office clusters; active and—when possible—sheltered streets; outdoor spaces with sunlight and shade; gathering places for work and social activity; scale indications for various distances; and flexible office space.

The final criterion, infrastructure costs, was more qualitative and became policy statement. For example, the response to transit needs was a policy of infill housing in the Downtown area to "permit one-third of State employees to live within walking or bicycling distance from work." Infill housing became a major scale determinant for the office buildings. Other concerns were land use, climate control, materials selection, and energy supply.

TVA's flagship

TVA constructed a similar set of criteria for their new office building program. Focusing on energy conservation, TVA assembled a blue-chip design team for their flagship project in Chattanooga. It included The Archi-
Like the California program, TVA’s considered broad environmental issues. At one point housing within the project site was recommended in order to seed the Downtown area. TVA already provided commuter buses for a percentage of its employees, a factor that generated a more centralized circulation scheme than a drive-and-park approach would have. Ralph Knowles’s concept of “the solar envelope” became a major criterion, eliminating high-rises and defining lot size in order to protect neighbors’ rights. Much debate centered on which building skin material to use based on the amount of energy required to produce it. Surprisingly, thin aluminum turned out to use nearly the same amount of energy per square foot in production as did bricks.

The most interesting and perhaps far-reaching program TVA employed was the peak power credit. As a power company, TVA is all too aware of the growing costs and problems of installing new generating capacity. Therefore, any reduction in peak demand meant dollars saved in new equipment. This calculation, amounting to about $700 per peak kilowatt, was figured above and beyond a life cycle cost analysis based only on fuel consumption savings.

**User needs vs energy**

Given these innovative programs, the central question became: do energy strategies necessitate a thermodynamic straitjacket which compromises or preempts human needs, or are they potentially compatible? Does regional, climate-responsive design philosophy, for instance, even help create amenities?

Several design strategies succeeded in balancing these goals. Increasing perimeter area for as much daylight as possible, a design principle employed throughout these buildings, reduced energy consumption and enhanced the human environment.

California’s Justice Building, San Jose Building, and Site Three have multiple courtyards to increase daylight penetration. Site One A, Site One B, and the Long Beach Office Building increase daylight zones by street side offsets, jogs, and terracing. The TVA design aggressively employs its solar courts for daylighting, using mirrors to reflect the light as needed.

Designing for daylight also affected the interior zones. All the buildings have greater proximity of work space to windows than is usual, generally by elimination of private perimeter offices. In several buildings, daylight penetration was increased with high ceilings and window heads. The Long Beach Building has a 14-ft floor-to-ceiling height; Site One A has 11-ft; and Site One B has 12-ft.

These architectural expressions also coincide closely with other program guidelines. Daylight elements such as the south side light shelves in the TVA building add texture and scale to the façade. The articulated massing answers the need for identifiable office clusters while the courts offer social gathering points. Task lighting is generally employed, allowing individual control and choice. In all the plans, massing for daylight generates a more immeasurable building, offering coveted views and a generous and varied interior.

Another energy design strategy employed in these buildings is the use of buffer zones, semienclosed or completely enclosed spaces using natural climatic forces to temper their
environment. The TVA solar courts and Site One atrium have operable louvers and glazed roofs, allowing passive solar heating in winter and shade in summer. The courts of the San Jose Building and Site One B have operable shades with no glazing, providing a less expensive tempered space, shaded and vented in the summer but sunny in the winter. The Justice Building is woven together with a grid of streets and courts, none of which employs mechanical air conditioning but which remain comfortable for circulation and work breaks. Organizing the building circulation in this way saves interior space and lowers perimeter heating and cooling loads. Some of the buildings use exterior balconies and landscaped areas to temper the microclimate surrounding them.

In contrast to buildings with homogeneous thermal environments, these buildings are organized by their transitional spaces, providing for that important program element of clear circulation. Reviving a grand architectural tradition, the courts replace the modern elevator core with a psychologically important social gathering place. As workers become more alienated and government becomes more labyrinthian, the function of these generous spaces could produce a stronger identity for the institutions, a monumentality which empowers rather than intimidates its users.

Diversity is a strategy for energy conservation which also coincides with user needs. By establishing a hierarchy of lighting needs and qualities, these buildings provide visual variety as well as energy conservation. In Site One and TVA, the lighting loads are reduced by separating the artificial light demands into ambient and task categories. This creates a less monotonous office environment. The circulation zones have different light levels from the courts. The layering of buffer zones, balconies, and covered walks generates a spatial richness which has long been lost from curtain-skin high-rise architecture. Facades are also more diverse; each orientation induces a different character. For Site One B and Long Beach, an element was developed in which shading devices can vary for each orientation. Site One has more disparate façades: operable shades on east and west, a fixed trellis on the south, and a varying structural grid.

The TVA building avoids the difficult east/west problem by organizing its core zones on these façades. Its south side uses a light shelf as shade and the north face is stepped, creating skylights on each level. This differentiation is reinforced by the skin materials. The south façade and atrium ends are clad in a bright brushed aluminum, augmenting the sun reflections, and the north side in brick, relating to the indigenous materials of the town. This may have the positive by-product of reinforcing psychological certainty. “East,” “West,” “North,” “South,” like

Conflicts
Not all energy-conscious design features have benevolent side effects. For instance, a conflict arose over operable windows. Workers wanted them and in certain respects they are considered an energy-saver. But restricting their use to appropriate days, estimating their effect on the mechanical system and the increased dirt and maintenance involved, were issues that were never resolved. If a building were under positive pressure, individuals could open windows in the winter without suffering consequences. In Site One A, key-operated windows were installed to make this option possible, with its balconies...
intended as a trade off, giving people free access to the outside.

A related issue is open plan versus private office space. Private offices were considered less energy efficient because they inhibited daylighting and the free flow of heating and cooling. On the other hand, "task" heating and cooling systems, as in hotels, may ultimately save energy by allowing individual control. And a thin building with glass interior partitions could resolve the daylight problems. As for economic efficiency and flexibility, there are those who now question the gospel of open-space planning. Bobbie Sue Hood's recommendations stated that "in fact, large, open, loft-type offices are often less flexible than offices with fixed partitions." On the other hand, her survey showed: "All those questioned preferred a private space for themselves but considered open plan appropriate generally." The danger of open plan is its tendency toward overcrowding, which is extremely common in government institutions.

The automatic features of the buildings present a potential conflict with people's sense of self-determination. These features operate with various rhythms and cycles. San José's courtyard covers operate seasonally. Site One A's east and west canvas shades operate on an hourly basis. The Long Beach shading system allows change to accommodate new internal functions. In both Site One A and Site One B, the atriums have operable shading mechanisms to allow passive solar heating in the winter and provide protection in the summer. The TVA complex has four modes of operation for its mirrored louvers over the court.

But these dynamic elements produce some architectural compromises as well as premiums. On one hand, Site One A's fabric east/west shades enhance the façades, developing a changing character morning to afternoon, adding interest and color as the shades track the sun. On the other hand, the dynamic features are run by computers and may seem oppressive. Some experiences in Canada attest to people's dissatisfaction with automated shades which preclude the workers' participation. The potential for user-operated shades is perhaps the best option, as long as occupants are sensitive to the results of their participation.

Buildings as symbols

On the whole, the climate-responsive features in these projects seem to enhance the human environment while saving energy. But ultimately our public buildings are more than energy machines or efficient workplaces. They communicate the intentions of our culture—toward technology, nature, and toward one another. Public clients may therefore be evolving a new form of civic architecture. However, sensitivity to people and spatial generosity are not necessarily inherent in energy-conscious design. As much is derived from the sympathies of the designers. The California State program was heavily populated with individuals, such as Van der Ryn, Hood, and many others, who shared a background in social issues developed at the University of California at Berkeley in the 1960s.

The California State Competition demonstrates another result (P/A, Feb. 1978, p. 70). Its program emphasized user-based concerns—light and views, scale and integration, community and informality. Five of the six finalists developed buildings along these lines, buildings that were highly textured, unimposing, the energy features so well integrated as to be invisible.

In contrast, the winner employed an active solar collector, the "solar slab," as its primary feature. The focusing-type collectors covered the south façade of the upper building completely, shutting out all views and light. The remaining office space was below grade, insulated with earth and penetrated by light courts. However, the solar collectors—though considered an extremely expensive cooling technique—were felt to have a visual presence. The building's form was seen as a powerful sign. Its monumental character ran counter to the program's stated intention but was consonant with longstanding yearnings for strong political and institutional statements. While the project provided a simple, clear circulation spine and much needed parklike open space, its form and scale are like a huge energy diagram announcing political intentions as simply as a billboard.

The TVA design shares some of these billboard qualities. Its lack of scale on the street creates an imposing form; diagrammatic in elevation and plan, monumental in section. The great shieldlike atrium ends may overpower the street. Certainly the mirrored-covered atrium skylight, sparkling from a distance, is a powerful sign, even if mistaken for a solar collector. The atriums may be overwhelming—giant in scale, linear, and systematic—or benevolent—clearly organized, alive with light, a common ground for a large, rambling institution, a proud symbol of what it demonstrates.

So there it rests. Energy-conscious design for public institutions is on the one hand an opportunity for a new kind of regionalism tied to climate and human comfort. On the other hand, it is a microphone for political aspirations. Energy use, though it affects all aspects of design, is not so deterministic as to pre-define a building's character. Ultimately energy-conscious design is an expression of social, economic, and political viewpoints. As such, its architectural expression is inevitably caught up in the identity crisis of government in our time: the tensions between bureaucrared bureaucracies and proud civil services; diagrammatic panaceas and subtle integrations; simplistic symbols and complex dialogues. It is caught, finally, between the individual and the institution. □
The Tennessee Valley Authority put together three architectural firms (Caudill Rowlett Scott, The Architects Collaborative, and Van der Ryn/Calthorpe & Partners), engineers, consultants, and its own architectural design branch for a new headquarters in Chattanooga (above and above left). Benham-Blair & Affiliates of California won the California State Office Building Competition with the design at left. Author Calthorpe feels the projects have as much to say about political symbolism as energy conservation.
An energy-conserving building is only as effective as the team that designs it. The important interaction between architect and engineer is discussed by Fred Dubin and P/A's Richard Rush.

Fred Dubin is president of Dubin-Bloome Associates, PC, founded in 1946, and a partner in Fred S. Dubin International, Rome, Italy. Dubin has served on or consulted to many national energy-related committees including the AIA. He has lectured and taught at many colleges and universities around the world and is the author of several books including Energy Conservation Standards for Building Construction and Operation with Chalmers G. Long. Fred Dubin's major projects include the Salk Institute for Biological Studies in La Jolla, CA; the Energy Conservation Demonstration Building for GSA in Manchester, NH; solar energy heating and cooling system for the George A. Towns Elementary School, Atlanta, Ga; the United Nations Environmental Headquarters, Nairobi, Kenya; the mechanical, electrical, solar, wind, and energy management services for the National Headquarters of the Solar Energy Research Institute in Golden, Co. Photography: Dorothy Alexander.

In years past your mechanical engineering expertise has brought you into contact with such architectural luminaries as Corbu and Louis Kahn. Their ideas have certainly influenced and broadened your interest in architectural design. Your experience in combination with your recent Master of Architecture degree certainly qualifies you as one of the leading professionals who can discuss the changing interface between the mechanical engineering and architectural professions. Your involvement with Kahn's Salk Institute in La Jolla offers a good contrast with your present role in the planning of the new SERI Headquarters in Golden, Colorado. How receptive was Louis Kahn to an idea that would affect the form of his building that basically came from a mechanical or energy consideration?

Louis Kahn had a very strong design philosophy, very strongly history oriented, very much oriented toward structure as an expression of place and the use of natural light to enhance form. When I could tune in with him and show that what I wanted to do was completely compatible with what he basically wanted, which most often was the case, and I had a good rationale for it, he would design and adopt mechanical, electrical, or energy constraints as basic needs.

In the Salk laboratory, for example, he had originally planned to use the interstitial space on only one floor. I was able to indicate that it was essential for each laboratory floor to enhance the mechanical and electrical installations, to preserve adaptability, to reduce materials, and conserve energy. He readily adopted the entire concept.

Mechanical engineering or energy constraints also affected the overall shape of the Salk buildings. La Jolla, Ca, the site of the Salk Institute, has a benign climate. Kahn's early predesign concept included no air conditioning but had curved walls and columns in juxtaposition to create venturi effects and natural ventilation throughout the structure. He had based his ideas on published climatic data at the San Diego airport 10-12 miles away. I told him we had better know a lot more about the microclimate on the actual building site. He agreed and promptly rented a house adjacent to the site which we occupied for three months. He learned that the microclimate at the site was completely different from the airport data. La Jolla had early morning fog, turbulent air currents, and updrafts from the sea and nearby cliffs. There were other problems including dust in the area from other construction and noise from aircraft. After the three months, I insisted upon air conditioning because laboratory processes cannot exist without clean air, quiet, and a controlled work environment.

So Kahn said, "Well, why do I want this curvilinear form?" And I said, "Well, you answer that one." He changed his mind. The new design expressed his philosophy in another way. When he was shown that energy and conservation were fundamental, he was quick to respond in his design.

In Salk, we were concerned first with the laboratory environment, but we were very early concerned with energy. There were many energy-conserving features: exterior corridors to protect the inner spaces from excessive solar heat gain, heavy thermal mass floors and walls, efficient services and distribution systems in the interstitial space, modular lighting capabilities with really selective lighting to suit varying tasks, high-temperature hot water instead of steam—and many others.
Louis Kahn was not particularly keyed to energy, but he was passionately linked to fundamentals. I think if he had lived a few more years, he would have seen more clearly that natural energy is poetry too.

Ten years ago you ran a basic mechanical engineering office. How has your office structure changed in recent years?

We now have four graduate architects on our staff. They are not necessarily designing whole buildings but are very much attuned to architectural design. All of them have had major energy and environmental training. None is registered incidentally, so we are not producing new buildings, but we are doing a lot of architectural design and analysis.

What precise role do the architects in your office play?

They are all heavily involved with passive solar design, wind, and energy-conscious buildings. We are doing early studies and quantification of passive design approaches. We are bringing such qualitative knowledge to our outside architectural colleagues on the design team, including the best utilization of space to reduce the energy loads. The design architects are most involved with functional space relationships for most effective heat storage or distribution. Wall partitions, for example, can enhance or obstruct the circulation of heat and the performance of a passive system. The materials themselves also can enhance energy conservation so we aid in clarifying the options.

In addition to our architects, we also have a computer specialist. We are bringing him up to speed on HVAC design while he brings others up to speed on computers. Another member of our staff, Amos Halfon, heads our computer section and is a very skilled HVAC engineer as well. Six people are especially trained in computer analysis and design.

We also have a number of new employees who have had solar and energy conservation in college but have very little practical experience. They are continually introducing the principles to some of our people who have been with us longer but who are strictly design engineers. We have interdisciplinary seminars within our office so that what one group knows can be shared with the others.

There is considerable difference in the way we practice now from 10 years ago. We used to have design teams, project captains, mechanical engineer, or electrical engineer. Before, our involvement with architecture was primarily my own domain. Now we have many more people who are concerned and involved with the total planning process. That is a big change.

What is your present role in the design for the proposed new national headquarters for the Solar Energy Research Institute in Golden, Colorado?

Of course the project is a joint venture. The design team, the Table Mountain Architects & Engineers, consists of Caudill Rowlett Scott, John Anderson, Rogers-Nagel-Langhart, and Dubin-Bloome Associates. Our influence was felt very early in the programming stage.

SERI polled all of their in-house scientists and administrative personnel at the start. Each one stated his needs. The poll specified 700,000 sq ft of building space. A preliminary cost estimate revealed that the budget could not support that much area. To stay within the budget we said: “You really have to pare your space. What are you going to do in this space?” We challenged assumptions and met with the personnel who would be using the laboratories to try to refine the program. We had limited success because we had insufficient fees in the early stages to thoroughly determine the specifics. We asked: “Do you need a hood? Do you need a sink? Do you need a high ceiling for experiments?”

We finally made our own assumptions of the number of hoods needed, the space requirements, and services needed. We were able to convince SERI to scale down their space requirements to 468,000 sq ft of building including 147,000 sq ft of laboratories. The architects from the other three joint-venture firms determined the nonlaboratory space requirements. Now that the conceptual phase is over we have hired Earl Walz as the laboratory consultant of the team for the design development stage.

After determining the conceptual needs for the laboratory, we asked: “How should these spaces be arranged?” I was holding out for interstitial space. I firmly believe that, for that type of building, interstitial space is very energy-efficient and cost-effective. Everyone finally agreed. As we proceed with the design, we are now studying the cost benefits. We were asked: “Isn’t interstitial space simply adding more costly volume to the building?”

Well, it isn’t just that much extra volume. We don’t have to light it to the same extent nor plumb it, except for the plumbing in the laboratories. It doesn’t need plumbing for its own use. We also don’t have to heat it or condition it. The space also serves as an exhaust fan gallery and accommodates equipment which would need more expensive space in a more conventional building. We worked closely with the cost estimator during this stage.

Then CRS sent us a conceptual plan of the laboratories. I said, “We’ll send you a plan of what we think the laboratory ought to be and let us get a response back from you.” We laid out the laboratories on a structural module—12 ft wide and 30 ft deep. We defined what was going to happen in each module and were able to do piping and drops to
obtain unit cost for materials, fan coils, etc., and sent it back to CRS. We suggested the spatial arrangement, which will of course be refined.

What will be the additional influence of the architect on the laboratory plans?

He will study where the offices are in juxtaposition to the laboratories. We want to transfer energy and heat from one space to another or pick up waste heat in the labs and use it in the offices. The physical relationship is very important between those spaces. I also want to be able to introduce fresh air into the offices and bleed it through the laboratories so I can use it twice.

The architect alone cannot plan without the engineer who knows the principles that will lead to conservation and reduction in capital cost. So, what discipline is involved? Well, everybody is involved.

It always seems as if no matter what team we have, there has to be a team captain. Who is the captain of the Table Mountain AIE team?

We have a project director originally drawn from CRS but now from RNL for administrative matters. Paul Kennon and I are the design leaders, and our team comes to a consensus on energy, budget, aesthetics, and functional requirements.

The definition of the leader is not necessarily the one who makes the decisions but the one who translates them. Is he usually the most general?

It doesn’t always follow that way. He must know enough to appreciate what he is being told. Someone must make evaluations. If there are conflicts, someone must decide. So far we have been able to reach a consensus in design sessions. It may not always be that way I am sure. We have an executive board with representatives from all of the four firms if a vote is finally needed to resolve disputes. I am responsible for meeting the energy budget since our contract with SERI calls for a strict hierarchy in design. The architect/engineer alone cannot plan without the engineer who knows the principles that will lead to conservation and reduction in capital cost. So, what discipline is involved? Well, everybody is involved.

The architect/engineer

It always seems as if no matter what team we have, there has to be a team captain. Who is the captain of the Table Mountain AIE team?

We have a project director originally drawn from CRS but now from RNL for administrative matters. Paul Kennon and I are the design leaders, and our team comes to a consensus on energy, budget, aesthetics, and functional requirements.

The definition of the leader is not necessarily the one who makes the decisions but the one who translates them. Is he usually the most general?

It doesn’t always follow that way. He must know enough to appreciate what he is being told. Someone must make evaluations. If there are conflicts, someone must decide. So far we have been able to reach a consensus in design sessions. It may not always be that way I am sure. We have an executive board with representatives from all of the four firms if a vote is finally needed to resolve disputes. I am responsible for meeting the energy budget since our contract with SERI calls for a strict energy budget. Architectural decisions which materially have an adverse effect on energy usage are vigorously challenged.

Sometimes these decisions are made at a very large scale, in the conceptual master plan for example. We asked questions: What are the building block locations? Where does the building fit into the slope and the contours of the site? Where can we build first and where can we add on? Where do the utilities come from and where do they go? I put many conditions on the master plan. I don’t want one building to shade another on the south side. I want it to provide shade on the east and west to reduce summer air-conditioning load. An architect might ask, “Can’t we handle it by fins or something?” Of course, but the site can do the task for you. For example, at SERI I would not accept the site on the top of the mesa, a condition first given to us. Energy and construction costs, as well as other nonquantifiable considerations, were studied. We discussed it at length and came to a consensus.

What changes in the production phase of the design were necessitated by the energy emphasis of the SERI design?

The conceptual design went beyond schematics in many cases. Some early solutions were worked out in some detail in order to control energy usage and construction costs. We did mechanical/electrical conceptual drawings, one liners, with typical lighting schemes, central energy plant, boilers, generators, rock beds, piping, services, and so on.

That is a rarity isn’t it?

We usually insist on it being done early. You cannot estimate the job or have any cost control without it.

Do you do it on every job?

I would say so. Here is what we do. We select the major pieces of equipment and distribution systems, piping, and ducts. We prepare a description and schematic diagram of the control system for plumbing, major drain lines, services, and utilities. We size the water storage tank and locate it. We size the distribution systems; the same for the power.

The professional cost estimator on the SERI job, Richard Greene, was able to take off hundreds of feet of pipe of various sizes from our conceptual plans. We did not include every elbow of course, but we really went beyond the conceptual design. The client insisted on knowing costs at the conceptual stage in great detail.

You mentioned that the SERI building is currently about 486,000 sq ft. Let us say you have a 3000-sq-ft branch bank building. A ten-man architectural office has no mechanical engineer in house but wants to do an energy-conserving design. In the preliminary conceptual phase, would you have them call in a consultant to rough out a detailed mechanical and electrical scheme?

Yes indeed. If an engineer spends one or two days at that stage, he can set the direction and save the architect money over time. For a 300-sq-ft building, the conceptual drawing is really one-line simple. “We will feed it from here,” maybe “box in this beam.” The
architect can ask "Well, what happens if I don't want to have a drop here—I want a clean ceiling?" The engineer then supplies the alternative. If you find an engineer who knows mechanical, electrical, and plumbing, only one person is necessary for the early conference, and a lot can be accomplished in one day.

What about specifications? The architectural spec writer may not be familiar with new energy procedures or different types of machinery. When you give him your specifications does he just plug them in bodily?

Yes. We generally write our own specs. Mechanical, electrical, then these interfaces. Let's look at rock bed storage systems—they are mechanical, architectural, structural; it's all of them. Now we have the lead, in designing them. We select the size, the shape, the space, the plenums, the kinds of rocks that we want for the storage bin. We'll sketch it. We will then give the design to the structural engineer to make sure it is structurally compatible with the rest of the building. If there is a building above the bin, can it be part of the foundation? So there is close coordination required with the structural engineer, site engineer, landscape architect, and building architect—all with the mechanical engineer. All disciplines are involved.

Another case is the solar ponds that we're doing for SERI. We know the size of the pond, the depth, the kinds of liners we want, drainage, how we want the services managed. But then the landscape designer may come along and say, "Okay, I'll give you a berm here and a plant here." And I say, "Don't plant any deciduous trees where the leaves can fall on the pond." So we've got this need for a chain of expertise. And that drawing will probably be on the site plan, and I don't know yet who's going to produce it. Probably we'll make sketches and give them to the person who's drawing the site plan.

The coordination of all of the activities which take place during the drawing stages of a building has classically been the job of the architect. Is there a difference in an energy building?

No. But in an energy-conscious design, the engineer plays a larger role than before. Very often in retrofits it is the engineer who must lead. In the new breed of energy buildings designed in the past three years, the engineer and architect have worked closer together than ever before.

It sounds to me as if in the total design process—how you design and produce a building—there has not been any revolution, but some change has taken place. If a man designed a building from scratch, from beginning to end by himself, before, chances are, if it's an energy-conserving building, he now needs help. If, however, an office did buildings that were big enough to merit a mechanical engineer, structural engineer, electrical engineer before, some of the choices of who does what and when they do it have shifted to one side or another. There is a body of information that is in the building process that never received the emphasis before. How that body of information sifts into the design depends on who's doing it. It has to be there.

What has changed a great deal is our attitude towards the environmental conditions. In the past, we looked at outdoor climatic conditions as affecting the building load. They still do. In addition, we now look at climate as an energy source. How do we use the climate rather than just combat it? If the air is dry, evaporative cooling is viable. If there is a large diurnal swing in the summer nocturnal cooling is viable. We determine where the sun will strike the building of course for solar heat in the winter and shade in the summer. Climate has become a design tool to be used as part of the energy system—not just affecting the energy system, but being part of the energy system. That is a change, going back to what people recognized long before. We are on the bridge between the fossil-fuel age and the age of alternative energy sources.

What other role model changes would you like to see in the future?

Traditionally architecture was not a social force leader but followed social force and implemented it. That really has to change. Why shouldn't architecture and engineering be the leader—a social force? Who do you leave it to? Who are the leaders? There is no "they." It's "we." If we perceive that energy is a national need, an international need, then who is better qualified to state these principles and try to implement wise utilization of resources in our buildings than the design professionals who are just as broadly educated as, perhaps more so than, the bulk of our lawmakers. We also have the additional insight of what can be done. The architecture and engineering professions must really be leaders for a change. They are very, very timid about doing it. This is what I would qualify as a professional vs. a mechanic or a good technician. Professionalism to me seems to be service and leadership. It implies awareness. To make ourselves aware and to try to implement our work to further the greater good. In all cases we help ourselves by doing it.
Leaving virtually no energy stone unturned, a proposed new research facility to be constructed in Colorado is to be a showcase and study of solar energy applications.

Possibly no building in this issue—or this decade—obviates the need for energy planning as does this project. Indeed, the name of the client is enough to indicate the intended result. The Solar Energy Research Institute (SERI) permanent facilities complex, Golden, Co, was designed by the Table Mountain Architects & Engineers, a consortium comprising Caudill Rowlett Scott, Dubin-Bloome Associates, Rogers-Nagel-Langhart, and John Anderson & Associates. As indicated in the preceding article, Paul Kennon and Fred Dubin acted as design leaders for the group, and the resulting proposal represents a fine tuning of architecture and engineering dictates.

Siting considerations, always crucial, received very thoughtful scrutiny at the proposed SERI location. Originally it had been thought that the complex would sit atop the mesa on the north end of the site; but a challenge to that assumption came right at the start. Kennon and Dubin agreed that by moving the facility south, it could be nestled into a three-sided bowl where it would benefit from natural shelter from north winds and maximum sun on the south exposure. The top of the mesa will be the site of wind generators and field test areas. Uppermost in the progression down the “sun bowl” will be the initial Main Institute building complex; additional laboratories and offices are to be added downhill to the south. Below that are, respectively, the initial phase visitor and energy centers, initial parking areas and warehouse, and initial solar ponds to be surrounded by future parking.

**Beginnings**

Among the many input parameters for the project, several affected the overall plan organization and the massing in a major way. The client stressed the imperative interaction between the scientific and the engineering disciplines in the SERI operation, resulting in certain adjacencies in plan. In addition to the decision to pull the facility into the south-facing bowl, the designers also desired to reduce its apparent scale, to lessen its impact on nearby residential and military areas.

The architects proposed a grid concept to form a matrix into which modular units of space could be plugged for maximum planning and future expansion flexibility. One result of combining these elements is a fairly extensive horizontal circulation system, as readily seen in the plans. These areas, however, do double duty. In both the east-west and the north-south directions, these spines offer the opportunity for the building to respond to the three-way slope of the site. At each north-south corridor/support function core, the overall mass pitches down toward the center.

Broader east-west circulation spaces add still another facet to the parti, while still allowing the building to step downhill to the south. They are also defined as “solar courts” and, as such, are centerpiece elements in the design concept. Insolation entering the courts will be stored by various passive collection systems for reradiation. A large amount of the solar court roof area will comprise movable panels which will permit the exclusion of sunlight when desired, as well as allowing either retention or dissipation of inside heat as required. The precise nature of these panels is still undergoing study and refinement. Additional solar energy may be harnessed by water tanks mounted behind south-facing skylights, and by active collectors. Both features are located on some of the flat roof sections of the complex, in addition to the large solar array planned for the area between the visitor center and the main institute building.

**There’s more**

Having provided for nestling the SERI complex into the contours on north, east, and west sides, for including the solar courts, and the active and passive collection methods, the design projects some added measures. The
active systems (some initial phase, others later) take several forms. Photovoltaic collectors, for instance, are projected to contribute 240 kW to the building electrical supply, with an additional 240 kW developed by wind power. The focusing solar collectors—40,000 sq ft of them—will be used in conjunction with four Rankine engines, producing a total of 400 kW. Also proposed are two bio-mass boilers which, using wood chips—available from the forest service—for fuel to turn turbine generators, promise 2 MW.

Among other measures incorporated in the scheme are the use of natural ventilation when and where possible, and of combination duct/light reflector fixtures to project natural light into interior spaces. Heat will also be reclaimed from building processes and equipment.

Solar ponds along the south end of the site will hold a saline solution to thwart convection currents which would normally occur, carrying heat to the surface to escape. A layer of fresh water, because it is lighter, rides atop the brine, acting as insulation. A black pool liner, an absorber, seals the bottom. The hot solution passes through a heat exchanger, actuating an absorption chiller to improve a heat pump's winter performance.

Not all of the measures at SERI have been covered here. Such elements as rock-bed storage, ice storage, evaporative cooling, gray water systems, and central computerized energy management are, like many of the features briefly touched on, subjects worthy of a complete discourse individually. What is important is that the SERI design team has pushed the state of the energy art to its current limits for the initial phase, with provisions for foreseeable and even speculative future applications.

The expression

Given the proposed matrix, the plan should adapt well to future demands. Short of abandoning this orthogonal arrangement, it is hard to see how any other system could respond better to the site, since the modular units and the vertical stepping seem to handle the challenge well. If there are any uncomfortable confrontations between grid and contour, they can, with care, be resolved in the final refinement process. While the canted ends of some of the building elements may seem to hang out there in a somewhat fashionable flourish, it should be noted that future additions will attach to most of them. All in all, the experience of the building in its site, the drama of vertical and horizontal spaces, and the natural draw that bisects the complex diagonally should make the facility exciting, dramatic, and memorable. We'll be anxious to see for ourselves, somewhere around 1984. [Jim Murphy]
Data continued

the south edge of mesa will be the actual building site.
Program: office and laboratory space and support functions, including conference center, cafeteria, administrative offices, etc., for a total of 915 persons. Total area (net) is 242,575 sq ft. Structural system: concrete systems being investigated.

Mechanical system: a combination of elements including bio-mass boilers, purchased power (20 percent of normal building requirements), wind generators, solar-powered Rankine engine generators, waste-heat recovery, solar ponds, and future photovoltaic solar cell arrays. No natural gas or oil will be needed.


Costs: budget, $65 million.
Photography: Andrew Kramer.

Legend
1 Main lobby
2 Information center
3 Solar court
4 Exterior garden
5 Interior garden
6 Cafeteria
7 Conference center
8 Bio/chemical conversion
9 Support shops
10 Research division offices
11 Photovoltaics
12 Administrative/technical services
13 Analysis and assessment
14 Technology commercialization
15 Photovoltaics program
16 Academic/international program
17 Energy resource assessment
18 Testing and measurement
19 Thermal conversion
20 Interstitial space
21 Exterior terrace
22 Vendor room
23 Remote job entry
24 Storage
25 Service room
26 Conference room

Progressive Architecture 480
129
Refitting for conservation

Tomorrow’s energy from yesterday

Don Klabin

Through a number of case studies, the author shows that the conservation benefits of reuse and continued use of existing buildings may be much greater than expected.

The Ryerss Mansion ("Burholme"), c. 1850, Philadelphia, Pa, recently restored by Francis G. Vitetta Associates, Philadelphia. Restored as museum/public library, the house features attic insulation, polycarbonate storm windows, heat pump/HVAC system, reinstallation of original shutters inside and out, blinds and shades, more localized light switching, fluorescent fixtures, relocation of attic work areas to basement.

Consider the following: in 1979 more than $40 billion was spent to renovate existing buildings and within the next several years this reuse activity will account for close to one-half of all building activity. More than 80 percent of the buildings that will be in use 30 years from now are already in use today. The importance of reusing old buildings is that they are repositories of energy. According to a 1977 study of New York City high-rise office buildings done by Syska & Hennessy with Tishman Research Corporation, those buildings built before 1900 averaged 95,000 Btu of energy per sq ft per year for all operating utilities over a five-year period. The best of them averaged 83,000. By comparison, offices built between 1941 and 1962 average 126,000 Btu per sq ft per year, and those from 1962-1970 averaged 115,000 Btu per sq ft per year. Other energy studies have shown that early 19th-Century buildings are even more efficient. Significantly, the sharpest declines in energy efficiency came with the development of central heating and air conditioning. The "architecture of the well-tempered environment" as Reyner Banham refers to it, depends entirely on mechanical forces to provide heating and cooling for comfort. It is an architecture that uses technology in the most inefficient way to overcome the energy deficiencies of glazing and overilluminination.

For a comprehensive analysis of the energy-saving potential of reusing existing structures vs. building anew, the computer models contained in the Federal Advisory Council on Historic Preservation's study entitled Assessing the Energy Conservation Benefits of Historic Preservation should be reviewed carefully (see p. 25).

Incentives for investment and imagination

Often much of the discussion among architects, engineers, and building owners about energy conservation remains energy
Typical ASHRAE
Energy Audit

The major sections and items within each section of a typical ASHRAE-based code are:

Design conditions
Outdoor design temperature.
Indoor design temperature.
Humidity.
Ventilation.

Exterior envelope
Maximum U-values of components (walls, roof/ceilings, floors, doors, windows).
Maximum overall U-values of walls, roof/ceiling assemblies, floors.
Maximum overall thermal transmittance value (OTTV) for exterior walls and the roof/ceiling assembly.
Insulation.
Vapor barriers.
Air infiltration at windows and doors.

Mechanical systems—HVAC
Sizing techniques.
Ventilation shut-off or volume reduction.
Minimum combustion efficiency.
Minimum coefficient of performance (for heating and cooling).
Air transport factor.
Controls (temperature, humidity, zoning).
Duct construction and insulation.
Use of economizer cycle.
Balancing.
Piping insulation.
Vapor barriers.

Electrical power
Power factor.
Voltage drop.
Lighting switching.
Metering.
Power consumption (motors).

Lighting
Illumination levels.
Lighting power budget.

Service water heating
Temperatures.
Flow rates.
Standby losses.

conservation because of perceived unsatisfactory payback figures. In today's highly inflationary economy, however, last year's "unfeasible" retrofit with a calculated payback of five years, for example, may be this year's "attractive" retrofit with a payback of three years. Consider, for example, that in the past year the price of heating oil in Massachusetts has doubled, inflation has exceeded 13 percent, the cost of insulation has increased 40 percent, etc. (this provides more than a 2:1 leverage in favor of insulation, by the way). These increases are far different from the inflation and discounting factors used by energy consultants in their 1979 calculations. It is clear, however, that in order to reverse the present trend to limited capital investment in retrofits to battle steeply rising energy costs in commercial buildings, we need some additional incentives.

Buildings
On the side of the designer, the government offered in 1979, and again this year, Appropriate Technology (AT) grants to promote the development of building technologies that meet local needs using available skills and resources. In New England alone, in 1979, 74 projects were funded with grants totaling $796,000; the average grant award was $11,000. It would be nice to think that architectural and engineering societies might consider increasing this seed money by returning to selected members a portion of the dues collected.

On the side of the building owner, financial consultants in the public and private sectors disagree as to whether the incentive for the building owner should be "solar bank" subsidies in the form of low-cost loans, for example, or energy investment tax credits, or exemptions from property and sales taxes. The issue remains, however, that we need something to prime the pump of energy conservation in the commercial building sector.

The government and even some local banks have been fostering conservation in residences using these incentives, while at the same time virtually neglecting conservation in commercial buildings by a conspicuous absence of offerings. Yet, technically speaking, many of the actual construction improvements for energy conservation in the commercial sector are often similar in nature, if not scope, to those in the residential sector, e.g., weatherization, ventilation reduction, etc.

The Finnish government's recent strategy in the area of housing design may be an appropriate model for our government's strategy for national energy conservation.

The Finnish solution was to create a tax benefit for the investor in housing below a stated size (100 sq m) and a tax penalty if above the upper bound of desired sizes (120 sq m). This scheme has particular relevance vis-à-vis the upcoming Energy Performance Standards. Regardless of the difficulty designers of federally financed housing may encounter at first in attempting to meet the BEPS Btu budget for the building, the provision of a financial carrot at the end of the stickty design process, if the budget is not only met but undershot by a certain percentage, would certainly entice the investment and development communities alike and is worthy of further consideration. What may prove to be the decisive factor, of course, will be the ease, or lack thereof, of achieving the stated budget in the first place, and only experience in simulating a number of designs will determine the practicality of Btu budget values.

The key to success in this endeavor, as with so many others, will be to entice the entrepreneurial spirit and Yankee ingenuity in all of us. This may mean using a diversified economic tool, one whose incentives might vary as a function of size of investment. Business owners, however small or large, need to know that their efforts at energy conservation are more significant than their electric meters and payback calculations may indicate, since they are all part of a larger plan.

Cities
It has been the experience of many DOE or other government administrators to observe less-than-complete success with energy conservation programs when they have not been keyed to a well-defined, political/economic/geographical unit, such as a municipality or town. The lack of cohesion results from inherent duplication of effort within groups, or gaps between groups, unconsciously working in parallel. The newest effort to unified conservation efforts beyond the scale of individual buildings is the selection of 17 cities in the United States as sites for a Comprehensive City Energy Management Program (CCEMP). This program, through its board of citizen advisors, will attempt to achieve a cohesive, multifaceted plan for each city tailored to the local set of conditions.

The success of the communities of Davis, Ca, and Portland, Or, in significantly reducing energy use on a community-wide scale was the stimulus for this program. Needless to say, the service of architects on these (and other) citizen advisory boards would be a valuable way to maintain a high professional profile and to assure that the newly developed energy conservation practices are consonant with other design standards and regulations.

Since the onset of the energy crisis in 1973, architects, engineers, and building owners have been working diligently to achieve lower costs and reduced energy consumption. The following case studies illustrate this point.
Refitting for conservation

Energy conservation in existing buildings

Case Study No. 1: Monadnock Building, Chicago.
The consideration for reducing energy use in the restoration and rehabilitation of existing—and especially landmark—structures is parallel to that for new structures and, in commercial structures, equally critical. In certain cases the fact that a given landmark structure may be less efficient in terms of contemporary standards of space utilization or other aspects makes energy conservation even more critical.

SOM's 1979 studies for the complete restoration and commercial redevelopment of the famous Monadnock Building (designed by Burnham & Root and constructed, during 1889-1893) was undertaken for Broadacre Management. This owner's representative was concerned with both architectural preservation and viable commercial redevelopment. The following components and alternatives were analyzed: double vs. single glazing, new vs. existing sash, insulation vs. uninsulated existing, masonry walls and roof, operable vs. fixed sash, central vs. decentralized mechanical system, reduction in lighting levels, and electrical vs. natural gas service as the fuel source for environmental control.

The principal finding of the SOM study was that the specific proportions, construction, fenestration, site, and climate of an existing building render results that are difficult to generalize. Second, especially in commercial structures, the detailed economics of development, of construction type and details of existing building, and the fuel escalation projections substantially affect the period over which cost benefits will be realized on energy-conserving first costs. Nonetheless, for the Monadnock Building, with 411,000 gross sq ft, 6:1 aspect ratio (400 ft north-south, 65 ft east-west), 16-17 stories in height with 35 percent glazing and 65 percent heavy masonry, it was found that double glazing could be financed with energy savings. It was also found that wall insulation could be justified if the interior finish of the exterior wall were to be replaced for other reasons, such as deterioration. A decentralized mechanical system might not only ease installation of new systems in an old building, but could permit savings in conversion time, and therefore energy use, if the owner and tenants could avail themselves of them. New sash or sealing of the existing sash to reduce crack section is essential to reduce infiltration, and could also show significant benefits. The existing character of the Monadnock Building also provided some benefits: the heavy masonry is clearly an asset in the Chicago climate because of the time-lag of its heat transfer, and the design of the bay windows shaped the interior space so that the layout of lighting fixtures could be arranged to provide adequate light levels on work surfaces but reduce general levels elsewhere.

A constraint provided by the existing building was the limited freedom in selecting the new windows. Reflective glass was considered and eliminated since it would not be required to attain ASHRAE 90-75 standards and would be damaging to the architectural character of the existing windows, which are recessed in the masonry.

The rehabilitation/restoration work in the building, which is currently occupied, is to be phased as the new tenant lease agreements are formulated. The elements slated for complete restoration are the exterior walls, cast-iron storefronts, first-floor lobby, and the famous cast-iron stairs. Tenant standards proposed for the refitting of the building were generated using contemporary renditions of the original building scale, including original door heights and proportions.

It is worthwhile to note that the SOM office proceeds through a predesign energy study on all renovations, whether a small library or a large office building. Their energy studies include in-house computer simulations using the TRACE and ASHRAE (APEC) programs.

Case Study No. 2: Baltimore City Hall, Md.
The Baltimore City Hall (P/A, Nov. 1977, p. 76) underwent a program of restoration and renovation during 1974-76 by Architectural Heritage-Baltimore (Thomas Amsler, Charles Hagenah, and Kenneth MacLean) in joint venture with Meyers & D'Aleo Architects. Their initial feasibility study was soundingly supported by public referendum for a bond issue to upgrade the 1875 structure. With its 2-4-ft-thick, marble-clad, exterior masonry walls, interior brick bearing walls, and vaulted brick coffers, the Baltimore City Hall is a premier example of a high-mass building and, thus, the time lag of its thermal response is of great significance.

Data compiled from similar heavy masonry structures at Harvard University indicate that the technique of night setback of thermostats is successful and appropriate for low-mass structures but not for high-mass structures where their storage of solar energy gained during daylight hours is reradiated at high levels during the evening hours. Lightweight buildings with their near-instantaneous heat gain and heat loss can be set back to 55 F, for example, and actually reduce consumption whereas in the high-mass building the structure will be heating itself above this level and therefore the automatic thermostat controls cannot be justified.

This lesson in thermal logic underscores the fact that different design strategies are needed for different buildings and that rules of thumb or other shortcuts in thinking should be applied judiciously.

Existing wood shutters located on the interior at the edge of the deep window recesses were stripped and refinished during the building renovation. After having been rendered inoperable by being painted shut over the years, the operable shutters are now of
valuable assistance in controlling indoor temperatures due to direct solar gain.

Other significant energy conservation measures were gained from the addition of insulation to the deep, uninsulated attic at the top of the Mansard roof, and through the use of heat recovery between fan-coil units at the perimeter piped separately from units in the interior zone, connected to a cascading chiller system (designed by R.G. Vanderweil Engineers of Boston).

Case Study No. 3: Mechanics Hall, Worcester, Ma.

A historic concert hall (P/A, Nov. 1979, p. 84) constructed in 1857 was restored and expanded in 1978 by Anderson Notter Finegold in response to strong community support to upgrade the building by meeting current safety and comfort standards while preserving the excellent acoustics of the hall. In order to provide adequate life safety for the audience of 1500 seated on the third floor of a wooden structure, a new lobby was constructed at the rear of the existing building.

This “solar greenhouse” is now a major entrance of equal importance to the historic front entrance, because of the location of the present parking areas and changes to the downtown pedestrian and vehicular traffic patterns over time. The angular addition, which follows the property line, serves three primary functions: as entrance, additional egress (stairs and elevator access for the handicapped), and lobby for overflow crowds. In addition, because of the architect’s use of glass full height for the exterior wall of the lobby, the space is used for meetings and exhibitions. The glass allows the lobby to advertise its functions at night, and during the day to conserve space-heating energy for the restored building by acting as a direct gain, passive solar collector. While there is a mechanical system to serve the lobby, it is not used at all on sunny days, and studies are now being made to consider recirculating the passively heated lobby air to other areas of the building requiring heat.

Anderson Notter Finegold’s joint interest in energy conservation and historic preservation has led them to work currently with a community group on a federally funded demonstration project to explore the passive solar and energy conservation potential in rehabilitating existing urban multifamily row housing. Still in design, a portion of the exterior masonry walls will be covered with translucent insulated sandwich panels and will also incorporate active solar rooftop collectors for domestic hot water, reflective mirror-finish aluminum blinds, operable insulated shades for additional nighttime conservation, and new double- or triple-glazed sash. Although this project involves strictly residential uses, there are direct and important ramifications also for multiuse or strictly commercial functions in existing masonry buildings which are common to many other downtown “Main Street America” streets.
Refitting for conservation

At Haverford Jr. High School, Haverford, Pa (below), fuel consumption is 30 percent lower after replacing 600 deteriorating windows and upgrading heating and environmental control systems.

Case Study No. 4: One firm’s experience.

Despite successes in promoting energy conservation design services, Vitetta Associates, an AE firm with offices in New Jersey, Pennsylvania, and Massachusetts, has discovered that most clients, whether public or private, develop attitudinal obstacles in evaluating capital expenditures for energy conservation purposes alone, even when the calculated paybacks are within a feasible range. These obstacles, however, are overcome when other architectural factors come into play, such as considerations of improved space utilization or expansion, change of use or irrepairable construction (the most notable example of the latter being windows begging for replacement because of old age, poor maintenance, or faulty installation).

At Haverford Jr. High School, Haverford, Pa, after upgrading the school’s aging heating and environmental control systems and replacing more than 600 deteriorating wood windows, fuel consumption is said to be at least 30 percent below that of prerenovation levels. In refurbishing the 50-year-old building from roof to boiler room, the architects revamped the entire heating plant, replaced duct work and piping, improved ventilation in shop areas, and installed sophisticated zone heat controls and thermostats throughout the 116-room facility. Renovations to the heating plant included the installation of three new oil burners and replacement of the fire box in each of the three boilers. The initial phase of the renovation was completed at a cost well below the $3 million budgeted for the work and included the purchase and installation of double-glazed replacement windows. Besides increasing energy efficiency, the architects also updated the school’s lighting system, relocated and expanded the library and industrial arts facilities, and designed an elevator to provide access for handicapped at five levels.

In upgrading the lighting system the architects called for more than 1200 new recessed fluorescent light units for classrooms and corridors and an additional 20 exterior floodlights. To avoid major disruptions in the educational program, more than 100 workmen were assigned to the fast-tracked job during the summer recess. As a result, at least 95 percent of the work was completed in time for the school reopening in September.

Replacing a 50-year-old roof on a 6-story light manufacturing facility for RCA in Camden, NJ, meant a costly investment. Since the company would have to remove and reset 34 air-cooled compressor/condensing units that were scattered across the roof, it sought a less expensive alternate means of providing comfortable cooling for the 560,000-sq-ft plant. In the redesign study, the architects learned that installing a new central-station direct-expansion screw-compressor system would cost about the same as resetting the existing condensing units. On the basis of this study, the company removed the rooftop units and purchased and installed a 300-ton direct-expansion screw-compressor evaporative-condenser system. The equipment has reduced power, operating, and maintenance costs by approximately $45,000 per year. Installed in the tower section of the building, the package uses all existing air handlers, ductwork controls, and refrigerant piping up to the fifth floor. The system supplies the 25 existing air handlers which in turn distribute a total connected cooling load of 208 tons. Suction and liquid piping, mounted on the ceiling of the fifth floor, can be tied into additional air handlers in the building by running branch piping from valves designed for that purpose. Most of the mechanical problems experienced with the old units have been eliminated. Preliminary data indicate that
power use has dropped 44 percent, resulting in an annual saving of approximately $15,000 in electricity. The equipment has also reduced demand charges. Maintenance has been reduced accordingly and lower maintenance material costs are expected to cover the labor costs.

Vitetta Associates has developed a computerized program for the purpose of evaluating existing building facilities for recycling purposes as well as for long-term maintenance schedules. The need to optimize the utilization of existing equipment in terms of brick and mortar has required that architects become increasingly involved in the evaluative process to determine the optimum use of existing facilities as well as long-term need. In response to the specific needs of the New Jersey Department of Education, Vitetta Associates has evolved a computerized facility survey program based on a dictionary of items found in the mechanical, electrical, and structural aspects of facilities. The computerized program is based on a work item code and unit cost (dollar) take off, which are documented on inspection reports done by relatively untrained instructors. This utilizes basic appraisal techniques rather than high-level technical skills. A critical portion of the computer program includes an evaluation of insulating values of all components, life-cycle costing for improvements to these components or their replacement, and the impact of these long-term improvements on the operating cost. The system involves a detailed, item by item cost appraisal for all remedial work, as well as a methodology for determination of replacement, modification, or recycling decisions.

The same program surveys and evaluation techniques are being applied in a crash program being undertaken for the Philadelphia Naval Shipyard in which 248 existing facilities are being evaluated and recommendations are being made for remedial measures. A large portion of these remedial efforts is being directed at energy conservation including window replacement, additional insulation, and other methods of weather protection. The life-cycle costs of these improvements is being analyzed. A proposed budget and maintenance program will be evolved from it.

Case Study No. 5: The Gillette Company, worldwide.

Energy conservation measures of the Paper Mate Pen Company involved some of its 50 plants in 26 countries. A corporate energy strategy was initiated in 1973, and the fruits of the company’s labors have become notable: a 38 percent saving worldwide, with savings at one facility (500,000 sq ft) as high as 44 percent.

Despite the use of different manufacturing equipment and different building envelopes, and given the widely differing climates from Spain to Minnesota, the energy-conservation strategies employed, which have been tailored to each particular set of circumstances, have been extremely successful. The quality of corridor and office lighting fixtures in the 300,000-sq-ft headquarters has been reduced with no loss in work area lighting intensity; high pressure sodium lamps have replaced fluorescent fixtures in manufacturing plants; heat recovery from compressors has provided space heating for warehouses; water consumption has been carefully tracked with recirculation savings equal to 417 million gallons per year (the annual water usage of 10,000 homes). All this, and the Paper Mate Pen and Safety Razor of 1980 work as well as the 1973 vintages.

To put the energy conservation in even a truer focus, Gillette’s annual expenditure for energy is now only approximately one percent—$20 million to generate $2 billion in sales. Without their energy conservation program, an additional $10 million per year (!) would be spent, with a calamitous effect on earnings per share.

Conclusion

As stated by Dr. Edward Teller, Nobel Prize-winning physicist, in his newest book Energy from Heaven and Earth: “No single prescription exists for a solution to the energy problem. Energy conservation is not enough. Petroleum is not enough. Coal is not enough. Nuclear energy is not enough. Solar energy and geothermal energy are not enough. New ideas and developments will not be enough by themselves. Only the proper combination of all of these will suffice.”

His clarion call for a pluralistic approach, one that will take advantage of indigenous resources as well as foster new synergistic technological developments, should be music to the ears of creative building designers. We are standing now at the brink of a new era which, undoubtedly, will shape new roles and opportunities for professionals. As in previous eras, architects should not hesitate to pick up the reins of leadership.

For the benefit of those architects who in the past, at the request of their clients, have laid energy pigs at the altar of first cost, hark: a new world is evolving wherein the heretofore sacred first costs are giving way to life-cycle costs. A significant moving (or inertial) force is clearly the banking community. However, that community cannot intuit what needs to be done. It is up to architects to persuade. We can no longer afford to bemoan our fate like some chorus in a Greek tragedy. The long range choice is to sharpen our skills on the cutting edge of technology or to become fossilized by the Fossil Fuel Age of Design—a mere 200-year flicker of the eye of history.

Acknowledgments

The author wishes to thank the following for their valuable assistance in providing information for this article: Stephanie Gibson, Northeast Solar Energy Center (NESEC), Cambridge, MA; Robert A. Hutchins, Skidmore, Owings & Merrill, Chicago, IL; Tyrone Pike and Stephen Weinstein, The Ehrenkrantz Group, P.C., New York, NY; John Whitehead, Francis G. Vitetta Associates, Westfield, NJ; Gary Vanderweil, R.G. Vanderweil Engineers, Inc., Boston, MA; Cameron Beers, Gillette Company, Boston, MA; Ansley Hagenah McLean Architects Inc., Boston; Architectural Heritage-Baltimore Inc.; Meyers & D’Alco Architects Inc., Baltimore, MD; John Ingwersen and James Alexander, Anderson Notter Finegold, Inc., Boston, MA; Bruce Keller and Douglas Gardner, Kalwall Corp., Manchester, NH; Richard Taylor, Interiors.

This chart shows the relative contribution of infiltration sources in a typical residence. (From Electrical World, Nov. 1, 1978.)
Levels of conserving

An energy-efficient library incorporating part of an old garage shows there are more avenues to conserving than might be considered.

When considering the many avenues open for energy conservation through building design, it is now increasingly recognized that the way is no longer limited simply to the prospect of reducing fuel consumption. At a broader scale, we now realize that conservation can also mean reusing, or making better use of, resources that already exist. In this respect, an existing building or even an entire city can, regardless of their age, be seen as valuable resources that already have considerable amounts of energy invested in them in terms of such things as materials, original cost of labor for construction, and even years of past maintenance. We now realize that all of this need not necessarily be thrown away, and it is the acceptance of just such an idea that has a great deal to do with the new 67,000-sq-ft library in New Rochelle, NY.

From its inception, the library scheme was seen not only as an opportunity for reusing something that already existed, but also as the focus for revitalization of the town's decaying urban center, which was itself considered a valuable resource that could be lost if something were not done about it fairly quickly.

The story goes back to the 1970s when, over a period of seven years, New Rochelle lost three of its major department stores. Other nearby communities had outstripped the town in terms of new retail development and had attracted the more moneyed buyers, leaving New Rochelle with a population unable to support the retailers in the manner to which they had become accustomed. In 1975, however, an AIA RUDAT visited the city, and a year after its recommendations were made, the community started a new $20-million capital improvement plan and revitalization effort. With funds coming from federal, state, and local sources, this comprehensive scheme was able to encompass a façade improvement program (40 storefronts have been refurbished to date), and an extensive pedestrian walkway system incorporating two new urban plazas. At the center of the plan, destined to become the focal point for a city that had previously had none, was to be the new library/cultural center complex facing one of the new plazas.

Pomeroy, Lebdska Associates, who were architects for the library with associated architect Fred W. Lyon, were also responsible for the town's new master plan. As a consequence, they were able from the beginning to integrate the building and the town into a more successful union than is perhaps usually the case. In fact, as Lee Harris Pomeroy explains it, the plan of the library was actually generated from the plan of the town, and this alone accounts to a considerable extent for the building's formal success.

The library

The library is divided into two sectors, which are basically the public and private zones of the building. The 4000-sq-ft public zone of the main lobby could be seen as oversized in relation to the rest of the building were it not for the fact that this area serves not only as a lounge, but also as an exhibition space, a coffee shop, and a lobby for the auditorium.

With the plaza in front (which can be used...
for pedestrian walkway, the auditorium, and its increased library capabilities, the facility has unquestionably taken on the role as a focal point of the city as was hoped. But in addition to this, and because of it, the library and its main plaza are also beginning to have a direct and positive effect on the buildings nearby. A number of exteriors have already been refurbished, and some store owners who were opposed to the plaza and walkway system in the beginning have now opened new entrances facing those amenities.

Not only has the library encouraged reappraisal of that which is around it, however, but it also has become its own best advertisement for encouraging the reuse of what already exists. The main library section of the building is housed in a recycled automobile garage, which makes up about 60 percent of the entire complex. From this older structure, the stacks are "hung" over the lobby (to free it of columns) in an arrangement that defines a three-story skylit gallery. The reading rooms, browsing areas, circulation desks, and offices are in the recycled building, where the low ceiling heights have been offset by introducing a series of new double-height spaces, by exposing the coffered ceiling, and by creating a wide, skylit central stairway.

The building, however, is not only an admirable example of intelligent conservation policy through its encouragement of revitalization around it and through its own use of recycled materials. In the most conventional understanding of the meaning of energy conservation through building design, the library is a model of good sense. Inextricably woven into its design is a major energy-conservation program. This includes a life-cycle program incorporating low-level task lighting, automatic switching, natural ventilation through operable windows, 100 percent fresh air ventilation through the air-handling system, double-glazed insulated windows, and the use of the plaza fountain as a heat sink. In addition, the exterior walls are highly thermally efficient; their panelized masonry skin is composed of white glazed porcelain tiles pressed into a 6-in.-deep factory-cast concrete system that also includes two inches of insulation, plus gypsum board.

A new space frame will soon begin construction at the south side of the building. This will support a 6500-sq-ft system of flat-plate solar collectors, for which the underground storage tanks are already in place, that will heat and provide hot water for the building. In addition, this new extension of the library will also enclose a new neighborhood market to be installed under the space frame. When all is completed, the New Rochelle facility will function at all levels of conservation: as a progenitor of the revitalization of the urban fabric, as an example of the intelligent reuse of existing materials, and as an energy conserver in the conventional sense.

[David Morton]
He wanted to conserve energy. We created an efficient thermal break.
He wanted to keep the elements out. We added a special system of weeps and baffling.

He wanted to control costs. So we put it all together for a surprisingly economical price.

The result is Thermizer—a remarkable new thermally improved framing system that permits flush glazing from either interior or exterior.

In certified tests for air infiltration and water penetration, Thermizer performed substantially better than industry standards require. In thermal tests, the warmest part of the glass was always colder than the coldest part of the metal. And Thermizer is versatile enough for both single- and multi-story building applications.
But good as these features are, what Thermizer does for the contractor makes it even better: Horizontal members run in front of vertical mullions, so the number of horizontal joints is substantially reduced. Dry glazing reduces erection time even further. And simple clips replace troublesome screw-and-clip connectors.

Thermizer eliminates the need for special expansion members too, since allowances are built into this forgiving system. And it can be ordered in stock lengths or custom-fabricated for special requirements.

Why not find out more about this and other TUBELITE® products by calling David Berg, one National Sales Manager, today at (314) 878-6952. He'll be glad to supply you with test results and additional data on Thermizer. The exciting high-performance system that's as easy on a contractor's deadline as it is on an architect's eyes.

CONSOLIDATED ALUMINUM
11960 Westline Industrial Drive
Pella Triple Glass Insulation System*

U Value: .31
R value: 3.23
Shading coefficient: .82
Now there’s an economical answer to severe weather conditions...

Pella’s new
Triple Glass Insulation System.

Here’s Pella’s latest energy-saving exclusive... the Triple Glass Insulation System. A single fixed pane of glass outside, a removable panel with double insulating glass inside, and a full ⁹/₁₆" of insulating air space between. This combination provides superior energy efficiency, and the price is very reasonable.

Other Pella package options for energy-economy are described below. Pella offers more energy-conserving options than any other major wood window manufacturer. All these options plus many other effective features mean a Pella package offers you the flexibility necessary to design efficient buildings for a wide variety of climates, sites and functions.

The Double Glass Insulation System outperforms welded insulating glass, yet costs less per window. (U value, .41; R value, 2.43; shading coefficient, .88)*

Solarcool® Bronze Glass in the removable interior panel can cut cooling costs. (U value, .41; R value, 2.43; shading coefficient, .59)*

Slimshade®, set between the panels of the Double Glass Insulation System, cuts heat loss and solar heat gain. (U value, .39; R value, 2.56; shading coefficient, .34)*

Solarcool and Slimshade can be combined for energy efficiency plus glare reduction with Slimshade open. (U value, .39; R value, 2.56)*

Triple Insulating Glass, ideal for large fixed units and sliding glass doors, provides outstanding energy conservation. (U value, .35; R value, 2.86; shading coefficient, .74)**

*Pella Clad Casement 2048 was used for testing. U and R values are given for the total unit. Slimshade data is for white slats tilted 30-45°. Information based on one or more of the following: ASHRAE Handbook of Fundamentals 1977; testing by Yellott Solar Energy Laboratory; testing by Rolscreen Company; testing by Dallas Laboratories; information supplied by P.P.G. U Value data based on: Outside temperature — 0°F; inside temperature — 70°F; outside wind velocity — 15 MPH.

**Data based on Pella Large Fixed Clad Casement 6068

For more detailed information, use this coupon to send for your free copy of our 28-page, full color catalog on Pella Clad Windows & Sliding Glass Doors. Call Sweet’s BUYLINE number or see us in Sweet’s General Building File. Or look in the Yellow Pages under "windows", for the phone number of your Pella Distributor.

Name

Firm

Address

City State Zip

Telephone

Mail to: Pella Windows & Doors, Dept. T3500, 100 Main St., Pella, Iowa 50219. Also available throughout Canada. This coupon answered within 24 hours.

Circle No. 395, on Reader Service Card
Elevonic 101...
A step into the future that saves time, energy and money.

Revolutionary in concept and designed using the latest elevonics* technology to provide the most economical operation, the new Otis Elevonic 101 microcomputer elevator control system vastly improves passenger travel time, reduces installation and adjustment time, conserves substantial quantities of energy and improves reliability.

New Generation Microcomputer
Otis HR gearless elevator systems, equipped with Elevonic 101 controls, can, for the first time, computer-control every aspect of elevator operation — velocity, position, direction, passenger travel and waiting time, door operation, car assignment in a group, energy usage and system diagnostics. Truly a new generation of elevator control — unmatched by any other system available.

Demand-Response Operation
The Elevonic 101 is unique among elevator control systems. It is the only system that can instantly and precisely react to actual traffic demands all of the time.

It’s software based, so it can be easily reprogrammed without replacing expensive hardware if a building’s needs change. The result is unequaled performance and passenger convenience and comfort coupled with outstanding operating efficiency.

Average passenger waiting time can be as much as one third less than our best previous equipment.

Energy-Saving SCR Drive
Silicon controlled rectifier (SCR) motor drives use about 30 percent less energy than motor generator sets. They use no power at all when the elevators are at rest. That means improved energy management and lower building operating costs.

Precise Floor Landing Stops
Elevonic 101 eliminates the large electromechanical position selector. A solid state transducer system measures car hoistway position to within 1/32” and provides continuous, dependable leveling accuracy. And, it automatically compensates for building compression.

Reduced Installation Time
The exclusive software-based controls are simulated, tested and adjusted prior to delivery. Total installation and adjustment time can be reduced by as much as 20 percent. And that’s not all.

Multiplexing — transmitting several signals simultaneously over a single wire — has reduced traveling cables from an average of three cables, each carrying about 70 wires, to a single cable with about 50 wires, further reducing installation time.

These are only a few of the major improvements that elevonics has enabled us to engineer into our new Otis HR gearless equipment. Others include reduced machine room space, smoother, faster door operation, reduced elevator downtime and additional ways to maximize energy efficiency.

We’ve given you just part of the Elevonic 101 story. For the full story on the Elevonic 101 control system, call your local Otis office to see how it can save you time, energy and money on your next project.

*Elevonics is the science of moving people and products through the use of advanced elevator and microelectronic technology.
Another breakthrough in energy savings and comfort conditioning.

Here's the world's first residential central air conditioning system to offer two-speed operation for increased energy efficiency.

**Take it from Dave Lennox...**

This newest of the "Landmark™" series, HS11, features the patented Lennox two-speed compressor that allows the unit to more closely match the cooling load. Conventional units always run at full speed when cooling is needed—even light amounts of cooling. The result: they use more energy than necessary as much as 80% of the time.

The Lennox HS11 eliminates these "overkill" periods by switching to low speed during less demanding conditions. When the compressor shifts from 3500 rpm to 1750 rpm, the unit consumes approximately one-half the electrical energy used at high speed. This two-speed operation not only provides more efficient energy utilization, but extends the life of the unit's compressor.

Available in 4 and 5 ton sizes, the HS11 offers other special features:

- Extra large wrap-around condenser coil for maximum cooling capacity
- All copper tubing
- Factory-installed, solid-state controls
- Super quiet operation
- Rooftop or ground level mounting

The HS11 offers unique selling benefits for quality home builders and light commercial customers.

For complete information on the HS11 two-speed air conditioning system and optional equipment, write Lennox Industries Inc., P.O. Box 400450, Dept.096, Dallas, TX 75240.

---

Circle No. 375, on Reader Service Card
The two-legged thermostat

Jay L. McGrew

The human mind and body have a tremendous potential to compensate for the errors in our buildings. Carefully instrumented research throughout the country has produced a striking conclusion.

Each animal is specialized to function efficiently under its own set of "thermal" environments. In general, temperature is controlled by altering the rate of heat loss to match heat production, but a limited ability to alter heat production based upon temperature is exhibited in some animals. Shivering, for example, in humans, dogs, and certain other animals is an attempt to increase heat production in cases of subnormal body temperatures. Heat loss, which can be varied over broad limits in warm-blooded animals, depends upon the combined mechanisms of radiation, convection, conduction, and evaporation.

Physiological studies have shown that over long time periods the human species has a great ability to adapt to very diverse climates. Consider, for example, the extremes of the Eskimo and the Negro. The Eskimo is physically adapted to succeed in the Arctic climate. He is short and rather stocky, with short fingers and extremities. He has a great ability to develop subcutaneous fatty tissue for insulation and the gastronomical ability to digest large quantities of energy-producing fat. The Eskimo has been described by various authors as being quite comfortable while mostly bare in an igloo at 32 F.

The Negro is physically adapted to the hot, humid climate of the Equatorial regions. As contrasted to the Eskimo, the Negro is characterized by much greater height, with extended extremities which increase heat loss, and little if any fatty tissue on those extremities. The Negro has a highly developed and efficient perspiration system, permitting him to effectively cool and maintain physical activity under extremely hot conditions. Persons from other geographical origins generally fall between these two extremes in their ability to tolerate heat or cold.

Within a given human group of common geographical origin, both systematic and random variations exist in the ability of the individual to adapt to the environment. In general, the younger individual tends to have a higher metabolism rate per pound of mass and a smaller surface area. Thus the younger person, producing more heat and losing less, is comfortable in cooler environments. As the person ages, the metabolism rate decreases as the surface area increases and the individual tends to require somewhat warmer temperatures. As a general rule, females have somewhat lower metabolism rates and also higher ratios of surface area-to-heat production than men. Thus females generally tend to prefer somewhat warmer temperatures than men of the same age and origin. The metabolism rate of females decreases more rapidly with increasing age than does that of the male.

In addition to the problem of maintaining constant temperature in the hypothalamus of the brain by losing heat at a rate almost equal to the rate of production, the feet, hands, and exposed portion of the head pose special problems in maintaining physical comfort. The body uses these three areas as special variable heat exchanging in maintaining hypothalamus temperature. If the brain senses a temperature rise due to increased physical activity or other factors, the peripheral artery system in these areas is dilated somewhat and warm blood is circulated closer to the surface, thus increasing cooling. Similarly, if the hypothalamus senses temperatures below normal, constriction of the peripheral arteries occurs.

Human comfort

Since the flow of blood to these three heat exchange areas might be greatly reduced or perhaps even stopped under conditions of extreme cooling, and such an event would, if continued, result in freezing and loss of the extremities, these areas are liberally covered with temperature sensors. Thus, the individual senses a feeling of cold and discomfort if the extremities are cold even though the body core temperature is proper. Comfort then is nature's way of informing the individual about the condition of various body areas and urging some corrective action to be taken. Feet, hands, and exposed portions of the head are the primary "comfort sensing" zones.

Stratification: During cold weather, a surprisingly large vertical temperature gradient will exist in a typical room. Our measurements in various buildings show that temperature differences of 10 F to 20 F are very common. Thus with a mid-room temperature of 70 F at the thermostat, the floor might be 60 F or even cooler. Many individuals will experience serious discomfort with their feet in 60 F air even though on the average the room is at 70 F. Older individuals will generally experience
Energy conscious consumption

greater discomfort than younger people under such conditions.

Vertical temperature stratification in cold weather results primarily from the effect of windows, infiltration, and room heating. A boundary layer of cold air flows down past the window and forms a horizontal layer of cold air at the floor. Cold air from the opening of a door will cause the same effect. Heat introduced into the room creates an upward flow of warm air. Thus, stable vertical temperature stratification occurs in cold weather. Sustained vertical air mixing will transfer heat to the floor, thus reducing the temperature gradient and increasing comfort. Our experiments have shown that it is necessary to duct air close to the ceiling and exhaust it at the floor at a volumetric flow rate equivalent to 1/20 of the room volume per minute to adequately reduce the vertical temperature gradient in cold winter weather. This vertical mixing is particularly important in cases of vaulted ceilings, large glass expanses, or frequent door openings. Proper mixing permits the building to be operated somewhat cooler to maintain a comfortable temperature over the exposed skin, then that individual will generate heat and produce an excessive amount of body cooling. Excessive heat loss and discomfort will result. But the radiation heat loss can also cause discomfort. Under normal circumstances a typical individual might radiate at least 5 and 10 Btu per hour per square foot of surface exposed to the environment, and sufficient blood circulation can occur to maintain a comfortable temperature over the exposed surface. Therefore, reduced circulation occurs, for example, because of constriction of the peripheral artery system resulting from general cooling of the body, or a cold radiation absorption surface is “seen” by the exposed body surface, low surface temperature and attendant discomfort will result. The figure next page indicates the relationship between comfort and the thermal energy which must be supplied to the radiating exposed body surface, the temperature of the cool absorbing surface.

It should be remembered that a comfortable surface temperature for one individual is not necessarily comfortable for another. If, as an example, a particular individual perceives 50 F skin temperature as “comfortable,” which is reasonable, and has a blood circulation capability adequate to deliver approximately 8 Btu per hour to each square foot of exposed skin, then that individual will generally experience comfort radiating to an absorbing surface at or above 40 F. If, however, the absorbing surface drops below 40 F, the individual experiences discomfort due to cold exposed-skin temperature.

A very common example of discomfort due to radiant cooling is the individual sitting next to a window on a cold winter day. The temperature of a single pane of glass tends to be somewhere near the average of the indoor and outside temperatures under calm, sunless conditions. For example, at night with no wind, if the room air is 70 F and the outside temperature is 0 F, the glass temperature will be about 35 F. Most individuals will be quite uncomfortable while close to such a cool surface. If, on the other hand, the outside air temperature were 30 F, the glass temperature would be near 50 F, and most individuals would feel comfortable in spite of the radiative effect. The downward descending layer of cool air in such conditions leaves the bottom of the glass at about the average glass temperature and forms the cold boundary layer on the floor as described earlier. Thus, the individual might not experience discomfort because of direct radiative skin cooling, but might nonetheless experience discomfort due to cool feet. An optically opaque drape covering the window will of course greatly ameliorate the problem of discomfort due to radiative cooling. Higher metabolic rates caused by such factors as increased physical activity decrease the level of discomfort as well.

The individual and energy use

A large fraction of the energy used in buildings is consumed in order to maintain human comfort but, as we have seen, “comfort” is not based upon a fixed set of temperatures but is dependent strictly upon the heat-production and heat-loss relationship between the individual and the environment.

In a study of energy use in a sample of homes in Denver, we were surprised to find that the home having the poorest energy conservation design used less total energy over the year and during each winter month than almost every other home in the study. In the same study we also found that no significant correlation could be found between double-pane windows and increased insulation, and reduced energy consumption for the whole building as a whole. Subsequently our studies in Salt Lake City, Seattle and Portland, Phoenix and Las Vegas have produced similar results. Others such as Wybe Van Der Meer of the University of New Mexico and the Home Builders Association of Washington State have reached similar conclusions. On the other hand, during the past few years we have also conducted detailed studies of heat flow through windows, walls, ceilings, and floors in occupied buildings and have found, for example, that double-pane glass clearly reduces heat loss from windows during cold weather, and adding insulation to an uninsulated ceiling also significantly reduces heat loss. It might then appear that the results of the overall energy use studies and our detailed heat-flow studies are contradictory. More careful analysis shows that such is not the case.

The occupant of the poorly built home has simply become a resident expert on energy...
conservation. She has learned to do the innumerable small things which, taken collectively, reduce energy consumption and thus compensate for the poor building. She has learned to operate the building economically while maintaining what she considers adequate comfort.

Whereas internally generated heat from lights, people, and equipment is generally large compared to envelope losses in nonresidential buildings, it is usually not too significant in residences. Typical results are shown in our recent detailed instrumented study of a modest frame home in Denver. The 950-sq-ft home was instrumented in early November, 1979, and was continually monitored for several months. The four uninsulated walls were instrumented with heat-flow to measure total heat-flow through the wall. Thermocouples were used to measure inside and outside wall surface temperatures. The floor and ceiling were also instrumented for heat flow and temperature. The floor is completely uninsulated and the ceiling is minimally insulated with a simple reflective barrier. Thermocouples were used to measure mid-space temperatures in the ventilated crawl space, and mid-space and under-roof temperatures in the ventilated attic. Hot water heater and furnace gas consumption were monitored by individual meters. Energy use in the building was monitored for the time period from December 1 through December 31, 1979.

During December about 7.5 million Btu flowed through walls, ceilings, floors, and windows, and over the Denver winter heating period we project a total heat loss of approximately 34 million Btu from the house. Total energy use for the house for the past year has been 148 million Btu in natural gas and 18.2 million Btu in electricity for a total energy consumption of 166.2 million Btu. For the minimally insulated home in cool Denver, heat loss through the structural elements is about 20 percent of the total energy consumed. Thus it can be seen that variation in such items as hot water and electrical usage due to the various living habits of diverse families can easily mask the effect of the structure. Indeed, returning to the low energy consumption in my first example of a poorly constructed home we can reasonably conclude that the occupant is responding to the economic need to save money. In such a case one would have to be extremely cautious in recommending any energy conservation measure to the owner because many "conventional wisdom" items simply would not produce measurable and economic savings.

Energy use in various climates
In our studies in the diverse climates of Denver, Salt Lake City, Phoenix, and Seattle, we evaluated energy use in single-family homes. A comparison of these study results is instructive. Seattle homes tended to be maintained at about 68 F in the winter (many were cooler), while Phoenix homes were maintained considerably warmer. In general the Seattle resident stated a preference for the somewhat cooler temperature, while the Phoenix resident readily indicated discomfort at temperatures below 78 F or 75 F. At the same time we found that the levels of artificial illumination in the Seattle homes were much higher than those encountered in Phoenix. Similarly, hot water heaters in Seattle homes were maintained at considerably higher levels than were those in the Phoenix homes. It can be reasonable argued that low electricity rates in Seattle may play a part in the high illumination levels and higher hot water temperatures found, but certainly part of the reason also might be related to the cool, damp, relatively sunless winter encountered in that area. Higher illumination and warmer water might tend to compensate for the cooler environment. On the other hand, in Phoenix, heat and light are the foes; lower illumination and tepid water are preferable.

Thus we see that in Seattle the individual is physically more comfortable in a cooler building since he has tended to adapt to cooler temperatures, but emotionally prefers brighter environments and hotter water. By contrast, the Phoenix resident has adapted to warmer temperatures but prefers more subdued light levels and cooler water.

Engineers and technicians at the Applied Science and Engineering (ASE) laboratory in Denver have studied energy consumption in residential and nonresidential buildings in various areas of the United States. They have conducted experimental research in actual buildings to develop a wide base of "real-world" data. They have instrumented homes and nonresidential buildings in Denver, Salt Lake City, Phoenix, Las Vegas, Seattle, and Portland to measure heat flow through ceilings, walls, floors, etc., and electrical energy use, furnace gas consumption, door opening, and many other factors. The development of precise computer models based upon the "real-world" data can be used by the architect or engineer, for example, to evaluate more accurately and readily the actual thermal effect of various types of window arrangements and treatments in a particular application, or to evaluate the actual payback of insulation or the effect of color on heat flow.

Conclusion: These studies clearly show that the building operator is the most important single variable in establishing energy consumption levels. Our studies show that a second factor contributing to the lack of correlation between good thermal construction and reduced energy consumption is the fact that in most homes and nonresidential buildings the envelope is not the major physical factor in energy use. We have instrumented numerous banks, churches, schools, office buildings, and other types of nonresidential buildings and have found that internal heat production and the mechanical equipment are generally the most important physical factors involved in their energy use.
Solar house and research facility, Denver

The American solar house is both part of the problem and part of the energy solution. Solar prophets and wisemen alike extol the merits of earth berms and sun for use in their new single-family dwelling. Regardless of the type of energy consumed or the efficiency of consumption, the single-family home is the worst possible fashion in which to live if the objective is optimization of energy usage. As tragic as it is, as per capita income increases, per capita energy consumption also increases. The most energy-conserving people in America are also the poorest. Conservation of energy is therefore not the top priority in choice of dwelling. When we, as architects, build a house, we accept energy waste and "space piracy."

The research and design which typifies all of Crowther's buildings is in greatest abundance in the houses. In his own new research facility home in Denver, he accepts the role of "space pirate." His laboratory-house-retreat-office keeps the paradoxical incongruities of the outside world at bay. Inside is a world where life makes more sense.

Like Dr. McGrew, author of the previous article, Crowther recognizes the importance of the human being in compensating and regulating energy consumption. He readily accepts the sensitivity of his own body to guide him in fine tuning his own interior environment. In a very real sense, he wears his building like clothes.

This is not the first home Crowther has built for himself. During 40 years of design and experimentation he has built five; his first one was built in 1943. All of his own houses have served as home offices, many have also been full-size test facilities, and some have been intended for multiple occupancy as this one is.

There were, however, two new programmatical explorations for this house that have had a rather large influence on the resulting form: first, the large solar-heated gallery space adjacent to the entry serves as a primary heat "accumulator" for the house; second, the cellular nature of the plan enables parts of the house to be thermally isolated. In keeping with the full-size laboratory function of the building, Crowther experimented with many different types of energy sources, as well as sizes and shapes of space. There are nine thermal zones in the building.

Central gallery: The key thermal zone in the house is the central gallery. Says Crowther: "Get the hottest air to one place—you can use it more effectively." Direct and reflected sunlight enters through a narrow band of double-glazed clerestory windows at the apex of the shed roof space. The dark colored concrete surfaces store the direct-gain solar heat and radiate heat. A ceiling plenum in the kitchen also channels heat into the gallery from the appliances. Of course heat given off from the occupants using the space also rises in the gallery. Excess heat is destratified by a fan-and-duct system that draws off the upper layer of heated air and delivers it to the concrete thermal mass of a storage room in the basement below. In the heating season, there-
The eastern elevation of the building includes the entry. After passing the entry air lock, one enters the gallery (above) and walks through the dining area (middle right) to the living room. From there (at right) both the gallery and dining space are in view.
Solar house and research facility

fore, the upper-level floors are warmed from below. In the cooling season, this heated air is exhausted into a large duct adjacent to the entry which also can channel air from the swimming pool on the lower level to the roof. **Work space:** The work space of the building can be entered and used in complete separation from the remaining building. The unheated entryway serves as a buffer from the building exterior to the office interior. To the south, the solar test deck acts as an additional climatic buffer. In the winter months the sunlight falls on the inside wall of the solar test deck, while in summer the direct solar heat falls only on the floor. As the space itself heats up, of course, the doors into the library can be opened. Also for daytime heating, a hooded venturi ventilator can draw the heated air through the cored slabs in the ceiling above the library by induction or wind movement. In the summer, the same ventilator can draw the cool night air through the test deck space and into the roof slab. The test space itself is, of course, vented in this manner. It can also be exhausted by the negative pressure created when wind passes over the wind-foil shape on the roof or through vents in the south elevation.

The heat source for Crowther's home office, adjacent to the library, is simply its wall and window. The thinly insulated 8-in. concrete wall is colored and textured to absorb solar heat. There is direct solar heat gain available through the double-glazed window. Blinds sandwiched between glazing sheets offer solar control.

**Main living area:** The living, dining, breakfast, and kitchen areas are designed to be a thermodynamically isolated ensemble within the house if necessary. The sitting area, breakfast nook, and kitchen all have direct sun, and when the greenhouse below the living room heats up, hot air is also available to the living space above it. The deep-set concrete boxed windows in the living room store heat in the winter and provide shade in the summer. By pulling insulating panels across these windows, heat gains and losses can be regulated. Crowther prefers that the heating and ventilating function of windows be separated. The windows are not operable. Ventilation is available from an exterior-to-interior weather-sealed ducted vent. Eutectic salts will be installed eventually behind the seating to further capture solar heat. Their low-temperature phase change captures heat and then serves as a radiator. A wood stove is nestled into the inside wall of the living space and can be used for cooking.

The breakfast nook provides another strategy with its direct solar gain taken by the dark quarry tile on its concrete floor, movable side-sliding insulation, and exterior canopy for summer shading. Ventilation is available but again separate from the fixed single-glazed window.

Both living room and kitchen receive additional light from "sky shafts," the periscoping vertical tunnels which channel reflected light down into the space with minimal heat loss. **Sleeping quarters:** The sleeping quarters rely on insulation and petty heat theft. Auxiliary spaces are protected from heat loss on the north side by a concrete-covered earth berm (the covered earth remains dry). Below the laundry and dressing space is the heated space storing drawn-off gallery heat, a solar heated water tank, and sauna. This heat permeates the concrete mass in this section of the house. The west-facing sunroom acts as a climatic buffer for the bedrooms. Direct solar gains to it are controlled by vertical shades.

From above, a "solar chimney" services the master bedroom. A solar chimney acts like a west-facing solar air collector with its lid off. By heating up in summer, it induces air flow in the space. Circulation begins outside on the patio. Air is drawn through a ducted vent (cooled) below ground and enters the room just above the floor line. It then circulates across the space at a diagonal and up through the solar chimney. In winter, the solar chimney is shut, but the underground duct is used to temper the fresh air brought into the room.

Sky shafts help illuminate the bathroom, laundry, and guest bedroom. A sky shaft also illuminates the garage to the east of the sleeping and dressing areas. The garage itself acts as a climatic buffer.

**Lower level thermal zones:** The lower level consists of four primary thermal zones. The thermal mass of the storage zone in combination with the sauna serves as a primary, well-insulated heat sink for the building. The caretaker's apartment can function completely independently from the rest of the house, and, although the functions of the swimming area and recreation spaces are related, they can be maintained as two separate zones.

The apartment space is below grade except to the south. The solar greenhouse serves therefore as the primary heat source with access through the greenhouse door. Venting from it is achieved when negative pressure over the roof's airfoil pulls the heated air up through a duct to the roof.

The pool space is, of course, heated primarily by the pool itself. When the sun enters the south-facing window wall, it falls into the deep end of the 11,000-gallon swimming pool. The sun shading is such that the lower winter sun penetrates well into the rear of the pool. Water, of course, is an excellent heat storage medium. A floating, translucent pool cover reduces evaporative heat loss. The pool is also heated by 400 sq ft of liquid solar collector on the roof of the building. (This is Crowther's first active collector for his own house.) Its heated hydrocarbon fluid circulates in a loop from roof to 1100-gallon concrete water tank in the underground storage space adjacent to the pool. The pool water is then piped over a heat exchanger from the storage tank. A water-to-air...
heat pump is installed to deliver tempered air to the spaces above, or it can be reversed to heat the pool in other seasons. The pool space is below the living room and its heat rises to the floor above.

Another south-facing greenhouse services the recreation spaces adjacent to the pool, the sun entering the greenhouse through clear, cellular sheet plastic. The white marble-chip patio outside acts as a solar reflector adding to the solar gain of the greenhouse. The space can provide air tempering, heat, humidification, and ventilation for the recreation space and is intended to function as a natural air filtration system. Return air from the spaces above is ducted down into the greenhouse. Fresh air is added when necessary through outside vents. Air is circulated with the help of an induced air flow which terminates in the large downspout from the roof. Filtered air then is directed back into the upstairs spaces.

**The total design:** All of Crowther’s buildings are designed from the inside out. There were fewer drawings for the Crowther house than for a normal building although the plan emerged only after several different versions. Crowther served as his own contractor and made running changes in the building as it was being constructed.

The spaces which need light and view are clustered to the south and west of the building. Earth berms protect the north exposure
Solar house and research facility

from winds. The east elevation faces the street, provides access by car, and asks rather emphatically for privacy. The recessed courtyard to the south will also offer privacy and augment the recreation spaces in the summer while opening the lower elevation to the sun’s direct and reflected rays. The walls extending out from the building will help control the air flow around it. Trees and foliage are strategically placed for shade in the summer and sun in the winter.

The elements of weather will themselves play an important role in the functioning building. Not only will the sun heat it and wind cool it, the snow will insulate its flat roof and reflect sun onto its walls and into its glazed openings. Rainwater and melted snow from the roof are collected in a 700-gallon cistern for watering the landscape.

The construction material is reinforced concrete. The floors are prestressed, cored, prefabricated slabs supported on steel beams and columns. The outer walls and foundations are solid prestressed concrete. The exterior walls are surfaced with a layer of polystylene board with a waterproof, self-bonding synthetic coating called “Settef.” The insulation is 4 in. thick from footings to the roof except on the south where the solar heat gain was desired, and only a 1-in. layer was used. The polystylene roof insulation is also on the exterior, covered with an aluminized protective layer.

Through the use of insulated, heavy thermal mass, Crowther is able to “ride out” rapid 40 F fluctuations in climate with only minor variations of interior temperature. In addition, the walls, floors, and roofs are all integrated thermally causing the structure to “pull” heat from place to place within the material.

The choice of material greatly affected the color of the building. Although Settef comes in a great variety of colors, a multi-colored surface would be impractical. The material is not mixed like paint and must be troweled into place. Crowther chose, however, to moderate the heat gain by applying a lighter color to the east and half of the south façade. Amazing as it may sound, he was afraid that he would overheat his building combating the cold Denver winter with the hot Denver sun!

The texture of the Settef also adds to the thermal advantages of the material. A high-texture material maintains its protective “thin film” better than a smooth surface in moving air. There is a similar motivation for inserting the windows to protect the thin film.

Reflective surfaces are another important part of the design. In addition to the snow and marble chips, a reflective surface on the garage wall bounces sun to the dark-colored recessed garage door, warming the garage in winter and helping to melt the snow on the driveway. The reflective surface on the visor over the gallery clerestory helps attract heat to the gallery as well as to the solar panels below the windows. In summer, with the snow gone, the aluminized surface of the roof reflects solar heat.

Energy holism

The logic and sensitivity portrayed in the spatial organization, siting, and configuration of the building proceeds from place to place, choice to choice, and scale to scale in the building. Rooms behave like ducts in channeling air movement, wall surfaces and colors are chosen to augment the decisions already expressed. Even the mailbox is designed using swatches of carpet to avoid heat loss.

Crowther’s design is expressed in time and is planned for change. If necessary, the building could be subdivided into four individual apartments.

What is constant in other designs is variable for Crowther. In addition to the physical shell of the building, consideration is given to air quality. Both organic and inorganic air filtration have played a role in the design. The building eliminates air infiltration; therefore, its air must consciously be renewed. The air outside is polluted, therefore, Crowther promotes adding air volume to his house in order to dilute the pollutants.

He is also concerned about the negative bodily effects that electromagnetic fields might have and has added wire mesh to the inner west walls and portions of the ceilings to ground them. He is acutely conscious of the biophysical effects of fumes, outgassing of materials, and all materials that come in contact with the body. He is a vegetarian and won’t allow smoking in the building, period.

He is monitoring the ionization content of the air in various spaces of the house. People are themselves “positive ion machines.” Residential and commercial interiors, however, typically lack adequate negative ions for optimal health. For this reason the major spaces in the house contain devices attached to the ceiling which initiate negative ionization. He is experimenting with the combination of positive field resonance and negative ion generators.

Few buildings built today are totally self-sufficient. Richard Crowther uses tiny 1000-watt electric heaters spotted throughout the upper floor: in the guest bedroom, the breakfast nook, the sunroom, and one in the living room. The bathrooms (there are five) have auxiliary 500-watt heaters. Crowther had originally intended that the liquid-to-air heat pump serve as his main source of backup and provided ducts for that purpose into the main spaces. In use, however, the building responds so well to solar energy that he prefers the “toaster” size electric heaters.

The key to the Crowther energy-efficient design is his use of buffers. The landscaping is a buffer for the building, and cellular buffer spaces protect the interior spaces from the exterior. The series of soft shields do not say no to nature, they just order her stay. [Richard Rush]

Data

Project: Solar Research and Energy Design Residence, Denver, Co.
Client: Mr. and Mrs. Richard L. Crowther.
Site: corner site with 100-ft and 125-ft frontages.
Program: 2400-sq-ft primary residence, 1000-sq-ft library, solar test deck and home office. 1000-sq-ft caretaker’s apartment with greenhouse, 1000-sq-ft indoor swimming pool area, 1000-sq-ft educational, recreational, guest quarters with greenhouse and three-car enclosed garage. Outdoor sunken courtyard and gardens.


Mechanical system: active solar collector for hot water, sauna, and swimming pool heating. Water-to-air heat pump incorporated in pool. Electric fans and assorted low-wattage electric heaters.

General contractor: Richard L. Crowther.
Costs: $320,000.
Photography: Joel Strasser.
Photos left to right and top to bottom: sunroom between bedrooms, dining and living rooms, library next to office, swimming pool space, kitchen, work space in guest bedroom.
City under sod

Covered on three sides by earth, this high-security correctional facility proposes an interesting energy-saving solution.

It may seem perverse to suggest that when we turn to models for energy-efficient cities, we should study an underground prison. Yet this facility, planned for a hilltop site in a wooded area 40 miles from Minneapolis-St. Paul, should offer valuable data on both energy conservation and the kind of environment created with earth-sheltered architecture. Designed by Gruzen & Partners and Winsor/Faricy Architects, the 275,000-sq-ft complex for 400 inmates will be covered with earth on three sides to cut costs of heating and cooling.

The rugged terrain, which varies up to 150 ft in elevation, including a large gully on the site, afforded the opportunity to create this underground community (even though one million yards of earth had to be moved). Yet in an area where the temperature averages 28°F in the winter months with 8159 degree days annually, the heat loss for a building this size would normally be about 2,763,000 Btu per hour. By burying the building partially into the earth and exposing only one elevation, the architects and engineers were able to cut the Btu consumption almost 20 percent.

At the beginning, the underground concept was difficult for some corrections officials to accept. They were afraid that the scheme would promote a claustrophobic environment rather than one that would further the rehabilitative goals of correction institutions. The architects, working within a prevailing enlightened incarceration philosophy, designed the spaces to mitigate any sense of being buried underground.

Design concept
The scheme breaks up the housing into seven 52-person units, all of which open out onto outdoor recreation areas. Even these outdoor spaces are subdivided: each "house" adjoins its own informal yard overlooking the large central court where scheduled recreation takes place.

The single rooms or cells in each of the units are staggered along this exposed wall, so that narrow, vertical windows will permit light to penetrate the rooms, while still maintaining an appreciable degree of security. In-
side, the rooms open onto semiprivate areas and connect to larger dayrooms, promoting that hierarchy of private to public space generally deemed significant to the livability of all types of housing.

The residential units are placed on the first two levels of the three-story-high buildings, with educational and administrative functions on top. The circulation on the top level is continuous; in the residential units, segmented for security. The unit dayrooms adjoin the courts, providing both access views and natural light. From the central court, inmates will also have a more expansive view through a bridge to a nearby ravine and hills.

A core building at one corner of the complex, also built into the hill, is the only building that comes into sight as visitors approach the center. Located between residential units and parking, it will mark the entry to the complex.

Energy features

The entire structure, of poured-in-place concrete frame and flat slab with retaining walls 30 to 40 ft deep, will be evident at certain points. Facing brick over poured-concrete surfaces on the exposed walls will be insulated with 2-in. plastic foam for a U-value of .06. The roof, which has patrol areas, will have a U-value of .04.

While the building is run on electrical energy, with a heat pump, a pipe coil will be installed to reclaim heat from return air and kitchen exhaust. This device, plus wall insulation, is expected to cut energy consumption for heating by 25 to 30 percent. The heat pipe coil was chosen over the heat wheel simply because the coil is smaller and easier to clean.

A closed water-storage system also conserves energy: in the off-peak hours, water is electrically heated to 105°F and stored in two 25,000-gallon tanks for peak demand. Similarly in the summer, cold water is stored at night for daytime air-conditioning needs. As an additional measure, a computer controls this storage, as well as regulating heating and cooling.

The complex, to be completed in the summer of 1981, should be interesting to analyze in terms of energy consumption as well as livability. Aside from the various correctional debates about the nature of incarceration, it would be instructive to analyze this kind of complex for its applicability for other facilities such as hospitals, colleges, and hotels. [Suzanne Stephens]
A recreation facility in Georgia uses sun not only for heating and cooling, but also for ice making.

Shenandoah Solar Recreation Center is probably the largest structure in the country to be both heated and cooled by solar energy. The building is thoroughly admirable in a great many respects, but even with this being the case, it has not been able to fulfill the precise role for which it was originally planned, which was to be a focus and inspiration for a new solar community.

The 58,000-sq-ft building was designed as the community center for a new solar energy suburb located 35 miles south of Downtown Atlanta. Shenandoah was to have had a solar technology park occupied by manufacturing and research/development industries involved in solar energy. Attractive tax incentives were available for both business and residential construction using solar devices, but few moved into the town, probably because those looking for the bucolic life in the sun could find it closer to Atlanta. The town foundered for a while, but then began to pick up when a new sales strategy was instigated, directed toward marketing houses in the wooded community as second homes. Shenandoah seems now to have found its level, and only the recreation center remains as a clue to its earlier prospects.

The center was designed by Richard L. Taylor and James B. Williams of Taylor & Williams (formerly Taylor & Collum), and its solar energy system was designed, under the direction of Dr. James R. Williams, by an engineering group at Georgia Institute of Technology.

The actual size of the building was determined by the requirements of its program, with the regulation ice hockey rink dictating the length, and the basketball court determining the height. Those, in turn, suggested the square shape—the most efficient volume-to-exterior form available for these needs.

To reduce heat loss and gain, the building is set four feet below grade, with the soil removed for excavation forming a berm of insulation around all but the building's north side, where double bronzed glazing is used to give views to the lake and woods beyond.

In order to have clear spans for the recreational functions, wooden trusses were used. These, in combination with a system of folded plywood plate forms, support 63 8½' x 21' flat-plate copper solar collectors displayed on a 10,500-sq-ft roof area. On this polished aluminum roof, the diagonal chords of the trusses are designed for supporting both solar collectors and reflectors at their respective optimal angles of 45 and 36 degrees.

The hot water collected is stored in a 15,000-gallon tank and a 5000-gallon buffer tank, and chilled water is stored in two 30,000-gallon tanks, all of which are embedded into the earth berm around the building.

The solar system, which can be augmented by natural gas, provides the space heating, cooling, and domestic hot water for the building. In addition, however, it can also provide heat for the outdoor pool when needed, and heated water can be used for the hourly re-
surfacing process required for the ice hockey rink. Waste heat from this process is not discharged, however, but used for controlling the temperature in the ice rink. In all, the solar system supplies 90 percent of the space heating requirements, and in its first summer of operation it provided 90 percent of the cooling needs for the center.

Wherever possible throughout the building, mercury vapor lights have been used with dimmers to minimize energy use. For natural daylight, insulated translucent fiberglass has been installed between the diagonal chords of the trusses at the east and west sides of the building.

The total additional cost for converting the Shenandoah center from a conventional design, as originally planned, to a solar-energy facility has been estimated at $726,000. This includes both the design and the installation of the energy system, for which the funding was made possible by a grant from the U.S. Department of Energy Research Development Administration.

When the building was designed four years ago, its fuel cost was estimated at $118,000 a year as opposed to $38,000 a year for the redesigned structure. Considering the fuel costs of that time, the payback period for the additional cost incurred by the solar system and its installation was estimated at 11 years. The absolute certainty about this building today is that that is one figure that will decrease much more rapidly than originally anticipated. [David Morton]
Milford Reservation Solar Conservation Center, Milford, Pa. and Prototype Passive Solar Townhouses

Kelbaugh & Lee move on to larger solar buildings and expanded philosophies, with divergent results.

The Milford Center (this page and facing) is intended as a teaching machine about energy and the environment for groups of urban youth. The axonometrics are coded to indicate which walls and floors are directly heated by the sun (in red) and which help store heat (in gray). Facing page: Two energy diagrams, for winter solstice and summer solstice, show expected thermal circulation. The project is under construction, with completion scheduled for fall.

The subject of energy consciousness and design is a touchy one. Many of the energy activists would just as soon forget about aesthetics and at least as many aesthetes would just as soon forget about energy. The group in the middle—of which Douglas Kelbaugh is a talented example—are faced with the difficult task of being the most visible people trying to order the implications and priorities of post-oil crisis architecture.

Kelbaugh, for instance, has been doing passive solar houses for the past six years; three years ago, he formed the firm Kelbaugh & Lee of Princeton, N.J. Two new projects, the Milford Reservation Solar Conservation Center and a government-sponsored prototype for infill passive solar townhouses, mark a certain coming of age for the firm. Not only do both extend the firm's penchant for ingenuity in what Kelbaugh calls "dumb technology," but they represent a determined, and changed, design standpoint. Says Kelbaugh: "I went to Princeton under Eisenman, Gwathmey, and Graves, and did flat roofs until Milford." He describes Milford as "vernacular imagery and historical vocabulary." Alluding to influence from Charles Moore, he suggests that the building is "meant to evoke images of wooden farmhouses of the region, despite the fact that the internal structure, floors, walls, and partitions are concrete to store solar energy." The townhouses, with their dormer windows, shed roofs, and cross-bar windows, are comparable.

Milford Center
Both projects are intended as national models. The Milford Center, now under construction, is to be a teaching machine. Up to 114 students at a time will be brought for two-week stints to learn about the environment. Part of that will consist of operating the thermal shutters, shades, windows, and vents, cutting wood for stove, fireplace, and furnace, and monitoring the composting toilets. On a 1600-acre tract near the Poconos, the nonprofit, all-year-round camp provides dormitory sleeping, dining, lounges, a library, classrooms, and an outdoor amphitheater.

Because of the facility's unique purpose, the architects made an effort to fit as many energy-conserving techniques into the relatively small (17,000 sq ft) building as possible. For passive solar heating—which is expected to provide approximately 75 percent of space and water heating—there are Trombe walls, drum walls, direct-gain windows, an attached
greenhouse, and hot water preheating. The hot water preheating tube, which extends the entire 160-ft length of the roof, is a Kelbaugh & Lee adaptation of conventional bread-box preheaters. In an insulated box, surrounded by aluminum foil and exposed to the sun through a double-glazed south-tilted edge, the 18-in.-diameter black pipe holds, and heats, water for about one full day on its way from the well to the water heater. At night a thermal blanket lessens heat loss.

Fourteen composting toilets—"easily the world's largest installation," laughs Kelbaugh—are expected to reduce water use by 40 percent. Along with the cheaper site-built concrete ones is one fiberglass prefab model so comparison statistics can be kept. There is a windmill to generate electricity. For cooling, part of the building is built into the earth. There are night vents and blowers to wash the masonry with night air.

The exterior is covered with cedar siding and roofed with corrugated asphalt. Inside, concrete block and vinyl are the norm, with special walls of glass block and Southern yellow pine and special floors of rubber tile and bluestone pavers.

**Infill townhouses**

The townhouses were commissioned by the Northeast Solar Energy Center. After years of Department of Energy and Housing and Urban Development sponsorship of single solar houses, the government decided to invest in multifamily housing with its inherent thermal and transportational advantages. Among the firms chosen were Kelbaugh & Lee in association with Donald Prowler of South Street Design in Philadelphia. Adapted to the Mid-Atlantic region, the houses come in two versions, south-facing and north-facing. The south-facing houses have a yard in front with a 6-ft wall along the street for privacy. The north-facing houses have their yard and a greenhouse in back. Large rotary ventilators, lifted from farms and factories, function atop chimneys, and bread-box preheaters dot the roofs.

As for the possibility of the project's ever reaching fruition, the architects are investigating the possibility of developing the townhouses themselves, in either Philadelphia or Trenton. While intended for a "moderate- to middle-income" market, the sale price estimates are more like $100,000 for the two- and three-bedroom units, perhaps less if renewal land is available. Exterior walls might be either wood or brick veneer. Most interesting are the alternating elevation rhythms between chimneys and windows, obscuring the actual distinctions between units. Perverse as well as ambiguous, that demarcation actually occurs down the center of the cross-bar windows.

Solar contribution to space and water heat is expected to be 62 percent. "I do not design for a preconceived auxiliary fuel bill," Kelbaugh admits readily. "I incorporate as much passive technique as is architecturally conven-
Prototype passive solar townhouses

Planned as urban infill for a mid-Atlantic location, this prototype (above and facing page) includes both north-facing and south-facing passive solar townhouses. The south-facing houses have a glass wall facade and front yard. The north-facing houses have greenhouses and yards in back. A huge farm or factory-type rotary ventilator is included for each unit. The complex rhythm of the facades obscures the divisions between units, which occur—not without mannerist perversity—down the center of the cross-bar windows.

Keeping the faith

Part of the coming of age is coming to terms with a contradiction within himself, and many like him. On the one hand, Kelbaugh sees solar design as a practical responsibility and a set of technical problems. Aesthetic considerations are unrelated. He designed his early houses in an abstract, 1920s-derived style; current projects in something more Colonial with occasional traces of his earlier de Stijl proclivities still apparent. He makes no claims of solar advantage for either.

On the other hand, Kelbaugh wishes to be identified with energy as a cause. And it is an identification which goes beyond lobbying. The firm's logo is a pseudo gum package with the brand name "Environmint" and the slogan "Here comes the sun." He and various of his energy-concerned colleagues have a loose association they half jokingly call "The Black Holes," but seriously think of as an alternative to the "New York Five." Their idea of how to incalculable the study of solar technology into university programs is to hold special "Energy Days" rather than simply fold the relatively straightforward technology into existing coursework.

Most to the point, Kelbaugh found himself, at this stage in his design life, needing to construct a position paper—self-commissioned. In it, he takes a view that can only be described as militant. He declares that "a new cosmology is here," that the shortage of fossil fuels is leading not only to design which incorporates solar technology but design which reflects a changed view of the world. It is a view in which man does not dominate nature but is merely another creature subject to its forces.

In manifestoes, it is always easy to read "should" where "is" appears and thus save the writer from the burden of proof. But this tract has more serious problems. The connecting links are missing. There is no discussion of what the technical relationship is between solar technology and any particular formal decision. There is no discussion of how the new cosmology might be convincingly expressed formally either, whether perhaps the use of natural materials or forms might be relevant or what the implications are for scale.

The point is that the manifesto, finally, is not really arguing for any given philosophy or any given formal expression of it. The argument is an attempt to give the implications of fuel shortages a level of theoretical significance it cannot possibly possess. Kelbaugh's motivation—if one reads it correctly—is understandable. A man who put two years into VISTA setting up a community design center and five years advocating community participation as a planner, he has long been looking for an incontrovertible sense of purpose.

The discrepancy is that Kelbaugh as a designer regards energy concerns as an important technical responsibility to be seen in perspective, and Kelbaugh as an advocate sees energy concerns as the basis of a philosophy. It is the former position that seems to hold the most promise. [Nory Miller]
Data
Project: Milford Reservation Solar Conservation Center, Milford, Pa.
Architects: Kelbaugh & Lee, Princeton, NJ.
Program: a 17,000-sq-ft dormitory and classroom building for urban youth to study energy and environmental issues on a rotating basis. Sleeping capacity is 114.
Site: 1646 acres of semi-wilderness near the Poconos.
Structural system: precast hollow-core concrete slabs on concrete retaining wall and column/beam with concrete spread footing foundation.
Major materials: cedar siding with double- or triple-glazed windows on the exterior; a corrugated asphalt roof and interior walls of concrete block, glass block, and wood (see p. 226).
Mechanical system: four types of passive solar heating, two types of passive cooling, wood/oil furnace.
Consultants: Raval Engineering, structural; Robert Bennett, mechanical.
General contractor: Dorsan.
Client: Milford Reservation.
Cost: $1.2 million; $65/sq ft.

Data
Project: prototype passive solar townhouses.
Architects: Kelbaugh & Lee, Princeton, NJ.
Program: one- to three-bedroom townhouses for upper middle income with passive solar benefits, 660 to 1684 sq ft.
Site: hypothetical urban infill in mid-Atlantic region.
Structural system: concrete slab on grade, load-bearing party walls.
Major materials: wood or brick exterior; painted concrete block and gypsum board interior; floors, quarry tile and hardwood or vinyl (see p. 226).
Mechanical system: forced hot air, gas-fired back-up furnace.
Client: Northeast Solar Energy Center.
Cost: $24,000 1BR; $60,000 2BR; $69,000 3BR; $40 per sq ft including $3 per sq ft incremental cost for solar systems.
Building Energy Performance Design Energy Budget: 45.7 MBtu/sq ft/yr (2 BR unit); 44.4 MBtu/sq ft/yr (3 BR unit).
The sun is used for cooling, not heating, in this partially bermed school in South Florida.

In a climate with an average daytime temperature of 75.5 F, and a number of degree days totaling 200, the cost of air-conditioning loads could send chills down the spine of any economically minded school administrator. The design for Floyd Elementary School seeks to counteract that expense. The school plans to harness solar energy to provide at least 70 percent annual energy for its cooling needs and 90 percent for its hot water.

The Miami-based firm of Saez/Facetti, founded nine years ago by two young Florida-trained architects Diego Saez and Richard Pacetti, obtained the commission to design the 70,000-sq-ft school. To do so they had to convince the school board that they could produce an energy-efficient building that would accommodate 930 students in the kindergarten through sixth grade.

The idea for the demonstration project had been initiated by the University of Miami, which desired to study the use of solar energy for air conditioning in a subtropical climate. Once interested, the Dade County School Board obtained a DOE grant to take care of the added cost of installing solar collectors. In turn, the school includes extensive energy-monitoring capabilities in an adjoining structure.

The rooftop solar collectors formed only one part of the energy-saving program. Not only were alternate means of energy supply sought, but ways to cut demand initially had to be explored. Thus a number of air-cooling features that could be described as “passive” or even just “low-key” were incorporated into the design.

Passive features

The 40' x 40'-square building, of conventional poured-in-place and precast concrete, is carefully bermed so little exterior wall is exposed to the sun. Two carefully incised portions of the berm allow glass walls to be inserted for access and natural light to the first level.

The walls exposed above the berm on the second level have been insulated with expanded polystyrene for a U-value of .09 (R-
The roof itself is protected from heat gain by expanded polystyrene insulation 3 in. thick which, with the composite concrete roof deck, creates an overall R-value of 29 (U-value is .034). In addition, the shading caused by the solar collector assembly should reduce heat gain even further.

A band of fenestration wraps around the perimeter walls of the second story. Since glazing would cause some heat gain, the architects installed aluminum louvered blinds on the outside of the glass for sun protection and security. The screen, with blades 1 1/2 in. wide, and 1 1/2 in. apart, still allows light to enter the classrooms.

**Low-key features**

To diminish the internal heat build-up due to artificial lighting used in the classrooms, architects Saez/Pacetti collaborated with electrical and mechanical engineer Aaron Hertz to come up with a specially designed lighting installation. Freestanding fixtures about six feet high, rather like minimal sculptures in their appearance, are placed throughout the interior of the school. In each of these high-intensity fixtures, three lamps, one a 400-watt high-pressure sodium vapor, one super arc metal halide, and one small quartz incandescent, are mounted within the top of the stand and directed upward at a reflective metal dish. These lighting standards provide glare-free uniform illumination. Hertz reports that the levels exceed 70 footcandles of equivalent spherical illumination with a visual comfort probability of 100. In addition, only two watts of electricity are used per square foot.

To further reduce the demand for air conditioning, Hertz and Saez/Pacetti installed a heat wheel that dehumidifies incoming air. The electrically run air-to-air rotary heat exchanger reclaims energy from conditioned exhausted air as it is replaced with raw outside air. This feature alone should reduce energy consumption by an estimated 30 tons. In fact all of these features are expected to substantially cut the demand for air cooling: the berm reduces the air-conditioning load by an estimated five tons, as do the roof insulation, the collector array shading, and the lighting fixtures, respectively. Since the second-floor wall insulation cuts the a/c load 2.5 tons, in toto these features knock off nearly 60 tons from the a/c demand. Usually schools of this size would require about 190 tons, or 54,720,000 Btu per day for cooling. Some—in the fingerlike configuration common with many open-plan schools—even require 225 tons. With these features, Floyd Elementary uses 125 tons of refrigeration on the hottest, most humid days and about 90 to 110 tons normally.

**The active part**

Unfortunately, because of technical problems, the active part is not acting right now. With the solar collectors in place, it is estimated that the collectors and the four lithium-bromide chillers hooked up to the collector will be able to provide at least 100 tons of the demand. The architects and en-
engineers favored multiple small-capacity absorption chillers for flexibility. At least four chillers were needed, explains Hertz, but each produces about 26-27 tons at its peak. The solar component and chillers of course would still use electrical power for pumps and cooling tower. But where they would save energy would be with the compressor.

Right now, the compressor, running on a fifth back-up centrifugal chiller, uses 90 to 93 kilowatts per hour to supply the 125-ton (peak) demand of the school. With solar collectors, that figure would be reduced by 60 kilowatts per hour.

The battery of solar collectors has been selected to conform to ASHRAE 93-77 performance specifications. Computer analysis determined that the angle of the flat-plate collectors could be as shallow as 15 degrees and still be effective, and thus diminish chances of damage during hurricanes.

In actually cooling the building, the chilled water is pumped to the heat wheel that creates the cool, dehumidified air. This air is then carried by fans through a medium-pressure duct system to variable-air-volume terminal boxes in separate zones of the building. Thus these units can be regulated independently of each other. A computer duct program and a special wash filter are additional features included in the mechanical system design that cut down on energy waste at the distribution points.

Since demands for heating the building are not high, it is warmed by radiant-panel electrical heating. Zone controls also regulate heat, which goes on when the temperature drops to 65 F.

Educational features
The design of the school reflects not only current thinking in energy conservation, but also newer, revised approaches to the design of educational facilities.

In recent years it has become quite commonplace for new schools to be built without windows. Generally this introverted measure is assumed to reduce threat of vandalism, ease maintenance, and prevent children from being easily distracted. Some energy conservation-minded people even think that no windows mean no heat gain. But as architects and engineers know, artificial lighting makes its own demands; air conditioning often has to compensate for heat from added illumination required.

In addition, schools in Florida and elsewhere have found that, with or without windows, vandals will be vandals; some speculate that the constricted atmosphere created by windowless environments brings out the vandal in everyone.

With one floor actually underground (or under-berm), Saez/Pacetti had to find some means of giving physical and visual access to the out-of-doors to the children on the first level. Besides the cuts in the berm on each of the four sides to introduce additional natural light into the classrooms, Saez/Pacetti installed silo-like lightwells along the perimeter of the school. Panels in the sides of the air shafts would permit firemen to use them as access chutes. The floors of the lightwells offer above space for plays, exhibits, and other activities in the conventionally shaped classrooms. Upstairs, the fenestration bordering the classrooms above the berm has been kept to a narrow depth of three feet, but placed at children's, not adults', eye level.

The public spaces of both floors receive natural light from porthole-like skylights in the roof over the main central stair, itself a dramatic focus for internal circulation. While open classrooms have long been favored in Florida, that too is undergoing serious revision. Saez/Pacetti designed the quadrants with sliding panels, to subdivide the quadrants into additional quadrants and diminish the sense of being in a gymnasium-like space.

Form for all seasons
The energy-saving features of the building and the spaces determined by the program are integrated quite nicely by the handling of the various formal elements.

The incline of the berm is too steep for the structure to actually melt into the landscape, however. Yet as the planting grows more lush, the blending of the manmade topography with the actual landscape is starting to occur. The result is rather like a machine-age Mayan temple—aided by the good proportions and the uncluttered, crisp detailing of the gray concrete walls and the orange metal pipe railing. The top of the lightwells, however, trimmed in segmented instead of curvilinear flashing, introduces a jarring note to an imagery that otherwise evokes current Milanese design.

The interiors are reasonably pleasant, although it is quite apparent that furnishings and finishes must be ordered from a stand-

Legend
1 Administration
2 Commons dining
3 Food service
4 Mechanical building
5 Mechanical room
6 Primary pod 1
7 Primary pod 2
8 Exceptional children
9 Kindergarten
10 Library media center
11 Intermediate pod 1
12 Primary pod 4
13 Intermediate pod 2
14 Mechanical room
15 Primary pod 3
16 Intermediate pod 3

Floyd Elementary School
ardized selection. Instead of installing hung ceilings, the architects decided to expose the ducts, electrical raceways, and water pipes to promote the impression of a clockwork-like mechanism on display for the inquisitive minds of the young. This open ceiling does swallow up some of the light that would otherwise be bounced back into the space. Nevertheless the articulation of the elements and the added depth in the ceiling create visual interest and spatial differentiation often missing in open-plan spaces. The lighting, too, shapes and molds the spaces, including the fluorescent cove lighting that dramatically washes the walls.

Exposing the concrete coffers of the ceiling and hanging acoustical baffles like pennants from the ceiling soften the architecture, too, and greatly help cut down the sound level.

A disturbing element inside is the limited choice in colors, particularly the overly intense hues of orange and blue here and there. The gray paint the architects chose for the interior walls of the lightwells flattens the space. Unless sunlight is bouncing directly down, these large concrete silos appear as rather gloomy apses at the edges of the classrooms.

These comments must be measured against the broader accomplishments of the entire solution. As a conscientious effort to save energy and provide a workable environment that children and adults can actually enjoy being in all days, its value as a prototype is considerable. However, final word will have to wait until the solar collectors are installed and the monitoring of the system is completed. [Suzanne Stephens]

Data
Project: Gloria Floyd Elementary School, Miami, Fl.
Architects: Saez/Pacetti Architects and planners, South Miami, Fl. Diego Saez, Richard Pacetti, Jeffrey Evans, William Liddy, project team members.
Site: ten acres in southern section of Miami, flat, lightly wooded.
Program: (see text).
Structural system: concrete and masonry. First-floor retaining walls precast twin tees; second-floor walls masonry. Second-floor slab and roof are precast joists, concrete deck.
Major materials: concrete, gypsum board, lath and plaster.
Mechanical system: (see text).
Contractor: B.E.C. Construction (phase 1), Marbilt, Inc. (phase 2).
BEPS: 57,000 Btusq ft/yr.
Photographs: Dan Forer.
Energy-conscious design is rich with potential. The source of the problem, however, is in the hands of people abroad. The immediate solution is in the hands of the people at home.

The slow, meticulous process of selection which passes for history is grinding up energy-conscious design as surely as it grinds up all forms of culture. Ten years from now there will be no "energy-conscious design." All design will be energy conscious. Until then it will act as a balancing force. And there will be some changes.

**Our lives:** The living habits of people have already changed. The foods we eat give us energy and use up other forms of energy. What we cook and how we cook it has come into focus. The clothes we wear are affected by energy either in their warmth, weight, permanence, or in the materials of which they are made. The cars we drive and the question of whether we drive at all has been asked again.

**Our cars:** The American public is apparently still content with paying $10-$15 thousand over time for a new automobile, an object which does nothing but diminish in value, cost more each year to run, and waste time and effort on repairs. This same public is reluctant to spend $1500 for a solar water heater because it is afraid that it will not work perfectly when installed. This will have to change.

In the heat of summer, traffic jams the city streets. Heat from the engines and the exhaust flows into the concrete streets and buildings. The air conditioners are on in the cars and the buildings. The hot air pours out onto the street. City air is polluted and the windows are closed. The answer is clear. Electric vehicles, low noise, no pollution, open windows. How long will it take?

**Our homes:** Any real estate agent can tell you why the single-family dwelling predominates. It is not because we enjoy mowing grass, shoveling snow, house repair, or because we enjoy that 40-minute drive to and from work. The house has proven to be a solid investment; even in the 1973 energy crunch, the combination of dwindling supply and increased demand kept prices up. The income tax structure in this country all but forces us to hock our lives for a house. Now the picture is changing. A single-family dwelling which is a generically poor user of energy can use oil for heating and increases the demand, reduces the supply, and increases the cost of oil. Whether or not you or I live in a house, whether we live in a region where oil is the primary fuel or not, in terms of inflation we all pay. We pay higher gas prices, transportation, and food costs, and we must include the price of the Sixth Fleet to defend the Persian Gulf. We all pay the price of the single-family house whether we live in one or not. This will have to change.

**Our country:** As long as the control of the environment is a decision made by people, it will be people who determine the balance between energy supply and demand. Through use, as has been shown in this issue, a poorly constructed building that is an energy sieve can be more conserving overall than an energy-efficient building poorly used. Obviously, this is not an argument for poor construction. It is an argument for intelligent utilization of energy-efficient buildings.

The options for environmental control of a building, passive or active, are put there by the architect. The environmental controls that are designed into the building are not just switches. The siting and orientation for environmental benefits determine what the envelope or mechanical options are.

The variables, then, are only put into the building as they are perceived by the architect. The more education and understanding
of the options and values which determine their selection, the more effective their resulting use will be.

The selection of options is based upon their effectiveness, their value in both abstract and monetary terms. The rest of the society and the governing bodies have a great deal to do with the value system which makes the selection of those options possible. Whether energy values are not present in the individual client, but are important for the general good, the government tries to create the values. Whether a piece of land is used as a forest, a single-family plot, an apartment house, or a jail is largely a decision of government. In its choice of building type and size, the government is affecting the energy situation to a much greater dimension than any architect can.

National lawmakers attempts to find the best possible route for the country as a whole. Therefore local, state, and regional needs are subservient to the national wellbeing.

The international situation is, however, the most primitive of all. Although a structure of law and government exists, it is clear that in and of itself the world is ungoverned and apparently ungovernable. Wealth: material or monetary; power: military or economic, and to some extent time and distance, still rule the world.

Our world: The world hovers closer to the brink of war than we like to think about. There is another threshold yet to cross with energy. It is not a threshold that we can be made to cross by law or that can be economically justified. It is not visible or tangible and not a switch or motor. The only near-term solution to the energy situation is our self-imposed will.

We keep waiting for the right law, the right sexy package, the right ad to make energy consciousness economically sound, culturally acceptable. It is not coming, repeat, it is not coming. We cannot legislate or sell culture. The society must voluntarily take a step. It must give energy consciousness value with a capital "V."

The stakes are no longer that vacation in the RV or the gas-pump price. We are putting wheat and corn into gas tanks and talking about thermonuclear war to protect oil. Not since medieval times have buildings been used as a weapon. Today, architecture is a weapon.

The last 20 years have fractured, exploded, and fragmented this country. The society came apart and is in the process of reassembling itself. We are a step from reassembly, a step from war, a step from a country bigger than the sum of its parts. This is not perfection or utopia. It is sanity. [Richard Rush]

There are several conclusions which can be drawn from this issue. Among them are:

1) International politics is the largest single force affecting our economy and therefore our buildings.

2) A bona fide energy technology has emerged which is recognized, used, and exchanged between countries. A concerted effort needs to be made by architects to exchange these ideas, experiences, technologies, and products. Most of the industrialized countries of the world, for example, have great expectations for solar water heating as well as photovoltaic and wind-powered electrical generation.

3) In its political activity, its lawmaking, and its buildings, the government can have a strong effect on the energy problem. The scales of energy responsibility and energy knowledge are not often related. Unfortunately many practitioners in the trenches of the energy war have lost the vital ability to generalize the problem.

4) The government and manufacturers of building products need to work with architects, engineers, and economists to develop a set of incentives which can be offered to building owners to retrofit their buildings for energy conservation.

5) Energy-conscious planning is essential prior to energy-conscious architectural design. Decisions made at the broad scale can add to or subtract from the options at the building site.

6) The Building Energy Performance Standards are upon us. Every practicing architect and engineer in this country has the responsibility to obtain, study, evaluate, and comment to the government about the positive or negative feelings that he or she has about BEPS. Several of the buildings in this issue have their BEPS budget numbers listed in the data block.

7) Energy-conscious design requires a team effort. The procedure of creating a building has been positively affected in the conceptual stages of design by the early formation of the team. Architects and engineers need to encourage team skills in their practice and their education.

8) The total thermodynamic behavior of a building for energy conservation can be very complicated. The computer represents a tool of great capacity and someone on the design team must eventually learn to use it.

9) The restraints on energy use affect more than just the building. They strongly affect its use and the health of the user. Architectural research must thoroughly investigate the biophysical ramifications of energy design as well as the behavioral effects and the impact of energy legislation on other types of building regulations.

10) The top energy designers are leading by example. As energy-conscious design becomes the rule rather than the exception, those architects who have led the revolution are leading us back to an architecture rich with invention. Energy-conscious design has spread to nearly every building type. Energy-conscious design—is there any other kind?
Save your energy!
...with Zero's new AIR-STOP Door System.

In winter, cold outside air infiltrates buildings.
In summer, the reverse is true: cooled interior air leaks out, or "exfiltrates".
In both cases, there is serious energy loss.
Zero now offers a way to eliminate such problems. We do it with one of our Air-Stop Door Systems.
Each system consists of a different combination of Zero seals. These facts prove their effectiveness:
Federal specifications call for a standard CFM (Cubic Feet per Minute) airflow factor of 0.5.
Unsealed, a typical door tested by us showed air loss due to filtration of 11 CFM—22 times worse than the Federal standard!

We tested 10 different Zero Air-Stop Door Systems and 1 double-hung window Air-Stop System. In every case, we bettered the Federal Standard. Using our Air-Stop System 1, we came up with a rating of 0.03 CFM!
The tests were run too late for our 1980 Catalog. If you want the results, though, we'll be happy to send them to you along with that Catalog. Just drop us a line.

Zero Weather Stripping Co., Inc.
415 Concord Ave., Bronx, N.Y. 10455. (212) 585-3230

Circle No. 418, on Reader Service Card
A CORIAN® solid value for both builder and buyer.

When you select CORIAN® building products for bath, kitchen or bar, you offer buyers a solid investment in luxurious beauty plus durability and ease of care.

The solid construction of CORIAN is unique. Marble-like patterns and colors run clear through. There's a depth and richness not possible with coated "synthetic marbles" or laminated plastics.

CORIAN is tough enough to take rugged wear without losing its look of elegance. It resists staining. And a little household cleanser does away with minor surface scratches or cigarette burns.

What's more, craftsmen can work and shape CORIAN as easily as wood, to carry out the most imaginative decorating ideas.

CORIAN comes in one-piece molded tops and bowls for baths, kitchens and bars in a range of styles and sizes. CORIAN sheet for kitchen and bath counter tops, wall wainscoting, bath and shower surrounds, and custom surfaces is also available.

Successful builders find CORIAN appeals to buyers. It's a solid investment in beauty, and adds more in value than in cost. For more information write: DuPont, Room 37724, Wilmington, DE 19898.

Circle No. 340, on Reader Service Card
TWAs Next Flight Out Pak
gets there the same day. Guaranteed.

Just $25 to any TWA city in the U.S.

If you have legal documents, last-minute contract bids or circuits for a "down" computer, which must be across the country in a matter of hours, you're going to like TWAs Next Flight Out Pak. It's the fastest, least expensive small package service available.

So-called "express" services can't deliver your package until the next day. And while other airlines can send it there the same day, the flight will cost you more. Only TWA will fly your package the same day you bring it to us, and for only $25.

If your item weighs less than 2.2 pounds and fits into our 13" by 17" pouch, then bring it to any TWA airport ticket counter or Next Flight Out drop-off area at least thirty minutes before the flight you want, and we'll fly it — to any of TWAs 54 cities across the U.S.

And, for an additional charge, we offer high-priority door-to-door delivery. Call us just 90 minutes before the flight you want. We'll pick up your package at your home or business, get it on the selected flight, and deliver the package to the receiving address. In just hours.

Same Day Service for Packages up to 50 Pounds.

For packages between 2.2 and 50 pounds, TWA has Next Flight Out service too. Ship your package the same day to any TWA city in the U.S., and it costs from $35 to $45, depending on the destination. And our high-priority door-to-door delivery is available for these larger packages, as well.

TWA also flies Next Flight Out Paks and packages from New York to London. For just $55 for the Pak and $85 for larger packages, we pick up, ship, clear through customs, and deliver to the door. The same day.

So if you have a package to send, and you want to save time and money, bring it to TWA. We'll get it there today.

For more information, or to arrange a high-priority pickup, just call our toll-free number: 800-638-7380.

TWA CARGO

You're going to like us

---

Circle No. 404, on Reader Service Card
Weathering for sale...

Wood and Cabot's Stains...made for each other

Cabot's STAINS

Here is a wood at its wonderful best. The architect, in specifying a finish for this home, sought beauty and more...a finish that would stand up to summer sun and winter cold, that would require minimum maintenance while protecting the wood for a long, trouble-free life. His choice: Cabot's Stains.

Cabot's Stains, in 87 unique colors, enhance the wood grain, grow old gracefully, never crack, peel, or blister...are ideal for shingles, siding, clapboards, paneling, and decking. In terms of natural beauty, economy, and ease of application, Cabot's Stains are best for all types of wood, exterior or interior, and all wood surfaces, smooth, striated, or rough-sawn.

Cabot's patented colloidal manufacturing process assures exacting standards of color, deep penetration, and wood preservation. In a world that is constantly shouting "new," Cabot's Stains are very proud to be "old, the original, and still the best."

For color cards and information, write:

Samuel Cabot Inc.
One Union St., Dept. 428, Boston, Massachusetts 02108

"Cabot's Stains, the Original Stains and Standard for the Nation since 1877"

Circle No. 328, on Reader Service Card
TERNE, FRANÇOIS MANSARD AND THE CONTEMPORARY IDIOM

Few architectural elements are more traditional than the classic mansard roof. Its current adaptation to highly contemporary design thus provides a dramatic example of "the very old becoming the very new," a phrase which Frank Lloyd Wright once applied to Terne metal itself. And wherever such fascia elements are used, the outstanding functional characteristics of Terne, along with its inherent affinity for both form and color, are available at relatively moderate cost.

FOLLANSBEE
FOLLANSBEE STEEL CORPORATION
FOLLANSBEE, WEST VIRGINIA

SAN MATEO COMMUNITY COLLEGE DISTRICT
SAN MATEO, CALIFORNIA

ARCHITECTS: CHAN-RADAR & ASSOCIATES, AND WEITON BECKET AND ASSOCIATES
SAN FRANCISCO, CALIFORNIA

ROOFER: MARUCH MANUFACTURING COMPANY
SAN BRUNO, CALIFORNIA

Circle No. 348, on Reader Service Card
Design flexibility and good engineering have been major objectives in the development of Blum railing systems. Components of the several systems are interchangeable to offer the designer the widest possible selection of metal, acrylic/wood and plastic components. Examples shown here illustrate the variety achieved by designers and executed through the ability of metal fabricators.

Blum's comprehensive catalogs supply data and methods for engineering design as well as clear and complete details of stock components. Thus the designer can specify Blum railings for style and appearance, for economy and structural soundness, and design railings to meet applicable codes or safety requirements.

All components are carried in warehouse stock in quantity and are available through architectural metal fabricators in all parts of the United States. Refer to Sweet's catalogs or request Catalog 13.

RAILING SYSTEMS

Carlstadt®
Acrylic/Wood Colorail®
Connectorail® Ornamental

JULIUS BLUM & CO., INC., CARLSTADT, NEW JERSEY 07072
N.J. (201) 438-4600 • N.Y. (212) 695-2236 • TELEX 13-3491

THE MOST COMPLETE SOURCE FOR ARCHITECTURAL METALS

Member of NAAM, NOMMA, NAAD & Steel Service Center Institute

Circle No. 319, on Reader Service Card
Break the barriers of accessibility, cost and space.

Barrier-free Bradpack wash centers are completely pre-assembled to save you time, space and money. Everything (including light, towel and soap dispensers, mirror, faucet and many other features) has been designed for convenient use by everyone, including the physically disabled. A Bradpack wash center comes to you in one piece—so you can set it into place and connect the water and electricity. With significant savings in floor and wall space as well as installation labor, these units are equally suited to remodeling or new construction applications.

Find out how you can break barriers to efficient washroom design. Send for our Bradpack catalog. A 30 minute educational film, "Barrier-Free Washroom Design" is also available for viewing. Contact your Bradley representative or Bradley Corporation, 9101 Fountain Blvd., Menomonee Falls, WI 53051 (414) 251-6000. TELEX 26-751.

Another right idea from Bradley
Don't lose energy through roof hatches!

Foam-insulated steel covers with U-values ranging from .09 to .17 make Inryco/Milcor hatches extremely effective energy-savers: less heat lost through the roof in winter, less heat penetration in the summer.

Inryco/Milcor hatches are also light in weight, have strong covers of composite design, and have clear, unobstructed openings. Single and double-leaf styles—available in many sizes. Check Inryco/Milcor hatches before you specify. You'll find the same high quality and dependability you've seen for years in our Access Doors!

More information is available in our Catalog 34-1. Send for your copy today. (It's in Sweets, too.) Special Products Group—Milcor Division; INRYCO, Inc.; Dept. D, 4069 West Burnham Street; Box 393; Milwaukee, Wisconsin 53201.

And don't forget BIG SMOKY™

Inryco's "large economy size" ALL-STEEL heat and smoke vent for buildings with 5 ft., 5 ft. 6 in., and 6 ft. joist spacings. Strong, rigid, lightweight...and energy-saving!
Great windows are as great at 110° as they are at 40° below

If there's any doubt in your mind about the value of energy engineered windows, come to Warroad when it's 40° below or Tucson when it's 110° above. We build some of the most energy-efficient windows in the world because they make any structure (1) less expensive to heat and/or cool, (2) more comfortable, and (3) easier to maintain. Heavy wood construction keeps heat from passing through frame parts. Double weatherstripping minimizes air infiltration. Triple glazing slashes the amount of heat gained or lost through the glass area. And Marvin has been offering all of these features for decades. Write or call for a catalog of beautiful, energy efficient windows. Marvin Windows, Warroad, MN 56763. Phone: 218-366-1430.

You've never been so insulated in all your life!

Circle No. 377, on Reader Service Card
Energy-related specifications

William T. Lohmann

The apparent impact of a new energy conscience on construction specifications is slight. Specifications do not group "energy" factors (or "safety" or "security") under a common heading. They are dovetailed into appropriate trade or equipment sections. Even products, such as reflective glass and solar-collector piping, find their places under familiar titles. There is no need to throw out your copy of the CSI "Masterformat."

We are faced, however, with a greater need for effective coordination between the architectural and engineering specifications in our documents. Design criteria are becoming more stringent. Systems are more complex. Rapid changes in test methods and performance data quickly make manufacturers' catalogs obsolete. Architectural, mechanical, and electrical functions are more independent than in the past.

An early meeting with the project engineers can begin to resolve potential conflicts in format, style of writing, and terminology. Sample specifications and master sections will help. Out-of-house consultants particularly need such guidance. They must also be cautioned to review drafts of the "front-end" documents prior to preparing their specifications, avoiding duplication of such information in places other than the General Conditions and Division 1 sections.

The flow of design information between architects and engineers is critical. Building construction impinges directly on mechanical design, affecting such factors as solar gain through glass and heat absorption of floors and walls. Mechanical and electrical equipment items likewise affect, indeed become, architectural features. Solar panels replace walls or roof. The possibility of future retrofit for wind-driven generators or photovoltaic cells involves present design allowances for structural support and access. Remember that a roofing manufacturer's warranty usually does not cover damage caused by roof-mounted equipment. Early overlap decisions in these areas should be documented in outline specifications and confirmed at each stage of design.

During preparation of the specifications, precepts for good technical writing apply—clarity, brevity, consistency. Extensive editing is sometimes necessary to achieve a uniform level of detail and a sense of cohesiveness in the documents. But it is worth the effort. Finding "furnish and install" in one section and "provide" in another can lead to erroneous bids. The same is true for other problem phrases—"exposed," "by others," "allowance"—if they are not defined and used consistently.

Duplication and omission of information are hazardous. To specify all motor starters in a section under Division 16 Electrical and also in the heating and ventilation sections under Division 15 Mechanical is both expensive and confusing. To forget them is disastrous. Common practice puts starters for loose motors in the electrical work and those for motors mounted in preassembled equipment in the mechanical sections.

Such trade "assignments" are often necessary. Wiring for other electrical components usually follows the guidelines established for motor starters. Full-color coding of piping and conduit should be specified under the painting section, yet stenciled bands and letters and adhered-backed labels normally appear in the mechanical and electrical sections. Pipe-covering requirements must be correlated for the plumbing, heating, refrigeration, and process piping trades. Unless indicated on the drawings, the specifications must define contract or trade limits for site utilities and building services.

When selecting mechanical and electrical equipment, investigate the impact of the new energy performance codes. The equipment must comply. Eventually, standardized testing, perhaps by rating agencies, will simplify its selection and specifications. Until then, specify required performance and means of determining compliance. The manufacturer should certify that his equipment meets or exceeds these specifications.

Perhaps the classic coordination problem has arisen with development of the "integrated" ceiling, involving up to six trades in one assembly. Because of its complexity, many firms now specify all components in a section under Division 13 Special Construction and cross-reference related work in the mechanical and electrical sections. This can result in a single-source responsibility for the entire system.

Before releasing the documents for printing, potential problem areas should be reviewed with care, preferably by someone other than the author. A final check of scope items, cross-references, and known problem areas will also reduce confusion during bidding and construction of the project.
Levolor has come up with a glare-and-temperature control system for large expanses of glass that dramatizes your original design instead of detracting from it. Overhead, Levolor Galaxy™ Sun Controller blinds redirect the sun's rays, for minimum glare, maximum summer cooling, maximum winter warmth. Used with Riviera™ blinds by Levolor at the window, as shown here, you have a total sun control system that is a visual plus, easy to install and engineered with Levolor technological standards—the highest. A system that can be operated automatically or manually. The beautiful answer to odd-shaped, hard-to-reach special glazing situations. Our Levolor architectural consultant can answer your specific questions. Write for information: Levolor Lorentzen, Inc., 720 Monroe Street, Hoboken, N.J. 07030.
To go to space, Rockwell International came to Clearprint.

Rockwell International specifies the finest quality drafting paper—Clearprint Paper—for its projects like the Space Shuttle Orbiter.

Because Clearprint won't ghost. It's tough, it won't crack, or yellow with age.

But don't just take our word. Send in the coupon, and put Clearprint Paper to the test.

Then you'll know why companies like Rockwell International specify the paper we perfected in 1933—Clearprint Paper.

The Space Shuttle: designed to be the keystone of the nation's space program through the 1990's, the Space Shuttle is the first re-usable space transportation system. Rockwell International Space Division is integrating the system and developing the payload carrying Orbiter stage for NASA's Lyndon B. Johnson Space Center. One of a series covering historic Clearprint design events.

Come to Clearprint for free samples.

Name __________________________
Title __________________________
Firm Name _______________________
Address _________________________
City _____________________________
State/Zip _________________________

Clearprint Paper Co., 1482 - 67th Street
Emeryville, California 94608

Circle No. 332, on Reader Service Card
Blanket your roof with silicone/urethane foam and get up to 30% energy savings.

It's like a nice, thick blanket for your roof. The Dow Corning® silicone/urethane roofing system snuggles your roof in protective layers of long-lasting silicone rubber and highly insulating urethane foam to keep water out, seal heat or cool air in. All year around you're saving energy, as much as 30 percent or more compared to an equivalent thickness of conventional roof insulation.

This lightweight roofing system is leak-free and weatherproof. Underlying urethane foam provides a seamless blanket of efficient insulation, and on top is a flexible membrane of Dow Corning silicone rubber that's unaffected by all kinds of weather—rain, snow, sleet, sunlight and temperature extremes from -80 F to +300 F.

The spray-applied, seamless roofing system reduces or eliminates ponding, excessive weight, and overlaps where water can enter. And the efficient insulation blanket drastically reduces thermal shock and deck movement that can damage conventional built-up roofing systems.

This roofing system can be installed on new roof decks as well as over most old built-up roofs. You save on costly roof removal and disposal and eliminate operational shutdown. Install the Dow Corning silicone/urethane roof system and rest easy.

For more information, contact Dow Corning Corporation, Dept. H7-510, Midland, Michigan 48640.

Dow Corning

Cost-cutting silicone elastomers.
REVERE SOLAR AND ARCHITECTURAL PRODUCTS, INC. made a commitment to solar energy years ago. Now, as the pioneer and leader in the manufacture of solar energy systems, we want to help you get your share of bigger than ever sun dollars in America's fastest growing industry.

We offer you five systems to capture original and retrofit solar powered applications in a wide range of areas, including: residential, institutional and multi-unit housing; swimming pools; and commercial and industrial buildings and processes.

CHECK THE AREA OF YOUR INTEREST

- **SUN-PRIDE**™: Complete domestic hot water system...from solar collectors to hot water tank. All components warranted by Revere.
- **SUN-CENTER**™: Pre-piped, pre-wired power package for solar domestic hot water systems. No pipe cutting. No joint sweating.
- **SUN-AID**™: Modular solar collectors for existing buildings. Include exclusive Revere Tube-In-Strip solar absorber plate, for trouble-free performance.
- **SUN-ROOF**™: Structural roof and solar collectors, all in one. Collector panels mounted flush with roof line. Hardly noticeable from ground level.
- **SUN-SWIM**™: Specially sized solar collectors with factory brazed tubes and joints. Easy installation...uses pool circulator to move the water through the collector loop.

Chances are you're thinking of quoting on jobs involving one or more of the above areas right now. Don't miss this golden opportunity to think Revere Solar and see how your sales and profit picture could be affected. But you need all the facts first. Call your nearest Revere Solar representative. Or fill out your name and address, tear out the whole page and mail to: Revere Solar and Architectural Products, Inc., Dept. PA 480 Box 151, Rome, New York 13440. Phone: 315/338-2401.

Name

Company

Address

City State Zip

REVERE
SOLAR AND ARCHITECTURAL PRODUCTS, INC.
A subsidiary of Revere Copper and Brass Incorporated
Bigelow, first in contract carpet, introduces a first.

MAGNELOK

U.S. Patent No. 4184304

the revolutionary carpet installation system that finally affords easy access to steel trench headers.

Leave it to Bigelow to develop a carpet installation innovation that specifiers, architects, building owners, electricians and maintenance staffs have been waiting for! MAGNELOK, a totally new solution for applying carpet over trench header ducts that permits easy access to the trench. The Magnelok system uses a special magnetic sheet to anchor the carpet, yet allows ready entry whenever and as often as necessary. If you have ever had problems with carpet used over trench header duct systems that would not stay down...or would not come up for access when necessary...or had unsightly, unsafe binding strips over the access areas...then the Magnelok system is the solution. You might know it would be developed by Bigelow.

For more detailed information and sample of this incredible product, write to: Bigelow Contract Department, Bigelow-Sanford, Inc., Box 3089, Greenville, SC 29602

Circle No. 316, on Reader Service Card
Solar collectors vs.
local ordinances

Norman Coplan

Of the many strategies for improving the energy performance of buildings, the installation of solar collectors poses the most immediate challenge to local codes and zoning ordinances.

If solar energy is to be a realistic alternative to traditional sources of energy, it is necessary that a serious examination and analysis be made of our laws to determine how they must be modified to accommodate and facilitate this technological development. One of the greatest concerns in this context is how our laws should be modified to ensure solar access to homeowners utilizing this technology, more specifically to protect solar collectors from shadow. One suggestion has been for the states to adopt legislation which would classify certain conduct and/or conditions, which might impair the use of solar energy, as a “public nuisance” under the inherent police power of the state to protect the safety, health, and general welfare of the community. Although this approach involves constitutional questions, statutory restrictions whose purpose would be to encourage the use of solar energy would undoubtedly be sympathetically received by the courts.

A more immediate obstacle, however, to the wider use of solar technology are local zoning ordinances or building codes which have not been reviewed and/or modified to accommodate the utilization of solar energy. Illustrative of this problem was a litigation in New York last year involving the effort of a homeowner to obtain a building permit to install solar collectors for his home, which installation apparently violated the then prevailing zoning ordinance (Katz v. Zoning Board of Appeals of the Town of Mamaroneck).

The petitioner in the Katz case had applied to the Municipal Building Department for a permit to construct a solar panel domestic hot water system, which panels were to be placed on the roof of his home. The permit was denied because of a provision of the local zoning ordinance which restricted the area of mechanical equipment to 10 percent of the roof area on which the collectors were to be located, whereas the installation of the collectors would cover 20 percent of the supporting roof. The petitioner appealed to the Town Board of Zoning Appeals requesting a variance. This was initially denied, but thereafter the petitioner revised his plans to reduce the area of mechanical coverage to 16 percent of the supporting roof area and reduced the angle of the panels so that their visibility from the front of the house was reduced by 70 percent. Upon his reaplication, the Board of Zoning Appeals again denied the variance, despite the fact that no neighboring residents objected to the variance and 26 neighbors actively supported the same. The petitioner then instituted a further appeal to the Supreme Court of New York.

The Court, in reversing the Board of Zoning Appeals, ruled that the Board had been incorrect in interpreting the zoning ordinance as limiting the mechanical coverage of the “supporting roof.” The Court pointed out that the petitioner’s roof was made up of eight separate sections and that the limitation was not to be measured by the section which supported the mechanical equipment, but rather in relation to the area of the entire roof.

More significantly, however, the Court ruled that even if the Board’s interpretation of the ordinance were correct, the denial of a variance to the petitioner was arbitrary and capricious. The Court said:

“It must be remembered that zoning ordinances, being in derogation of common-law property rights, are to be strictly construed against the municipality and in favor of the landowner. Even if Section 89-45A were applicable to petitioner’s proposed construction, this Court finds and so holds that petitioners have shown practical difficulty sufficient to justify an area variance.”

“In this day of what for better expression may be termed the energy crunch, the purposes of restrictive zoning must, to some extent, give way to declared policy of governments to conserve energy in all ways possible yet consistent with environmental standards... In the accomplishment of the above, it is incumbent upon the zoning agency to adopt an attitude other than an ostrich head-in-the-sand approach, especially when adoption to changing scientific advances follows and complies with national and state interests in energy conservation. It has been said that our increasing dependence on foreign energy supplies presents a serious threat to the national security of the United States and to the health and safety of the American people, and that, further, ‘the mass production and use of equipment utilizing solar energy will... promote the national defense.”

The Court concluded by pointing out that in furtherance of the public policy of the United States, the Energy Tax Act of 1978 was adopted, providing a monetary incentive for domestic solar hot water systems for private dwellings and that such policy has been followed by similar State expression of public policy and monetary tax relief. In particular, the Court pointed out that the Energy Law of the State of New York imposes upon municipalities the duty to review their rules and regulations not only to make them consistent with the State declared policy for energy conservation, but where “inconsistent, to make necessary changes to comply with the Act’s stated purposes.”

Implicit in the Court’s decision was a criticism of the Town for failing to review its ordinances to make it comply with prevailing public policy. It is apparent that proper planning to achieve the use of alternate sources of energy includes, as an essential ingredient thereof, the necessity for reviewing and revising local zoning ordinances for their compatibility with such objective.
"Lighting costs were keeping my profits down..."

"Until I put energy-saving Watt-Miser™ II fluorescents up."

Saving money on lighting costs is what Watt-Miser II fluorescents from GE are all about. They use less electricity than standard fluorescents; yet give you about the same amount of light. So wattage reduction is immediate...and so is savings.

Watt-Miser II F40 can save you up to 14% on the electricity each lamp consumes when they replace your standard four-foot F40 fluorescent tubes in a typical two-lamp open strip Rapid Start fixture (about 11% in a typical four-lamp recessed Rapid Start fixture).

Watt-Miser II Slimline, rated at 100 lumens-per-watt, can save you up to 20% of the fixture wattage.

High-Output Watt-Miser II lamps use almost 14% less wattage than conventional eight-foot mA Output lamps.

Watt-Miser II Power Groove® is an exclusive GE energy-saving lamp that can reduce your fixture wattage by more than 18%, compared with a standard T12 1500mA lamp, in a two-lamp fixture.

For the ultimate combination in efficiency and savings, there's the new Maxi-Miser™ System from GE.

Two Watt Miser II F40 lamps and the new Maxi-Miser II ballast in a Rapid Start two-lamp fluorescent fixture will average up to 24% more light per watt than standard F40 systems - and use as much as 19% less wattage.

Ask your GE representative to show you how much you can save with Watt-Miser II fluorescents. Or contact General Electric Company, Dept. C-921, Nela Park, Cleveland, Ohio 44112. Phone: (800) 321-7170 (In Ohio (800) 362-2750).
FOR ALMOST ANY DOOR

better, less costly, more attractive control

Three basic models for simplified specification, for the improved hanging of most swing doors.

- Add a side jamb pivot if you like, a Rixson door pivot is still less costly than either a pair and a half of heavy duty butt or anchor hinges.
- Provides superior anchorage than either butt or anchor hinges, with screws in shear (not tension) and without reinforcement.
- Eliminates door drag and binding, by supporting door top and bottom, with weight primarily resting on bottom pivot. (Typical hinges place weight on side jamb.)
- Even distribution of door weight assures longer life; better withstands racking of door holder and human abuse.
- Contemporary architectural design. Other pivot sets for special applications, extra heavy doors, security installations, electrical uses.

Only Rixson-Firemark offers the better way...a full line of performance-proven door pivots.

Ask the door control specialists:

RIXSON-FIREMARK
9100 West Belmont Ave., Franklin Park, Illinois 60131 and Rexdale, Ontario 312/671-5670

A SUBSIDIARY OF CONRAC CORPORATION

Circle No. 393, on Reader Service Card
Admittedly, looks were not the first consideration in designing our Safetyline Door. Safety was. So we gave it a flexible rubber guard to save fingers. And perhaps even save you a lawsuit.

We gave it a cylindrical stile and a 2-point flush-mounted locking mechanism. And a push-pull that fits snugly so it doesn't snag clothing. It was the only door of its kind. And it still is.

Now come the looks. A variety of looks, including the textured panel above, to dovetail with any design.

And if you don’t find exactly what you want, we'll custom make it.

Either way, you get a door that doesn’t give up aesthetics for safety. Or vice-versa.

Your Amarlite Representative will be happy to show you all the ways we’ve dressed up the Safetyline Door. For more information, write to Amarlite Anaconda, P.O. Box 1719, Atlanta, Ga. 30301. Or you can call us at (404) 691-5750.

AMARLITE ANACONDA

Circle No. 307, on Reader Service Card
The future and politics of energy

Books

The Politics of Energy
Why President Carter's Energy Plan Is
- Foolishly reasoned
- Economically destructive
- Dangerously dependent on Nuclear Energy
- Represent the true potential of Solar Energy
And what we should be doing instead

Barry Commoner


Reviewed by John P. Eberhard, Director, Architectural Research Association, Inc., Bethesda, Md.

These two books, one by a renowned environmental biologist (Commoner) and the other by a team of newly acclaimed Harvard Business School professors, arrive at very similar conclusions by taking considerably different approaches. Their conclusion, that conservation (or more clearly, improved energy efficiency) is the best energy policy alternative for the United States, should be welcome news within the architectural community. As I will suggest a little later in this review, it is the professional design community—and more specifically architects—that have the responsibility and the opportunity for making the largest contribution to reducing our nation's dependence on fossil fuels. It is worth noting, as well, that the long-awaited report of the National Academy of Sciences, "Energy Policy in Transition 1985-2010," has added still more reinforcement to this message of conservation. The Academy study insists that "slowing the growth of energy demand will be essential, regardless of the supply options developed during the coming decades. In fact, the demand element of the nation's energy strategy should be accorded the highest priority."

Both of these books are well written but are stylistically and conceptually different. Commoner is quite clearly an advocate and a critic. He is an advocate of a policy alternative he has coined "The Solar Transition," and is a severe critic of the past and present Federal policymakers. The Harvard Business School professors are policy analysts with good common sense and what would appear to be no beginning bias towards any of the alternatives they discuss. Each of us probably brings some preconceptions and personal bias to the reading of any book; and each of us naturally tends to accept with a positive nod of the head statements the author makes which support our point of view. We naturally find it difficult to believe the authors are very well informed if they happen to [Books continued on page 193]
We started building insulated windows for the energy crisis ten years before there was an energy crisis. Today, everyone's looking for ways to sell energy saving, especially in windows. And it's no secret that many of today's products were developed yesterday. But when you're building quality housing, you can't afford "Johnny-come-lately" products. You want a proven performer, a window with a winning track record.

Like the Alcoa Alaskan Insulating Window. The engineers at Alcoa's Technical Center started working on the Alaskan years ago. They designed it with the kind of concern for detail that goes into every new Alcoa product. A thermal break to cut heat loss. Twin panes of welded-edge glass for increased insulation. And double weather stripping to minimize air infiltration.

The result? A window that's proven itself even in the harsh climate above the Arctic Circle. A window that's ready to meet the energy crisis. Today and tomorrow. And a window that you can sell with confidence.

When you're considering energy-saving windows, think of the one with the proven track record—the Alcoa Alaskan Window. And to find out about available sales support, write:
Alcoa Building Products, Inc., Suite 1200, Two Allegheny Center, Pittsburgh, PA 15212

Alcoa means business, and the Alaskan Window means more business for you.

Alcoa Building Products INC.
SUBSIDIARY OF ALCOA
differ with us. I approached both of these books in much the same manner. I expected to agree with Commoner because I thought I knew what he would say, and I expected to disagree with the Carter book because of all of the publicity the authors had received. (Besides, I am an alumnus of MIT.) Just the opposite happened. I found Barry Commoner's student tones and fuzzy policy position to be difficult to accept, but I found the good common sense and clear prose of Energy Future to be easy to read and very convincing.

The only difficulty I found to be common to the two books was an academic penchant for extensive footnotes (although they are thankfully scattered at the end of the books and not scattered over every page of text), and the diarrhea of numbers. I'm going to assume, for the purposes of this review, that you have some general sense of the numbers involved with energy and that whether or not we expect to use 80 quads of energy or 135 quads by the year 2000 is not critical to your professional response. If buildings use 26 percent of the nation's energy budget or 31 percent is not going to impact your opportunity, and whether or not solar energy has a payback of 2.8 years or 8.4 years is less critical than that you resolve to inform yourself and your colleagues of how you can incorporate "energy-conscious design" into your practice. Both books take some pains to point out the weakness of numerical calculations that others have made—Commoner even calls the energy models of the Carter Administration "the politics of deceit"—but both books tend to draw specific conclusions of what would likely happen to energy prices that have turned out to be far lower than what has actually happened at the gas pumps only a few months after the books were published.

Barry Commoner makes the following argument. The Carter Administration's National Energy Plan as presented to Congress in April 1977 was "confused" at best and probably "deceitful" on purpose. He argues that although the plan called for conservation measures, including the development of energy alternatives such as solar and wind energy, that the plan was actually a not very subtle support program for the oil industry. He also points out that the disparity between facts in the tables, facts from a complex mathematical model (PIES) used by the then Federal Energy Administration, and the prose of the President's message, the legislation got hopelessly mired in Congressional committees resulting in what Commoner calls the "Politics of Defeat."

In Chapter 5 of his book, Commoner comes to the crux of his presentation. He points out that fossil fuels in the final analysis are finite—they can be and likely will be used up. As they become more and more scarce their price will continue to escalate. He suggests that the 'Politics of Choices' leaves us only two alternatives for the future—solar energy (in its broadest sense this includes wind power, bio-mass, and photovoltaics) and nuclear energy (but only if it is based on the breeder reactor). He argues that nuclear energy, even though highly subsidized, is a new technology that seems already to have lapsed into "economic senility," while solar energy is an old technology ready to cross the threshold of economic viability.

Commoner's dénouement is "the Solar Transition." He argues that we should use our dwindling supply of fossil fuels in a manner that "bridges" from the present situation to a future time in which we will be well supplied from renewable sources. He sees natural gas, supplemented with gas from bio-mass and co-generation as two of the major ingredients of this strategy. What he seems not to recognize is the possibility that new inventions and innovations might substantially change the nature of demands as well as sources of supply. He also makes a strong argument for more "social governance" in major policy decisions because electric utilities and oil corporations will oppose a solar future—what many readers will suggest is reworking our economy into more of a socialist state. For me the book's central strategy remains un-

Books continued from page 191
Strong steel windows for ninety-three years is the strong reputation of:
The William Bayley Company
Springfield, Ohio 45501
Tel. 513-325-7301
AN AFFILIATE OF CONTROL SYSTEMS CORPORATION

Books continued from page 193

convincing, but then you should read it and decide for yourself.

Robert Stobaugh, Donald Yergin, and their Harvard colleagues are much more convincing and far easier to read. Their central theme is very clear. The United States needs a balanced energy program based on realistic assessments of our supply and demand alternatives. They point out quite convincingly in their first five chapters that each of the fossil fuel alternatives—oil, gas, coal, and nuclear—has an inherent limitation as a supply alternative. Even if each of them were to achieve the goals of their most ardent supporters, they would not provide sufficient supplies through the end of this century (much less beyond) to meet our projected demand on a "business as usual" basis. They arrive at the same position as the first energy report of the American Institute of Architects (dated 1974), namely that conservation is our "key energy source." They conclude that "in the near term, conservation could do more than any of the conventional sources to help the country deal with the energy problem it has."

While the architectural community should surely support the thesis of Energy Future, there is one serious flaw in the authors' discussion of conservation in buildings. They quote Dick Stein on the need to reverse our commitment to sealed buildings—that's fine. They quote Don Watson and Bruce Anderson when they discuss the opportunity for passive solar design—great! But, when they advocate a major program to save energy in existing buildings, they turn to the limited concept of "retrofit." To quote them, "Retrofit is a space-age term, describing the upgrading of a complex system through the insertion of improved components." In buildings, they say, this means changing equipment and structure to improve thermal and lighting efficiency. Somehow, with all of their common sense, they missed the key point: people and their activities place demands on energy sources not the inanimate buildings that provide shelter for these activities.

An empty building, a ghost town, or even an unused bedroom needs no retrofitting since no one will need to be kept comfortable there. We need to be sure that existing buildings have a good fit between their program requirements and their existing space configuration before we worry about palliatives such as more insulation, storm windows, or even cogeneration. We should be sure that our architectural evaluation of fitting program requirements to available space also includes any "energy conscious" redesign we can do to make a better fit with the climate. That's a good role and an important one for architects to play. If this kind of analysis is done thoroughly and with imagination, it can represent the largest reduction in building energy demand—and it comes right off the top of the demand side. We obviously have not done a very good job of selling our role in the energy picture thus far or two such thorough books would not find it so easy to largely ignore the role of architects in energy conservation.

Energy Future makes it clear that: "No easy remedy will solve the energy crisis. Solutions, however, will emerge from a recognition and comparison of benefits and risks, possibilities and obstacles, across a wide range. Political choices are therefore involved, which is why the energy crisis is a crisis of our political system." How will you vote?

The streamlined years


Within a few years of the depression, everything from soup cans to airplanes in the U.S. had been redesigned, either to satisfy public demands for a more stylized approach to consumer products or to keep up with competition from other manufacturers. In this heavily illustrated, well-documented book, the author discusses all aspects of design including architecture, and he emphasizes the work of such leaders as Raymond Loewy, Norman Bel Geddes, Walter Dorwin Teague, and Henry Dreyfuss.

Circle No. 315, on Reader Service Card
Architectural accessories by Landscape Forms are notable for meticulous design and imaginative use of woods and fiberglass in tables and seats, benches, planters, planter-benches and receptacles. The complete catalog includes more than 5,000 products in a great variety of styles, sizes, materials, and finishes. For more information write to: Landscape Forms, Inc. Route 3, Kalamazoo, Michigan 49001 or call 616/381-0396.
the triumphant scope in textures and tones

VICRTEX®
vinyl wallcoverings

L.E. CARPENTER and Company • A Dayco Company, 170 North Main Street, Wharton, N.J. 07885. (201) 366-2020/NYC (212) 751-3565

DISTRIBUTED BY: VICRTEX SALES DIVISION. New York, Atlanta, Chicago, Dallas, Los Angeles, San Francisco, Boston.

Minneapolis, Toronto, Montreal. HOWELLS, INC., Salt Lake City/PAUL RASMUSSEN, INC., Honolulu

Circle No. 362, on Reader Service Card
THE TK FINE LINE
DRAFTING SYSTEM.

Switch to the drafting system that makes it easy to get precise, accurate drawings and pays for itself in savings on everything from labor to refill lead. It's the Faber-Castell TK Fine Line Drafting System.

Choose from constant line widths of 0.3mm, 0.5mm, 0.7mm or 0.9mm. The TK Fine Line System features tempered polymer leads in the most popular grades for paper and vellum, plus special Filmar leads for drafting film.

Then pick the pencils that bring out the best in the leads — TK Fine Line Pencils with semi-sliding sleeves that prevent lead breakage.

The leads and pencils work together as a system, delivering precise, uniformly black lines that erase without ghosting. The result is a clean, dust-free drawing that reproduces beautifully in diazo machines, copiers, microfilm and other photographic methods.

Compared to 2mm drawing leads, you'll save up to 75% with TK Fine Line Leads. Save again on man-hours and lead wastage because TK eliminates lead pointing. And save even more on reduced inventories of lead holders, leads and pointers.

See your Faber-Castell dealer for the full story, or send today for more information.

Precision that saves you money.

Faber-Castell
Circle No. 352, on Reader Service Card
Here, for the first time in this century, is an opportunity to re-examine the philosophy of the Beaux-Arts school of architecture.
NEW
11 Public Relations for the Design Professional
By Gerre Jones.
278 pp. illus. . . $18.90
This authoritative book on public relations written in easily understood language for architects, engineers and other design professionals explains how to plan, set up and carry out a PR program that meets special requirements, as well as how to take advantage of overlooked opportunities for free publicity from the media.
Circle B611 under Books.
12 Living Spaces: 150 Designs from Around the World
Edited by Franco Magnani.
Translated by Robbi Mitchell.
120 pp., illus. . . $22.50
This magnificent book provides a wealth of imaginative and practical ideas for homeplanning and decoration for people confronted with the problems of confined living space and the resulting tensions which are often exacerbated by noise and pollution. The superb full-color photographs demonstrate interiors to safely aesthetic as well as practical needs.
Circle B612 under Books.
13 Anthropometrics for Designers
By John Coney.
176 pp., illus. . . $4.50
This unusual book provides an illustrated account, principally through diagrams, of man's dimensions and other physical data. His limitations and his peculiarities — data essential in many specialized fields of industrial or commercial design.
Circle B613 under Books.
14 Architectural Illustration
The Value Delineation Process
By Paul Stevenson Oles.
288 pp. . . $34.50
In this copiously illustrated, clearly organized explanation of his value delineation system, the author presents a detailed description of the process which has resulted in these award-winning delineations that show realistically how a designed structure will appear when built.
Circle B614 under Books.
15 Structure in Nature is a Strategy for Design
By Peter Pearce.
245 pp., illus. . . $45.00
An innovative and completely illustrated approach to architectural and environmental design, based on a study of responsive and adaptive structures in nature (molecules, crystals, living cells) that conserve energy and materials.
Circle B615 under Books.
16 Earth Sheltered Housing Design Guidelines, Examples, References
Prepared by the Underground Space Center, University of Minnesota.
318 pp., illus. . . $17.95
This comprehensive and timely study offers a comfortable and economic approach to underground housing based on modern construction techniques. Provides plans, details and photographs of existing examples, and shows how to design homes using such low-cost natural resources and energy-saving systems as layers of soil insulation and passive solar heating.
Circle B616 under Books.
17 Drawing File for Architects, Illustrators and Designers
By Marc Szabo.
295 pp., illus. . . $14.95
This book provides over 200 pages of figures — in the most common and natural positions, activities, and types of wearing apparel, as well as dozens of drawings of boats and cars, all of which can be copied freely — by direct tracing photostats, or photocopying machine. This page tear out easily to form an easily accessible fingertip scrap file.
Circle B617 under Books.
18 Design Cost Analysis for Architects & Engineers
By Herbert Svinburne.
317 pp., illus. . . $18.95
This first-of-its-kind book shows architects and engineers how to analyze and estimate the costs of building construction during the design stage when the potential for controlling costs is greatest.
Circle B618 under Books.
19 Architectural Stained Glass
Edited by Brian Clarke.
234 pp., illus. . . $23.50
The contributors to this book (through their stunning designs) emphasize stained glass as a constructivist art form, taking it out of its medieval ecclesiastical context and putting it into a contemporary framework, both social and architectural.
Circle B619 under Books.
By Robert C. McHugh.
169 pp., illus. . . $14.95
This guide is a step-by-step presenta-
tion on how to produce working draw-
ings as an integral aspect of commun-
ication between designer and builder. Includes convenient check-lists, bu-
The following items are related to the theme of this issue, energy conservation. They are grouped here for the convenience of the reader.

Daylight control

Daylight control is a function of almost every aspect of design, from the direction the windows face to the size and shape of the room inside. In terms of products, there are basically four kinds: things to put outside the window; things to make the window of; things to put inside the window; and things to adjust the level of artificial light. Many devices have been around for years with the state of the art having as much to do with how to use these products as what is available. Architects are discovering, for instance, that the plastic-coated aluminum panels from industrial buildings can be very useful as shading devices.

Integral to the process is redefining the task from simply defending the interior against overheating. Daylight control now means harnessing the sun to reduce lighting load resulting in techniques like light shelves to bounce sunlight into buildings. Movable louvers with one side reflective and the other matte can be very effective in beaming light deep inside as can blinds with the same properties (available on custom order and in development as a stock item). Several companies are working on photochromic window glass, which, like "polarizing" eyeglasses, adjusts its tint according to brightness. Other researchers are taking a serious look at refractive glass, those ripple windows from the 1940s. The ripples were made of prisms grooved into the glass which bring light in and bounce it off the ceiling, allowing deeper penetration. But bringing sunlight in is only half the task; the rest is to turn lights off to compensate. To the traditional on-off switch and more recent stepped controls, solid-state circuitry has introduced continuous dimming, either by user controls, mechanical dimmers or photo-electric sensors.

In addition, attention is being paid to avoiding heat loss as well as heat gain. Among the newest items are heat mirrors—films applied to the inside of windows—which reflect infrared rays back into the room; and rolling screens and shutters of wood or plastic, that have been used in Europe which both modulate daylight during the day and form a thermal barrier at night.

Products

Solar screens of tiny fixed louvers tilted at 17 degrees protect against heat and glare. The screens, installed outside sun-exposed windows, keep building interiors up to 15 degrees cooler while admitting diffused daylight. Almost invisible from the inside, the screens permit as much as 84 percent clear outward visibility, according to the manufacturer. The screens are made from a bronze alloy coated with an organic finish for corrosion resistance and are enclosed in aluminum frames. They are adjustable, controlling the amount of daylight entering the room. The sensor sends a signal to the power control to gradually reduce power to lamps as daylight increases, according to the manufacturer. The screens are made from a bronze alloy coated with an organic finish for corrosion resistance and are enclosed in aluminum frames. They are adjustable, controlling the amount of daylight entering the room. They are made of PVC with dead air space, PVC with polyurethane insulation, or aluminum with polyurethane insulation. American-German Industries, Inc.

Rolladen shades shield against heat loss or gain, reduce sound, and also serve as security guard, since they lock from the outside. When not in use, they roll up and store out of sight. Shades operate by manual crank, pulley strap, or electric motor. They are made of PVC with dead air space, PVC with polyurethane insulation, or aluminum with polyurethane insulation. American-German Industries, Inc.

Paesar fluorescent lighting controller has a sensor that automatically monitors the amount of daylight entering the room. The sensor sends a signal to the power control to gradually reduce power to lamps as daylight increases, maintaining a constant level of light. The manufacturer says that lighting energy savings of as much as 50 percent are possible, and that cooling costs are also reduced. Lutron Electronics Co.

ECALO (Energy Conservation Automatic Light Output) is an available-light sensing system that adjusts fluorescent lighting to a predetermined level. The intensity of direct or reflected sunlight, are reported to save 43 to 58 percent in energy used.

Payback period is six months to three years, depending upon the type of fixture used. Controlled Environment Systems, Inc.

NorCore® high-strength, lightweight plastic honeycomb material is used in transparent ceiling, walls, partitions, skylights, and geodesic domes. It has light transmission or translucent properties and retains a high degree of thermal insulation. Because it is a thermostatic, it can be molded into curved shapes through the thermal forming process. It is available in opaque colors, clear transparents, transparent tints, and translucent colors. Norfield Corp.

Exolite double-skinned acrylic sheet for glazing offers high light transmission, good U-value, and easy on-site fabrication. Integral ribs form a series of insulating air cells. The material has high rigidity and load strength, impact resistance, and excellent weatherability, according to the manufacturer. Panels are 5⁄8 in. thick, 47 1⁄2 in. wide, and come in standard lengths up to 20 ft. Uses include glazing, skylights, and lighting fixture diffusers. CY/RO Industries.

SOL-VEIL is PVC-covered fiberglass material offering shade with visibility. Intended for exterior window installation, it also can be adapted for use on window interiors. The material can be used on roll-up shades, spring rollers, or on motorized versions controlled by a solar cell. Panels that slide, vertical blinds, and other treatments are possible. The fabric requires little maintenance; it can be vacuum cleaned or washed with a mild detergent. Sol-R-Veil Inc.

Products and literature

[Products continued on page 202]
Nobody simplifies ceramic tile like your American Olean Sales Representative.

When you're considering using ceramic tile, there's one person you can always count on for help. Your American Olean sales representative.

You'll get help in specifying the proper tile for the job. Help in answering those tough, technical questions. And helpful suggestions — for new and imaginative ways to use our tile.

You'll get more. Your American Olean sales representative helps see that your ceramic tile installation is completed as specified, no matter where it is. Because backing our representatives, there are American Olean sales service centers and manufacturing plants across the country. And there's even more coming on board this year.

Get information about our fine ceramic tile and allied products plus the name of your American Olean sales representative. Check our catalog in Sweet's General Building File or call us at (215) 855-1111. Or write American Olean Tile Company, 2734 Cannon Avenue, Lansdale, PA 19446.

American Olean is Ceramic Tile.
The Tri-Therm Skylight has an outer dome of GE's Protect-A-Glaze® sheet and an inner diffuser panel of GE's Lexan® structural sheet which combine to provide three layers for high impact strength and superior thermal properties. The outer dome has a pebble finish and comes either clear or tinted for solar control. The skylights provide daylighting and thermal gain to help reduce energy requirements. They are lightweight, economical, and easy to install. Faulkner Plastics. Circle 107 on reader service card

Insulating skylights of translucent, impact-resistant sandwich panels are adaptable to many types of installation. Single panel size is up to 6' x 25', with larger areas covered by multilayer units. The fiberglass-reinforced skins provide diffused light without excessive loss of heat. The panels are offered in a choice of core patterns, skin colors, surface finishes, and light-transmission values. Cencel Corp. Circle 108 on reader service card

Single, joint-free all-plastic skylights provide natural light and insulate against thermal heat loss in winter and solar heat gain in summer. The 1/2-in.-thick sandwich panels have a 1%-in. dead-air space which results in a U-value of 0.425. Outer and inner skins are translucent fiberglass-reinforced acrylic polyester laminated to a 6" x 6" interlocking grid core. The skylights transmit about 40 percent of the sun's rays in a diffused manner, without glare. Solartron Corp. Circle 109 on reader service card

Cool-View reflective glass comes in four configurations, each with a choice of glass and coating. Weath-R-Proof insulating glass has two lights separated by dehydrated air space and offers the greatest environmental control. Monolithic is a single light for economical glazing in warm climates. Laminated is used in installations requiring safety, sound control, security, or for overhead glazing. Spandrel is coated or strengthened. Environmental Glass Products. Circle 110 on reader service card

Sunglas Reflective, a reflective glass, blocks up to 65 percent of the sun's heat and has 30 percent visible light transmittance to reduce reliance for artificial lighting. A thin metallic oxide permanent coating reflects solar energy, and the special composition of the glass absorbs and reradiates additional solar energy to the outside of the building. By eliminating hot spots near windows, the glass helps to maintain more uniform temperature in the building. Ford Glass Division, Environmental Products Dept. Circle 111 on reader service card

Literature

Operable windows of several types are described and illustrated in a 20-page brochure. There are styles with narrow slat blinds between the outer and inner glazing to aid in heat and glare control. Others have insulated glass or double glazing. In-swinging and pivoting windows can be cleaned, or replaced in the event of damage, from the inside. Detail drawings and photos show window construction. Disco Aluminum Products. Circle 200 on reader service card

Sun Control products shown and described in a four-page color brochure include Harosol® fold-up awnings, Haroscreen® sun protecting material for the outside of buildings, Harodark® 100 percent blackout blind, and Haro Sunbreaker® aluminum louvers. General information, construction details, fabrics, control methods, and applications are provided. Hamel, Inc. Circle 201 on reader service card

Nunsun transparent reflective film for windows reduces glare, provides daytime privacy, and adds shatterproofing characteristics to glass. According to the manufacturer, use of the film on windows of a building where glass area is equal to 10 percent of floor area will reduce air-conditioning energy required by one-third and heating energy required by one-fifth. The film is also available in roll-up shades that have the advantage of being adjustable up or down. Thermo-Screen, Inc. Circle 203 on reader service card

Vertical blinds can cut summer heat gain to lower air-conditioning loads. They also are adjustable to reduce glare. Several fabrics are available, some with perforations to allow the view to be seen even when the blinds are closed. There are some types that also provide acoustical control. Materials available, applications, and specifications for various types of blinds are provided in a 24-page brochure. LouverDrape, Inc. Circle 204 on reader service card

Blinds for conserving energy are the subject of a six-page brochure. Diagrams show how they save energy, winter and summer. Graphs indicate dollar savings in heating and cooling costs. Included is a table of shading coefficients for Riviera blinds, along with data supporting the charts shown. Levelor Lorentzen, Inc. Circle 205 on reader service card

Kool/Wall track-mounted solar screens reduce solar heat gain in the summer, yet can be retracted to let in the winter daytime sun and lowered to retain building heat at night. A four-page brochure discusses and illustrates details of the controls, track design, and installation. The system can be combined with photoelectric lighting zone controls to reduce artificial lighting needs. Kool-Shade Corp. Circle 206 on reader service card [Products continued on page 204]
COLORKLAD creates updates easily!
for commercial or residential new construction and remodeling.

COLORKLAD really assisted in the update-remodeling and expansion of the old Pacific Northwest Bell Telephone building in Spokane. The award-winning project called for wrapping a brick curtain wall around the entire existing building and providing an air conditioning system with external ducts hidden inside spectacular COLORKLAD fins. The fins climb vertically the entire height of the structure. Results: More space and a handsome new brick exterior accented by esthetically-pleasing COLORKLAD. A marvelous downtown renewal!

This one project illustrates three important features of COLORKLAD: the unique prefinished steel sheet that has gained widespread acceptance for roofing, fascia and other protective and decorative building applications.

COLORKLAD, in nine exciting colors, is beautiful. Its use opens new creative vistas to architects and owners alike. COLORKLAD updates for remodelers, COLORKLAD brings distinct and obvious feeling of tomorrow, not only from appearance but from unseen features such as wearability.

Finally, COLORKLAD is easy! Easy on the pocketbook. Easy to obtain. Easy to install and maintain.

Building Products Division
P.O. Box 380, Mpls., MN 55440
LOCAL 612-378-1131
MINN. ONLY 800-552-1202
NATIONWIDE 800-328-7772

Vincent
BRASS & ALUMINUM CO.

SEND FOR OUR NEW COLORKLAD BROCHURE AND FREE COLOR SAMPLES TODAY
PA-04-80

Name ____________________________
Title ____________________________
Company _________________________
Address __________________________
City _____________________________
State ____________________________
Zip ______________________________
Circle No. 420 on Reader Service Card
Lighting devices

While much of the world still depends on burning oils and wax for its light, the technological changes in lighting since the oil embargo in developed countries has been dramatic and promises to be even more so in the future.

We now speak of lamp efficacy in lumen output per watt consumed. Energy saving means both lowering wattage (lighting accounts for five percent of U.S. electrical use) and redirecting the heat lighting produces.

Office planning now frequently means task/ambient arrangements and a host of new products. In addition, the relationship between visual comfort and worker productivity has led to serious experimentation and new offerings in prismatic, polarized, batwing, refractive grid, and tinted lens fixtures.

Much of the research has been devoted to increasing lumens per watt from fluorescent bulbs—which have been brought from 37 to 100 in the past 40 years and are expected to go higher. Lower wattage bulbs (34, 35) for 40-watt ballasts are available and in situations where a bulb resulting in a 10 percent reduction in illumination is acceptable, even further savings can be effected. Fluorescents that work as conventional incandescent bulbs will be available soon. Incandescents can be expected to move from 17 lumens to 30 per watt.

Products

A three-lamp fluorescent troffer, designed with one less lamp for energy saving, can further cut energy costs because it is wired for one, two, or three lamp operation. The troffer is 3½ in. deep, has a door that can be hinged from either side, and has a 2" x 3" wiring access door. Keene Corp., Lighting Div. Circle 112 on reader service card

Energy-efficient fluorescent lighting fixtures, Form 4, in 4-ft and 8-ft standard length use one or two fluorescent lamps. They may be mounted directly to the ceiling, hung from stems or cable hangers, attached to the wall by brackets, or mounted wall to wall. They are suitable for direct lighting, indirect lighting, or a combination of both. Lighting diffusers are parabolic-shaped louvers or acrylic lenses. Finishes offered include nine colors and three metallics. Columbia Lighting, Inc. Circle 113 on reader service card

SPJ2 ambient lighting uses both metal halide lamps rated up to 100 lumens per watt and high-pressure sodium lamps rated up to 118 lumens per watt, and accommodates ballasts for up to 400-watt lamps. The luminaires provide improved lighting and cost savings in open-plan offices where partitions are 42-65 in. high, and lighting cannot project above the panel. The units can be mounted on shelves, on panel sides, or on freestanding files. Because one lamp provides as much light as 16 4-ft fluorescent lamps, fewer fixtures are required, reducing wiring and installation costs and cutting HVAC loads. SPI Lighting/Area Lighting Div., McGraw-Edison Co. Circle 114 on reader service card

Products continued on page 206

Now, all the benefits of carpeting...
with better static protection than tile.

Compu-Carpet™

COMPU-CARPET anti-static carpeting is a unique, high performance floor covering developed specifically for use in modern offices, computer rooms, terminal areas and other static-sensitive environments. Attractive and durable, Compu-Carpet has anti-static properties superior even to those of hard surface flooring.

Compu-Carpet meets IBM resistance recommendations. Since its anti-static properties are inherent in its construction, protection is assured for the life of the carpet. Compu-Carpet carries a 5-year static and wear warranty. See Sweet's Catalog 9.28/Un. Send for complete details.

For computer rooms

For general office areas

32 Southwest Industrial Park, Westwood, MA 02090, (617) 326-7611

Circle No. 413, on Reader Service Card
You're looking at the second best reason to use our stain.

A lot of professionals use Glidden Spred Oil Stain because it's beautiful. And that's all right, because we happen to agree with them.

But to find the real beauty in Glidden Spred Oil Stain, look past its appearance. To the way it seals and protects wood.

As Spred Oil Stain is applied, it penetrates the wood. To repel rain, snow, humidity. A tough, resistant coating that lasts.

Ease of application? That's dependable, too. Painters will find that the Glidden formula keeps pigment in suspension longer. So our stain goes on smoother, with less stirring.

You should also find Spred Oil Stain's 83 colors useful. Every one as beautiful as the color you see here. Plus our easiest to use stain deck yet—solid colors on one side, semi-transparent on the other.

Spred Oil Stain from Glidden. Our reputation for quality and performance proves you'll get more than a beautiful building.

Glidden

Circle No. 355
ParPower spot track lights use all-purpose lamps, yet provide concentrated light because of the reflector design. Air flow around the bulb has a continually cooling effect which prolongs bulb life. Less heat is generated because low-wattage lamps are used. NuTone Div., Housing Products Group, Scoville.

Circle 115 on reader service card

Indalux® indirect ambient lighting using energy-efficient HID lamps, features computer-aided reflector design to provide maximum light distribution, in a pattern consisting of three basic components: direct lighting providing maximum reflectance without glare; reflected light offering maximum wide-angle light; and diffused lighting to reduce direct brightness and eliminate hot spots. There are three lighting systems: high-level symmetrical, high-level asymmetrical, and low-level for mounting below 72 in. J.H. Spaulding.

Circle 116 on reader service card

WAL wall-mounted luminaires provide energy-efficient illumination for walkways, courtyards, entrances, building security, and loading areas. An aluminum reflector directs light at the target, without glare. There are two types: a clear lens model for areas where light control is necessary; and a prismatic lens model where light distribution to the front and sides of the fixture is required. The luminaires can be used with high-pressure sodium, mercury vapor, or metal halide lamps. Crouse-Hinds Co.

Circle 117 on reader service card

The 'Electronic Halare' bulb is an energy-saving bulb that fits standard household fixtures. To become available in 1981, the bulb has electronic controls in the base and an arc tube in the top. It has high and low settings, with the high setting producing as much light as the 150-watt setting of the typical three-way bulb using about one-third the energy. General Electric, Lighting Business Group.

Circle 118 on reader service card

A fluorescent lighting remote control regulates lighting levels to reduce electrical usage. Lighting is triggered by electrical impulses from the control along existing electrical wiring into the controlled fixtures, where a small receiver turns on the lamps. Maximum range of the device is 300 ft. It can be installed on most new or existing 120- to 277-volt fluorescent systems without major rewiring or redesign. Sylvania Lighting Services, General Telephone & Electronics.

Circle 119 on reader service card

Wall-SavER-30 is an extended-life reflector light bulb that saves up to 55 percent in energy costs over the higher wattage bulbs it is intended to replace. Its beam focuses about 2 in. in front of the bulb, permitting the 67-watt ER-30 to replace a 150-watt R-40 flood lamp at a substantial saving in energy according to the manufacturer. The bulb has a life rating of 5000 user hours and comes with a one-year free replacement warranty. Duro-Test Corp.

Circle 120 on reader service card

Energy-Lok® energy-saving ballast for fluorescent lights is said to have double the life of standard ballasts. For use in commercial, industrial, and institutional buildings, the ballasts are expected to save from $90 to $360 per fixture over the life span. Designed for two-lamp, 40-watt fixtures, the ballasts can be used with either standard or energy-saving fluorescent. Jefferson Electric.

Circle 121 on reader service card

Emergency lighting energy planning table illustrates the economies of using Products continued on page 211]
It's happening at American Standard.


There's more excitement! Three new whirlpool baths, a soaking bath with whirlpool, and an enormous 20' deep whirlpool bath for two. All accentuated by the newest luxury of American Standard Dualux fittings. Backed by the American Standard reputation for quality.

We're saying to every one of your customers: "Take a look at American Standard." And they are!

America's bathrooms are coming to life!
These guys don't make glaring mistakes.

They bought precise light control by Holophane.

Some owners rarely give a second thought to lighting - "If it's bright, it's right."

But that's wrong. Because the best lighting is controlled lighting. The kind of lighting knowledgeable architects and engineers recommend for clients like Oliver's Meats. They know that Holophane offers precise light distribution with minimum glare. Excellent for large department stores, schools, auditoriums, offices - and butcher shops.

Efficient use of energy is another benefit of controlled lighting by Holophane.

And choices range from HID luminaires to prismatic lens fluorescent fixtures. They all deliver illumination which can reduce eyestrain and promote better worker productivity while giving products more customer appeal.

Learn more about our commercial lighting line by calling your local Holophane representative. He'll show you the latest in attractive high quality lighting. And provide the ESI, VCP and cost data you'll need to prevent glaring mistakes.

Or contact Neil Thompson, Johns-Manville Sales Corporation, Holophane Division, P.O. Box 5108-PA4, Denver, CO 80217. Phone 303/979-1000.
battery-operated equipment. The table includes information on the company's newest products such as models that power remote heads, multidirectional units, exit signs, and an emergency lighting fluorescent power pack. Dual-Lite Inc.

Circle 122 on reader service card

Tracklighting designs added to the Lytespan line include: "Bell" Lytespot, with an internal reflector and a special lens to concentrate the light beam; "Flashlyte," a slender shape for accent lighting or a soft wash of intensity light; and "Scoop" Domelight, for installation on a track or suspension from a cord. Lightolier.

Circle 123 on reader service card

A 12-volt track-lighting accent light with a self-contained transformer has been added to the TRAK-1 lighting system. It is cylindrical, with a rotating bezel for easy orientation of the beam pattern. According to the manufacturer, it offers energy-efficient operation along with other features including concealed wiring and swivel with positioning lock. Progress Lighting. Subs. of Walter Kidde & Company, Inc.

Circle 124 on reader service card

Literature

Campus lighting brochure provides engineers, architects, consultants, and designers with information about campus lighting. Also included is information about cost payback. For example, according to the manufacturer, converting a typical mercury vapor system to high-pressure sodium reduces energy consumed by 14 percent while providing 100 percent more light. A 12-question test helps in the evaluation of the effectiveness of present lighting. The 10 luminaires described have applications in parking lots, indoor athletic facilities, walkways, building entrances, roadways, and driveways. Lighting Systems Dept. General Electric Co.

Circle 207 on reader service card

X-Parabolic fluorescent luminaire. Basic design concept and energy-conservation, cost-saving, and light-output advantages are presented in a 48-page brochure. Photographs, drawings, graphs, and diagrams support the text. Typical applications include offices, schools, stores, and hospitals. Lighting Products, Inc.

Circle 208 on reader service card

'Design Criteria for Lighting Interior Living Spaces' is intended as a guide to designing lighting for all interior spaces. It defines lighting problems in detail, presents the design objectives, and discusses quality and quantity criteria to be used in the design. Sections on lighting methods, equipment available, and energy considerations are included. Copies of the 56-page paperback are $7 to IES members, $12 to nonmembers. Order ISBN-0879950064, prepaid, from Illuminating Engineering Society of North America, 345 E. 47 St., New York, NY 10017.

Low-energy consuming light fixtures for showrooms, stores, display windows, galleries, museums, homes, and offices are described and illustrated in a six-page brochure. The lamps, which consume less energy and generate less heat than standard voltage lamps, are available with light beams ranging from very narrow spot to wide flood. There are several fixture styles and mounting devices. Lighting Services Inc.

Circle 209 on reader service card

HandiLiter-S, an energy-saving light fixture, is shown and described in a [Literature continued on page 213]
Add an 8th wonder to your world:

VEREL® Casement Collection VIII
MODACRYLIC FIBER

The Egyptians closed space in. Cohama Specifier opens space up. With our Space Planners' Casement Collection VIII, styled with a blend of Verel® modacrylic fiber for inherent and permanent flame resistance, you design openness as part of any room decor with the light, airy look that begins with window treatments.

Ask your Cohama Specifier sales representative about adding an eighth wonder to your world... our Verel® Casement Collection VIII. Be sure to see it at NEOCON XII, Space 910-A.

Verel is Eastman's trademark for its modacrylic fiber.

Cohama Specifier
CONTRACT FABRICS

295 Fifth Avenue, New York, N.Y. 10016 • 212-564-6000
UNITED MERCHANTS AND MANUFACTURERS, INC.
Circle No. 324, on Reader Service Card
four-page catalog. Specifications, ballast information, and installation data are provided. Applications listed include shipping docks, bank canopies, assembly lines, security areas, parking garages, and covered walkways. Chart compares the number of fixtures required for equal light output, operating cost for each, and savings possible. Guth Lighting. Circle 210 on reader service card


Monitrol LC-500 automatic control permits lighting cost reductions averaging 40 percent, according to the manufacturer. A six-page, full-color brochure explains the necessity for lighting control, describes the unit, and supplies technical data on both installation and operation. Data provided show that the system offers a 15-month return on investment. CSL Industries. Circle 212 on reader service card

Maxi-Miser® systems are described in a four-page brochure that provides electrical data and specifications for fluorescent lamp/ballast systems. Compared with standard fluorescent lighting, Maxi-Miser is said to use fewer watts and to reduce energy costs by as much as 21 percent. Information is also provided about performance, energy savings, and payback period. General Electric, Lighting Business Group. Circle 213 on reader service card

Perimilfer luminaires are highly efficient wall lights that use energy-saving HID lamps. The luminaires provide uniform lighting at a 6 to 1 ratio of spacing to mounting height, compared to 4 to 1 with other wall lighting. Four-page brochure describes internal and external features and provides installation data, mounting detail specifications, and photometric data. Hubbell Lighting Div., Harvey Hubbell, Inc. Circle 214 on reader service card

Interior lighting catalog for 1980 offers 16 pages of integrated ceiling/lighting systems. Included are energy-efficient luminaires, modular suspension grids, air-distribution equipment, acoustical and decorative ceiling materials, and lighting for open-plan offices. Selection guide lists components for each system. Johns-Manville Service Center. Circle 215 on reader service card

PAR and R reflector lamps as substitutes for standard incandescent lamps are described in an eight-page lamp engineering bulletin. With reflectors en...
closed within the lamps, they are unaffected by dirt and operate at higher lighting efficiency. The bulletin has instructions for calculating power cost savings possible with PAR and R substitutions, an example of savings in a typical installation, and a complete list of available lamps with built-in reflectors. Lamps, an example of savings in a typical installation, and a complete list of available lamps with built-in reflectors. Lamp Commercial Div., Westinghouse Electric. Circle 217 on reader service card.

Photovoltaics

Photovoltaics are a Buck Rogers technology which is available today. Light-induced electromagnetic reactions in silicon crystals cause an electric current to flow. When a series of cells are wired together, on the roof, for example, enough electricity can be generated to run the air conditioning of a house in Las Vegas or to provide electricity for a whole housing complex in Quincy, Ma. Although the price is prohibitive, it is now possible to reliably furnish electricity to a building with an array of photovoltaic cells. As recently as last year, manufacturers were predicting the esoteric technology to come into economic range by 1986. Now the supply and demand curves are expected to cross as early as 1982. You can thank the Ayatollah for that. We can also thank the stimulus of government funding which has helped researchers with giant steps towards practicality. Bugs to be worked out are relatively simple ones: how to build an inexpensive direct-current submersible water pump; how to convert direct current to AC cheaply; or perhaps how to permit the consumer to credit his electric bill by wiring directly into the electrical grid for the community.

Literature

Unipanel® solar electric panels convert light to electricity through photovoltaic effect. The panels are suitable for low-power applications such as telemetry stations, environmental sensors, alarm systems, radio communications, and emergency lighting. The high-efficiency solar cells are encapsulated in silicone rubber on an aluminum frame. The panels can be used singly or in series/parallel arrays and come with brackets adjustable to a range of angles to suit their location. Solarex Corp. Circle 218 on reader service card.

Solar electric panels and a motor designed and built to be used with the panels are described in a product bulletin. Information includes characteristics, construction, and areas of application of the panels. They are made up of a series of 18 4-in. cells completely sealed between two sheets of glass and framed with aluminum. Wm. Lamb Co. Circle 219 on reader service card.

'Building Blocks for Solar Electricity' describes solar cells, panels, arrays and electrical generator systems. It provides a formula for estimating the size of a solar-electric system. Diagrams show how solar electricity is made. Specifications for standard panels are included. Solarex Corp. Circle 220 on reader service card.

Photovoltaic system components are described in a six-page folder. Cells are covered with tempered glass and backed by polymer-coated steel foil. The parts are fused by a special laminating process and enclosed in an aluminum frame that is sealed to prevent moisture penetration. Batteries that store the electricity are also described. An explanation of how the system works is included. Arco Solar, Inc. Circle 221 on reader service card.

Solar electric systems and cells are discussed in a four-page brochure that shows typical panel configurations and explains how electricity is produced from solar energy. Product bulletins for several types of solar power modules provide electrical performance data, application information, and a list of the features of each module. Photowatt International, Inc. Circle 222 on reader service card. [Products continued on page 216]
FLEXCO Unitized Installation Makes Seamless Vinyl Floors

Factory pre-grooved tiles for fast, economical installation

Flexco Contract V Vinyl Tile and Flexco Conductive Vinyl Tile may be "heat welded" into a seamless, one piece floor by Flexco Unitized Installation. Floors installed by this unique method are literally fused together by application of a special vinyl bonding strip of contrasting or harmonizing color to the floor tile. Made of a special formulation of pure vinyl resins, the 36" x 36" x 1/8" factory pre-grooved tiles are installed in a conventional manner, then vinyl bonding strips are fused with tiles in the grooves with a portable heat weld gun. The result is a unitized floor without seams. Because of the special vinyl formulation heat welding of the tiles is fast and permanent.

Flexco Contract V Vinyl Tile and Conductive Vinyl Tile are made in a wide range of contemporary colors.

Flexco can supply on special order Contract V Vinyl Tile and Conductive Vinyl Tile which meets Class A fire rating requirements.
Windmills

Make room for wind energy! In modern terms, the dream of wind energy in areas of dense population has eluded us. Midwestern farms are ample proof of its viability at a certain scale of use, but we will probably never see wind machines in the suburbs servicing a single-family dwelling. We are starting to use wind power for backup energy use in special building types and in clusters of buildings. The irregularity of small-scale wind electrical production must be accommodated by either regular energy demand, batteries, or conversion to a more convenient form of energy. Direct current must be converted to AC for most conventional uses, an expensive proposition for the moment. Very large-scale installations have plugged directly into the electrical grid through transformers. When wind is used with buildings, equipment is usually isolated structurally to avoid vibration problems. The path for optimum air flow downwind and upwind must be considered. Land formations, landscaping, and buildings all affect the air flow. New designs in the last few years have improved the appearance of the wind generator.

Products

Windstream® 33 is a second-generation wind turbine generator in the 10-20 kW size range that can be interfaced with an electrical utility. It has three blades with a total diameter of 33 ft. Power output is 15 kW at 24 mph. Windstream and its tower have a 25-year design life. It is intended as a supplemental power source for various applications. Grumman Energy Systems.

Circle 123 on reader service card

Cycloturbine® is a wind turbine that can be tied directly into a utility grid. When the wind is blowing, it supplies electricity; when windpower is not available, power is automatically drawn from the grid. Other systems include one that is used with either an alternator or a generator to provide electricity to run or supplement power for domestic hot water or resistance baseboard heating. Another has a drive shaft to the ground to provide energy to an air compressor, water friction heater, or pump. Pinson Energy Corp.

Circle 126 on reader service card

High Reliability 2 kW (HR2) wind generator is designed for remote, unattended sites where high reliability and minimum maintenance are required. It is built to withstand severe environmental conditions. The generator produces over 2 kW in a 20-mph wind and up to 700 watts in an average wind speed of 12 mph. A variable axis rotor control allows the rotor/alternator assembly to tilt up to a vertical axis in a high wind to prevent stress to the machine. North Wind Power Co.

Circle 127 on reader service card

Literature

Enertech 1500 wind system, installed at a windy site, can produce up to 60 percent of electricity required by a typical home. It is intended for use where utilities are available to be drawn on when demand is high or wind power is low. A 16-page booklet contains information about the system's features, site considerations, towers, and tax credits, and provides technical specifications. Enertech.

Circle 223 on reader service card

Wind power theory, battery storage, glossary of terms, equipment, site evaluation, and other design information makes up the first part of this 48-page catalog. Products listed include equipment for generating and storing energy, controls, weather instruments, towers, and grounding devices. Catalogs, at $3 each, can be ordered from: Sencenbaugh Wind Electric, P.O. Box 11174, Palo Alto, CA 94306

'Site Selection and Evaluation Handbook for Wind Energy Systems' provides information about factors to be considered in selecting wind energy sites and choosing properly sized systems. It lists sources of wind data and includes diagrams showing wind patterns. Names and addresses of manufacturers of wind measuring equipment are provided, along with a description of the type of equipment [Literature continued on page 219]
It's no wonder more and more builders are siding with Simpson Ruf-Sawn 316. It's all in the overlay. The overlaid surface of Ruf-Sawn 316 has a unique woodgrained texture. It's deeply embossed with a ruggedly handsome real-wood appearance. And it provides a near-perfect surface for paint or solid color stains, with the amazing ability to hold a finish up to 3 times longer than any raw wood surface!

It's even available prefinished! So you don't have to spend extra time for preparation or paint. With a wear surface that's really tough! The rock-hard resins in the overlaid surface help protect against extreme weather conditions. So Ruf-Sawn 316 stays looking good, season after season. With little or no maintenance.

All the structural advantages of plywood. Ruf-Sawn 316 gives you both the convenience and strength of plywood. It's light weight, too. And it doesn't require additional sheathing.

Let Ruf-Sawn 316 make your job look even better. Or select Stucco 316, another attractive product in our overlaid plywood line. Contact your Simpson distributor today. Or write Simpson Timber Company, 900 Fourth Avenue, Seattle, WA 98164.

Ruf-Sawn 316

Simpson

Circle No. 408, on Reader Service Card
American Solar King is pleased to introduce an entirely new collector for the 1980's. The new Solar King "DECADE 80"™ Model SG-15 may be just what you've been looking for.

The SG-15 brings together high performance and low cost in a very competitive combination. DSET test results are self-evident. The SG-15 has a strong performance curve. In fact, we believe it is one of the most efficient flat plate collectors available anywhere.

With prices currently ranging from $11.14 to $13.60 per square foot, depending on purchaser status and quantity, we believe you will agree the SG-15 could be your answer to high performance at a low cost.

If you would like specifications on the SG-15 "DECADE 80"™ flat plate collector, please write or call. You may have found what you've been looking for.

Circle No. 314, on Reader Service Card
The Helical Wind Turbine (HWT) is an airfoil and rotor design employing four sets of two blades. It allows for high aerodynamic efficiency and high torque capabilities, making it suitable for low to moderate wind characteristics. A six-page color brochure describes the turbine and its power output at various speeds. Also included is a cutaway model of the HWT generator made by GE. Environmental Energies, Inc. Circle 224 on reader service card

Heat pumps

A heat pump is an ingenious contraption that takes advantage of the heat exchange during a phase change in certain fluids. A liquid which turns to gas at a low temperature takes heat from its environment. A compressor can raise the temperature of the gas still further so that on contact with a cooler environment it releases heat and condenses or returns to a liquid state. The heat pump has been around for over 25 years. It was not until the early 1970s, however, that the business went wild. In areas of the country where electricity is the main energy source, the heat pump can be very effective for heating (above 32 F) and cooling. It competes very well with resistance heating. Pumps move heat from water into air (as water source) or air to air (air source). As the environmental temperatures are seasonally reversed, the pump which heats can also be made to cool. Over a half million heat pumps were installed in homes last year. They are part of every active solar cooling system or ice maker, for that matter. The reliability of the heat pump has improved greatly in recent years.

Products

The Space-Pak® heat pump offers year-round heating and cooling where conventional installations are difficult. Air distribution is through preformed flexible ducting that can be installed quickly and easily. The interior unit can go in the attic, basement, garage, closet, or similar area. It can be used where add-on or replacement heating is needed and ducts are not available: in offices and professional buildings requiring design flexibility; in multi-unit buildings requiring individual heating/cooling systems; or in older homes with inadequate ducts. Dunham-Bush Inc. Circle 128 on reader service card

AYB gas chiller-heaters, for year-round use, are available with capacities from three to five tons. Delivered capacities range from 36,000-60,000 Btu for cooling and 90,000-135,000 Btu for heating. They can also supply either chilled water or hot water for a variety of residential or small commercial applications. Functions are changed by changing settings on a room thermostat. Arkla Industries. Circle 129 on reader service card

The HPII "Legend" two-speed heat pump, for rooftop or ground level installation, delivers cool air in summer, heat in winter. The heat pumps come in two sizes, each suitable for residential or small commercial building use. Since the units operate at low speed most of the year, substantial savings are possible. The 1½-ton model supplies 1½ tons of cooling with an energy efficiency ratio (EER) of 8.7 at low speed. The 4-ton model, operating at high speed, has an EER of 8.5. Lennox Industries. Circle 130 on reader service card

Split system and packaged heat pumps. EERs of 8.0 to 8.1 and COPs of 2.7 to 2.9 are provided by split systems which also have a demand defrost cycle that is (Products continued on page 220)

Architects the world over are covering Problem Walls with FLEXI-WALL.

Flexi-Wall’s Plaster in a Roll™ is the unique one-step solution to covering concrete block, poured masonry, chipped plaster, old tile, drywall, even glass and plastic. When dollars get tight, it’s Flexi-Wall to the rescue.

Maximum durability. Goes up like wallpaper, but because it dries as hard as plaster, it covers blemishes and bumps, bridges gaps and voids. Comes in 23 decorator colors. Easy to clean, extremely durable.

An optional anti-graffiti covering makes Flexi-Wall perfect for high-traffic areas.

Flexi-Wall... the architectural solution that covers problem walls with a decorator finish.

The cost effective Problem Solver that meets your specs and beautifies your design.

• Hospital Approved
• Class A Flame Spread
• Eliminates Lead Paint Hazard
• O Smoke Generation
• Produces No toxic Fumes
• GSA Contract #GS-00S-64549
• HUD Contract #0PHCCOM-2878
• City of New York Dept. of Bldgs., #MFA 6-79-M
• See Sweet’s File 9.13/FL

FREE SAMPLES. CALL OR WRITE TODAY.

Circle No. 347, on Reader Service Card
The Templifier® heavy-duty heat pump for industrial, commercial, and institutional applications captures waste heat from fluid, usually water, amplifies it, and transfers it to liquid, again usually water. It can generate hot water up to 250°F, and ranges in capacity from under 100,000 Btu to 20,000,000 Btu. The system, sources of heat, system efficiency, and some typical installations are described in an eight-page brochure. Use of the system in amplifying a solar collector system called Native Sun® also is discussed. Westinghouse Electric Corp., Industrial-Commercial Tem­ plifier Dept.
Circle 132 on reader service card

Literature

‘Commercial Buildings’ explains the application of EnerCon water-source heat pumps in commercial buildings. The 10-page brochure discusses how the air-conditioning system reclaims, recycles, and stores energy. Statistical data on life-cycle costing and descriptions of the models available are included, along with illustrations of typical applications. American Air Filter Co.
Circle 225 on reader service card

Sunpath® high-efficiency heat pumps are designed for residential or small business heating and cooling. Eight-page brochure shows features of the solid-state logic module. Charts provide heating and cooling data, wiring diagrams, dimension information, and operating details. Accessories for field installation are described and shown in drawings. York Div., Borg-Warner.
Circle 226 on reader service card

T.H.E. heat pump for residential use is available in seven models with a coefficient of performance (COP) range of 2.7 to 3.1, and energy efficiency ratio (EER) from 8 to 9.2. Technical information, outdoor unit and indoor furnace unit specifications, and performance data are provided in a 12-page brochure. The Coleman Company, Special Products Group.
Circle 227 on reader service card

Energy Recovery System (ERS) heat pump systems are described and illustrated in an eight-page brochure. Diagrams illustrate the energy recovery principle. Features are listed for several air-to-air and water-to-air models. Command-Aire Corp.
Circle 228 on reader service card

WeatherKing® heat pump brochure lists the features of the indoor and outdoor units of a completely assembled, factory-wired split system. Charts show heating and cooling capacities, specifications and ratings of both units, and dimensions. Addison Products Co.
Circle 229 on reader service card

Energy conversion systems. Application engineering manual is a 24-page booklet providing product information about heating/cooling systems. It discusses system design, heat pump installation, and operating instructions. Dimension and performance data and specification guide are included. KoldWave Div., Heat Exchangers, Inc.
Circle 230 on reader service card

Self-contained and split unit heat pumps. Six-page brochure explains briefly how heat pumps work to heat and cool. A drawing of the outdoor unit shows its internal features, and descriptions explain their functions and advantages. Johnson Corporation, Subs. of Magic Chef. 
Circle 231 on reader service card

Sun Dial® split system heat pumps for heating and cooling are described in a six-page bulletin. Components are listed as are factors to consider in the selection of a heat pump system. Diagrams illustrate how a split system works in both heating and cooling cycles. The bulletin also provides data about the characteristics of nine models. Square D Company.
Circle 232 on reader service card

[Products continued on page 222]
More power to you.

Tempo 3 delivers. It’s the open office system designed to manage the electronics explosion. Easily. Effectively.

Real Capacity. Our unique design offers four raceways in each panel base—room for up to sixteen 25-pair cables and six 20-amp circuits.

True Flexibility. Our modular wiring makes rearranging easy. Order pre-wired outlets on one or both sides, in the base or at desk height. And outlets can be added anytime.

So don’t get caught with your power down. Let us show you all the advantages of Tempo 3. Call your Shaw-Walker representative. Or write Shaw-Walker, 934 Division Street, Muskegon, Michigan 49443.

SHAW WALKER
Rational Energy Analysis Program (REAP BX) in extended basic language can be used with a programmable calculator. The program is based on latest ASHRAE procedures and other industry sources. Using local weather data, it can calculate heating and cooling energy consumed by fans, pumps, air handlers, and other equipment and can do a comparative analysis of system alternatives. Results are provided on an easy-to-read printout. Carrier Air Conditioning.

Circle 133 on reader service card

Wireless Overriding Triple Control (WOTC) is a solid-state control that provides automatic programming of multiple conditioners from a central location to permit nighttime setbacks. When the building is occupied at other than normal hours, however, the system has overriding capacity to return to the daytime mode. It can also provide separate controls for areas having different schedules. Climate Control Div., The Singer Co.

Circle 134 on reader service card

Zero Energy Band thermostats provide heating and cooling setpoints for a range over which no energy is needed to maintain space temperatures. They can be applied to new or existing HVAC systems. There is also a dual thermostat to provide for both heating and cooling ranges. Honeywell, Inc.

Circle 135 on reader service card

The Optimizer is a programmable timer with solid-state logic circuitry to delay heating startup in the morning to the latest possible time based on actual interior and outdoor temperatures. It will interface with existing systems to provide almost immediate benefits. According to the manufacturer, cost of the installation can be recovered within a single heating season in many instances. Robertshaw Controls Co.

Circle 136 on reader service card

The Energy Monitor translates kilowatts to dollars and cents to make the user aware of the actual cost of energy. It also provides heating/air-conditioning cycling when use exceeds a budgeted amount. Digital readouts show accumulating use, use to date, projected use for billing period, “over-budget” alarm, and bill to date. It can be used in industrial, commercial, and residential buildings. The Dupont Energy Management Corp.

Circle 137 on reader service card

Solar energy systems for space heating, hot water, air conditioning, and industrial processing heat provide economical energy for schools, hospitals, offices, factories, and homes. Systems are pre-wired and preplumbed for ease of installation. Evacuated tube solar collector models with parabolic reflectors deliver energy efficiently even on cloudy and cold days. Sunmaster Corp.

Circle 138 on reader service card

Styrofoam SM sidewall insulation for use in remodeling includes two types for exterior applications and one for interior use. The insulation is attached between metal Z-channels, then covered with siding materials. For a stucco finish, the insulation is covered with expanded metal lath and finished with three coats of stucco. When the outside cannot be insulated, Styrofoam is applied to the inside and finished with ½-in.-thick gypsum board. The Dow Chemical Co.

Circle 139 on reader service card

Model 107 woodstove, constructed of cast iron, has baffles designed to provide heating efficiency. According to the manufacturer, the cast iron conducts nearly 50 percent more heat than steel. The model can be used in a fireplace during the heating season and is easily dismantled and stored in the spring. Upland Stove Co.

Circle 140 on reader service card

Sun-Center, a solar power package for domestic hot water, requires only two joint connections to begin to operate.

[Products continued on page 223]
Insulating glass is a good idea.

Insulating glass with Kawneer's Insulcast 450 is a great idea.

Insulating glass can be a wise investment since it pays off in terms of heat savings, fuel savings and comfort. Now, carry your good idea a little further and consider the framing system.

Kawneer's new Insulcast 450® Thermal Framing can make a big difference. By adding Kawneer's new Insulcast 450 Thermal Framing your total investment in the combined system will pay back even quicker. In fact, when compared to a non-thermally broken system with insulating glass, Insulcast 450 can reduce the payback period by as much as 15%.

The faster payback is made possible since the small additional investment in Insulcast 450 can provide an additional 20% reduction in total heat loss.

Not all thermal framing systems are alike.

Kawneer's Insulcast 450 features the exclusive IsoLock® thermal barrier. IsoLock positively interlocks the interior and exterior metal removing the potential danger of framing failure and glass breakage. It also reduces condensation and its damage since heat conduction is minimized to the point where the framing system stays warmer than the glass.

Insulcast 450.
The designer's element.

The clean, slim framing members of Insulcast 450 present a flush grid appearance which enhances reflective and tinted glass. Combined with seamless face members it's the perfect solution for designs that require the practicality of insulating glass and esthetics to satisfy the designer's eye.

For more information about Kawneer's new Insulcast 450 Framing System write Kawneer Architectural Products, 1105 N. Front Street, Niles, MI 49120 (616) 683-0200.

* A trademark of The Kawneer Company

Kawneer
The designer's element

Circle No. 368 on Reader Service Card
A WORD ABOUT BUILT-IN INSULATION

This big fella doesn't need to worry. His thick layer of blubber helps protect him from the elements. Not all animals have this built-in protection. Not all masonry buildings do, either. Although concrete blocks may look alike when they're installed, there is one pre-insulated block which nearly doubles the insulation characteristics of a masonry wall. Korfil. The concrete block with built-in weather protection. Korfil blocks not only save time, labor and clean-up costs at the site, they save money for your customer as well, by significantly reducing heating and cooling costs on the completed building. In today's energy crunch, that's an important consideration.

For the best insulation, take a tip from the walrus. Specify Korfil on your next construction project and get built-in insulation with guaranteed results.

...Because it makes sense.
The unit, which can be hung on the hot water tank or on a nearby wall, is made up of a pump, expansion tank, differential thermostat, float-type air vent, check valve, flow regulator, pressure-relief valve, pressure gauge, and drain-shut-off valve. Revere Solar and Architectural Products.

Circle 141 on reader service card

Literature

'Solar Spectrum,' a newsletter, covers solar installations on a project basis, providing information on funding, historical details, design, installation, and system performance. The newsletter is available without charge to building owners and architects, mechanical engineers, contractors, and plant engineering staff personnel. Write on firm letterhead to: Marvin Goldberg, Managing Editor, Solar Spectrum, Solar Thermal Systems, Division of Exxon Enterprises, Inc., P.O. Box 592, Florham Park, NJ 07932.

The 'Solar Energy Technical Training Directory,' published by the Solar Energy Research Institute (SERI), lists 91 post-secondary institutes offering training programs in technical fields such as solar system fabrication, installation, and maintenance. Many offer associate degrees or certificates upon completion. Copies are available free from: The National Solar Heating and Cooling Information Center by telephoning toll-free 800-523-2929 (in Pennsylvania, 800-462-4983).

'The Solar Energy Design Handbook' is a 32-page book providing information about fundamentals of solar energy, its collection, storage, and distribution for both water heating and space heating. It offers design recommendations for solar systems and designing for heating requirements. Supporting data provided are degree days, installation charts, and collector tilt factors. Copper Development Association.

Circle 233 on reader service card

Architectural glass with Saflex polyvinyl butyral interlayer is discussed in 20-page, four-color brochure. It reviews the heat absorbing, light and glare control, and ultraviolet control properties of laminated glazings. A chart shows the heat and light control characteristics of laminated architectural glass with more than 10 different colors of Saflex interlayer. Monsanto Plastics & Resins Co.

Circle 234 on reader service card

Architectural glasses that save energy in buildings and homes and provide daylight illumination are described in a 28-page illustrated booklet. Products include Solarban®, Solarcool®, Twindow®, Xi glass-edge insulating units, and high-strength laminated products. Also included is information about structural silicone glazing systems that provide a seamless appearance. PPG Industries.

Circle 235 on reader service card

The 'Solar Attic' combines normally wasted attic heat with a passive solar system for space heating and domestic hot water heating. Solar energy admitted through roof glazing is collected and stored in water-filled storage tubes. Low-power fans direct air over the

Literature continued on page 226

Mini Planfile. "There's no better way to store plans."

60% Smaller.

Mini Planfile (requiring 7 sq. ft.) has the same capacity of 12 conventional flat drawer files (requiring 17 sq. ft.).

Lower Cost.

Mini Planfile units cost less than conventional, same capacity flat drawer file systems. The more Mini Planfile units you need, the more you save.

New Concept.

Patented vertical filing gives ultimate drawing protection and surprisingly easy, same height access. Unique compression system keeps drawings perfectly flat and smooth.

1200 Sheets.

Up to 1200 active drawing storage in a slim 14" profile. Removes flat drawer bulkiness.

Write for our free brochure.

2120 Fourth Ave.
Lakewood, New York 14750
Telephone
716/763-1815

Circle No. 409, on Reader Service Card

Aluminum Curtain Walls, Vol. 9, discusses the use of the walls in energy conservation. The 32-page book reviews the fundamentals of exterior wall design to permit transmission of energy that would otherwise have to be supplied mechanically. Energy factors of curtain wall systems for four buildings are included. Architectural Aluminum Manufacturers Association.

Circle 236 on reader service card

Trocot® roofing systems for energy control can be used on flat roofs. According to the manufacturer, they eliminate problems of cracks and leaks, blistering, and the effects of ponding. A 12-page brochure discusses energy saving advantages of the system, typical assemblies, and provides specifications. Typical installation details are shown. Dynamit Nobel of America, Inc.

Circle 237 on reader service card

Mass masonry energy brochure provides an explanation of the role of thermal mass in the transfer of energy. It explains the use of the "M" factor graph and includes sample problems. Masonry Industry Committee, International Masonry Institute.

Circle 238 on reader service card

The Solar Attic combines normally wasted attic heat with a passive solar system for space heating and domestic hot water heating. Solar energy admitted through roof glazing is collected and stored in water-filled storage tubes. Low-power fans direct air over the [Literature continued on page 226]
Literature continued from page 225

tubes' surfaces to distribute the heated air where it is needed. The concept, components, and information about how it works are provided in a four-page brochure, along with data on performance of space heating and water heating. Solar Components Div., Kalwall Corp.
Circle 239 on reader service card

Settef exterior wall insulation and finish is described in an eight-page brochure. It discusses installation, thickness, and physical and performance properties, and illustrates installation details. Short form specifications are also included. Compo Industries.
Circle 240 on reader service card

Building materials

Major materials suppliers for buildings featured this month, as they were furnished to P/A by the architects.


DISTINCTIVE WOOD FIXTURE

low level illumination in a new light

"The Junior Jefferson" is a versatile fixture designed to enhance patios, walkways and other low level lighting sites. It is laminated of custom selected, kiln dried Western Red Cedar and harmonizes with any surroundings. Fastidious craftsmanship follows a tradition of more than 50 years. A wide selection of globes for incandescent to 100W is available. Direct burial or wall mounted.

10 New Remodeling Ideas With Cedar.

Free. It's the latest addition to the Architect's Cedar Library. 10 "how to" case histories on residential, commercial, recreational, and restoration projects, plus simply over-roofing with red cedar shakes and shingles. Full color before and after photos, plans, the works. Free.

Respond.

Red Cedar Shingle & Handsplit Shake Bureau
Send to: Suite 275, 515-116th Avenue N.E., Bellevue, Wa. 98004. Or use the reader service number.


10 New Remodeling Ideas With Cedar.

Free. It's the latest addition to the Architect's Cedar Library. 10 "how to" case histories on residential, commercial, recreational, and restoration projects, plus simply over-roofing with red cedar shakes and shingles. Full color before and after photos, plans, the works. Free.

Instructions for catalog of wood lighting standards and accessories.
Ryther-Purdy Lumber Company, Inc.
305 Elm Street
P.O. Box 622
Old Saybrook, CT 06475
Phone (203) 388-4405

Write on your letterhead for catalog of wood lighting standards and accessories.

Ryther-Purdy Lumber Company, Inc.
Circle No. 397, on Reader Service Card
Introducing Sunglas® Reflective, it blocks up to 65% of the sun’s heat.

New Sunglas Reflective blocks the heat to help reduce the high cost of air conditioning.

Installing Sunglas Reflective can, over the lifetime of your building, amount to a saving of thousands of dollars. Because it blocks up to 65% of the sun’s heat, it can aid in cutting air-conditioning operating costs and may allow for the use of smaller air-conditioning units.

A new concept — blocks the heat. Yet lets in the daylight.

While Sunglas blocks the sun’s heat, it lets in more daylight than most other reflective glass products. This means reduced solar heat load while permitting the use of natural daylight for illumination — this unique property presents another big saving potential. It also helps minimize hot spots so room temperatures remain more uniform and comfortable.

Ford Sunglas Reflective for a natural color view of the outdoors.

Sunglas Reflective lets in the beauty of the outdoors without noticeably affecting its natural color. The neutral silver coating reflects the surrounding outside environment and provides a full-color view of colors throughout the day.

New Computer Program shows you how to S.A.V.E.

Ford’s new computerized S.A.V.E. program (Systems to Analyze Value and Energy) can help you determine your solar glass requirements and savings quickly. Find out more about the S.A.V.E. program and Sunglas Reflective so you can take the heat off you and your budget. Sunglas Reflective is available now and it can be cut, tempered and fabricated locally. You’ll find that choosing Ford Sunglas Reflective will be a nice reflection on you.

Sunglas Reflective is backed by Ford experience and a 10-year warranty.

Before we ever marketed Sunglas Reflective, we field-tested more than 2,000,000 square feet of it. The result? When the heat was on, Sunglas Reflective performed very cool. For more information, send for our detailed product information kit including all the specifics of our warranty by writing: Ford Glass Division, 300 Renaissance Center, P.O. Box 43343 Detroit, Michigan 48243, or call toll free 1-800-521-6346.
architect to provide professional services
research, development, design, con-
struction, alteration or repair of real
property such as residences, office build-
gings, public buildings, or factories, pre-
sale and full site drawings and ex-
citations. Must be familiar with
European construction and metric calcula-
tions and standards, Master's Degree in
Construction Engineering required. At
a 4 year experience, 40-hour week,
electrical production conditions, $17,000 per
yr. Contact Peter F. DeMeo Associates,
1489 Main Street, Stoneham, Ma.

Architect: Progressive architectural and
interior firm, concentrating in en-
cryption design, housing, industrial,
commercial, and educational buildings
in the West. Nucleus of seven regis-
ted professionals seek exceptionally tal-
ented, design oriented architect who
wants to invest in his own future. Professional
licensure required, energy background im-
plicit, and knowledge of LEED and
AIA preferred. Salary based on
experience. Send resume to
Pers. Mgr., P.O. Box 2530, Winchester,
Va 22601. EOE M/F.

Building Technology Professor: MIT
Department of Architecture seeks junior
or senior faculty to teach and carry out re-
search on HVAC and mechanical systems in
buildings, with particular reference to
energy conscious building design and in-
tegration of mechanical systems with
building program. Essential qualifications
include education in field of energy, prefer-
able with advanced degree; proven
research ability; and current experience
as designer or researcher of environ-
mental control systems. Submit
applications to: MIT, 77 Massachusetts Ave.,
Cambridge, Ma 02159. MIT is an Equal
Opportunity/Affirmative Action Employer.

Dean: School of Architecture. We are
seeking a candidate whose work is innova-
tive within his or her own field of architec-
ture, and experienced in academic & ad-
ministrative matters. MIT encourages
qualified women & minority candidates to
apply. Candidate should be able to sup-
port creative & diversified faculty and
student work, communicate dynamically,
be sensitive to the needs of surrounding
urban communities, & the challenges of
higher education today. Send resume & 3
letters of reference by May 30, 1980 to:
Personnel, Box DAM, New Jersey Institute
of Technology, 529 High St., Newark, NJ
07102. Equal Opportunity/Affirmative
Action Employer M/F.

Design Architect: For an established
architectural office in Providence, Rhode
Island. Challenging position, strong em-
phasis on design, team approach, Excel-
ten benefits. Immediate opening. Submit
resume to The Robinson Green Beretta
Corporation, P.O. Box 2599, Providence,
R.I. 02906. All replies are confidential.

Design Architect position available with
prominent firm located in Pacific NW for
person with 3-5 yrs. experience in
surgical interior design and space
planning, along with assoc. colors and
wall selection, etc. Position responsi-
ble for concept design and space planning of
office buildings, etc. Offers excellent prof.
design and planning opportunities.

Design Architect: One/two years
experience preferred. Salary based on
experience. Excellent fringe benefit pro-
grams available. NOAA general contractor in the Shenan-
dale Valley of Virginia. Send resume, pay, & salary history to:
ard Shockey & Sons, Inc. R. G. Brown,
Pers. Mgr., P.O. Box 2530, Winchester,
Va 22601. EOE M/F.

Environmental Psychology Ph.D. Pro-
gram, City University of New York: Two
anticipated faculty openings beginning
Sept. 1980. Credits, experience,
interests must match at least one of the
following: Environmental design
sensibility, commitment, Interest in envi-
ronmental social science research. Par-
icipatory work with user/community
groups—emphasis on implementation.
Social science and formation, implementa-
tion of environmental policy, knowledge of political and alter-
tative ideologies (applicants from eco-
nomics, geography, political science,
planning, etc.). Philosophical/theoretical/
ideological analysis and critique of environ-
mental social science. Send c/o letter of interest by April 20: Maxine Wolfe,
Environmental Psychology, CUNY, 33 W. 42
St., NY, NY 10036.

Faculty Position in Design and Housing:
Faculty Member, The University of Iowa,
Ph.D. or M.F.A. preferred. Respon-
sibilities: teaching undergraduate and
graduate courses in interior design, advis-
ing students. Send letter of application by
May 12. Reply to: G. Marshall Assoc., P.O.
Box 66083, Chicago, Il 60666.

Project Architect position available with
growth oriented design firm in the South.
Qualified person should have degree and
3-5 yrs. exp. in the design of comm.,
inst. and proj. work. Also req. is the abil-
ity to lead projects; supervisory and con-
structive design input; ability to work
along with interfacing with clients. Firm offers ex-
cellent growth potential and compensation.
Reply in confidence to: G. Marshall Assoc.,
P.O. Box 66083, Chicago, II 60666.

Project Architect, req. by well known A/E
in the Midwest. Qualified person should
possess degree and reg. plus 4-6 yrs.
exp. in the design of comm., inst. and of-
ce bldg. projects. Individual should also
be capable of assuming project leadership
role; supervisory, communicative, and
maintaining client relationships. Make
representatives in confidence at: G. Marshall
Assoc., P.O. Box 66083, Chicago, II
60666.

Dean: Faculty Position in Design and
Housing: The University of Iowa.
Ph.D. or M.F.A. preferred. Responsibilities:
teaching undergraduate and graduate
courses in interior design, advising
students; conducting research in creative
work and professional design; directing
M.A. theses. Ability to work in the interdisciplinary context of
a home economics department within a
liberal arts college. Position open for
pay period beginning Aug. 1980. Salary
and rank commensurate with experience and qualifications. Equal
opportunity/affirmative action employer.
Send resume to: G. Marshall Assoc., P.O.
Box 66083, Chicago, Il 60666.

Junior Faculty Position in Design and Housing:
University of Iowa, Ph.D. or M.F.A. preferred. Responsibilities:
teaching undergraduate and graduate
courses in interior design, advising
students, conducting research in creative
work and professional design; directing
M.A. theses. Ability to work in the interdisci-
plinary context of a home economics department within a
liberal arts college. Position open for
pay period beginning Aug. 1980. Salary
and rank commensurate with experience and qualifications. Equal
opportunity/affirmative action employer.
Send resume to: G. Marshall Assoc., P.O.
Box 66083, Chicago, Il 60666.

Junior Faculty Position in Design and Housing:
University of Iowa, Ph.D. or M.F.A. preferred. Responsibilities:
teaching undergraduate and graduate
courses in interior design, advising
students, conducting research in creative
work and professional design; directing
M.A. theses. Ability to work in the interdisci-
plinary context of a home economics department within a
liberal arts college. Position open for
pay period beginning Aug. 1980. Salary
and rank commensurate with experience and qualifications. Equal
opportunity/affirmative action employer.
Send resume to: G. Marshall Assoc., P.O.
Box 66083, Chicago, Il 60666.

Project Architec}req. by well known A/E
in the Midwest. Qualified person should
possess degree and reg. plus 4-6 yrs.
exp. in the design of comm., inst. and of-
ce bldg. projects. Individual should also
be capable of assuming project leadership
role; supervisory, communicative, and
maintaining client relationships. Make
representatives in confidence at: G. Marshall
Assoc., P.O. Box 66083, Chicago, Il
60666.

Project Architects: Positions open in
dynamic interior architectural consulting
firm specializing in hotels. Project archi-
tects should have extensive experience
needed for job implementation from concept
drawings through construction, including
client contact and travel. Strong firm, brisk
pace, prestige projects, international
clients and excellent salary. Send resume
to: Jutras, Nobili & Hard Associates, Inc.,
54 Middlesex Turnpike, Bedford, Ma
01730.

Project Architects/Managers/Designers:
Nationwide personnel consulting service.
Positions for all experience levels.
Emphasis on health care facilities, office
interior, institutional, commercial, medical
buildings, etc. Salaries commensurate with
experience. Submit resume to:
Mr. Paul E. Radauska, Superintend, 111 Maryland Ave.,
Rochville, Md 20850, (301) 424-8000, ext.
231.

President's Position: Key manager/architect with national A/E design firm, experienced
and proven successful in building organization and in all aspects of corporate leadership, is a significant can-
didate for your company's president and general manager. Reply to Box 1361-328,
Progressive Architecture.

Situations Open

Job mart
Most builders and architects will agree that floor tiles are tough, their beauty far outlasting other types of residential flooring. But, up until now, there was just one thing that kept them from being at home in apartment buildings. They were noisy.

That's why GAF has created Gafstar® Quiet-Cor® underlayment. A revolution in apartment flooring.

You install it right over concrete. And although Quiet-Cor measures only 1/16th of an inch, it makes a big difference in how floor tiles sound one floor below.

Tests proved it. In fact, its use has already been approved by many municipal housing codes across the country.

Which not only means less noise for tenants. It also means less headaches for you.

And speaking of less headaches for you, Quiet-Cor is available as a complete flooring program that includes adhesives, Quiet-Cor underlayment in 3-foot rolls, and your choice of floor tiles.

GAF makes them all. And sells them all.

So now you can have the beauty and performance of floor tiles in the apartments you build.

And not have to worry about disturbing the neighbors.

© GAF Corporation 1980.
To enhance the traditional and contemporary elements of my design, I specified Shakertown Siding.

Frederic Albert, Cassway/Albert & Associates, Architects

It's the easy way to put up cedar shingles.

Now there's an easy, more affordable way to add the beauty and texture of cedar shakes or shingles to your designs. Shakertown Siding. It's made of straight grained #1 grade western red cedar shingles or shakes, permanently bonded to an 8-foot-long plywood backing. There are no seconds or grade faildown. Application is 3 times faster than individual shingles or shakes. No specialized labor or tools are needed. And with most building codes, Shakertown Siding can be applied directly to framing, so no sheathing or stripping is required. So construction is faster, labor costs lower, and the look you get is always straight and true, because Shakertown Siding is automatically self-aligning.

On your next job, specify Shakertown Siding. It's available in 4 textures with 7” or 14” exposures and even or staggered butt lines. Write us for complete product information and specification details.

Shakertown Siding

Box 400, Winlock, Washington 98596, Phone (206) 785-3501. In Canada: Bestwood Industries, Ltd., 6188 Kingsway, Burnaby, B.C. V5J 1H5

The Easy Way

Southwestern, small architectural/engineering firm seeking experienced and/or ambitious architectural practice with a concern for each project on an individual basis. Located in the semi-arid four corners area near the southern Rockies in an energy development area with many outdoor recreational opportunities. Two permanent positions available in a firm with a diverse practice and excellent growth opportunities: architectural draftsmen with 5 years minimum experience or graduate architects with some office experience for involvement in all phases. Registration desirable. Salary commensurate with experience. An equal opportunity employer. Excellent fringe benefits. For prompt consideration contact George Trosky, AIA, MSR, 335 East Main, Farmington, NM 87401, (505) 325-3521.

Specifications Writer required by well known design firm located in MidWest. Qualified person should have 3-5 yrs. exp. in the prep. of comprehensive Architectural Specifications relating to major institutional, comm. and office bldg. project: competency with detail function with min. of supers. and assume major responsibility. Degree and computer based exp. desirable but not mandatory. Firm offers excellent compensation, stability and future growth potential. Contact our representatives at: G. Marshall Assoc., P.O. Box 66083, Chicago, IL 60666.

Str. Interns/Architect required by leading design firm located in the MidWest. Positions require degree and very high level of competency with 3 to 5 yrs. exp. in the competitive design and planning of architectural interiors associate, with major office, inst. and comm. projects. Qualified person must also possess the exp. and/or ability to direct a design staff, interact effectively with clients and maintain a successful interiors design profit center. Successful growth oriented firm offers comp. salary, excellent professional environment and living location. Contact our representatives in confidence at: G. Marshall Assoc., P.O. Box 66083, Chicago, IL 60666.

Systems Analyst/Programmer to work on computer applications to Architecture. Emphasis on data-base systems. Architectural degree and experience developing computer systems required. Send complete resume and salary requirements to Barry Milliken, Skidmore Owings & Merrill, 400 Park Avenue, NY, NY 10022.

Vermont Technical College, Randolph Center, Vermont. Full-time position teaching two year students in Architectural and Building Engineering Technology. Lecture and lab instruction: Architectural Drafting; Construction Materials and Methods; Design; Environmental Systems. Require B. Architecture or equivalent, minimum of five years post-degree professional experience and Architectural Registration. Teaching experience desirable. Appointment effective fall term 1980. Salary negotiable depending on qualifications. Liberal fringe benefits.

Send resume and names of references by May 2 to Winston Pierce, Vermont Technical College, Randolph Center, VT 05061. An Equal Opportunity Employer.

Vice President of Design/Development: A major Dallas based hotel development company has position for senior design architect to head in-house architectural design team working on luxury hotels. Company just completed 900 room hotel, has another hotel under construction and four under design. Lead design experience in major hotels and high-rise commercial building essential. Salary and opportunity commensurate with very substantial responsibility. P.O. Box 58600, Dallas, TX 75238.

Situations Wanted

Architect: Extensive background in Marketing, Client Relations, Office and Project Management. Project experience includes programming, design, construction documentation and construction administration. Seeking challenging marketing and/or management position with growth opportunities in progressive, quality organization. NCARB, AIA, CSI. Diversified project experience ranging to $15,000,000. Box 1361-529, Progressive Architecture.

Architect: NCARB, 21 yrs. experience, corporate/private practice and architectural education (instructional, administrative); areas of concentration: institutional, private and public residential, commercial; family, heavy civic involvement—seeks to close small practice, associate with superior medium-sized architectural firm in design/marketing capacity with partnership potential. East preferred: Box 1501-330, Progressive Architecture.

Architectural Services

Computer Applications: Software development services for architectural, engineering and construction management applications. Automated solutions in the areas of computer graphics, space planning, data base systems, cost estimating, and the analysis and maintenance of office and management information. Write: Robert J. Kraskc, 1250 North LA Salle Suite 3E, Chicago, IL 60610, (312) 337-1556.

International Plastics Consultants, Research and Development: Specializing in low and moderate cost housing systems for developing countries and for domestic markets, applications of plastics in building and architecture, specification writing, university lectures, variety of other services. Armand G. Winfield Inc., 2879 All Trades Rd., P.O. Box 1296, Santa Fe, NM 87501, (505) 471-6944.


Rita Sue Siegel Agency: An international search and placement organization serving the design professions. Ms. Woody Gibson directs architecture and interior assignments. Our clients include every important corporate design group, consultant office and institution. Please inquire about our screening procedure and the range of services we provide. 60 W. 55 Street, NYC 10019- (212) 586-4130.

Slate Roofs: A handbook of data on the constructing and laying of all types of slate roofs. Written in 1929 and now reproduced. Completely relevant today. Many details. Send $7.25 to Vermont Structural Slate Co., Inc., P.O. Box 98, Fair Haven, VT 05743.


Tree Stamps: TREE LINES' top quality line of rubber stamps offer the quality of hand carved trees, people and cars with the convenience of stamps. Write for free catalog: TREE LINES, 52 Raleigh Road, Belmont, MA 02178, Dept. B.

Notice

Please address all correspondence to box numbered advertisements as follows:

Progressive Architecture
% Box
600 Summer Street
Stamford, Connecticut 06904

Advertising Rates (Effective January '80 issue)
Standard charge for each unit is Thirty-five Dollars, with a maximum of 50 words. In counting words your complete address (no address supplements; counts as five words, a box number as three words). Two units may be purchased for Seventy Dollars with a maximum of 100 words. Check or money order should accompany advertisement and be mailed to Job Mart % Progressive Architecture, 600 Summer Street, Stamford, CT 06904. Insertions will be accepted not later than the 1st of the month preceding month of publication. Box number replies should be addressed as noted above with the box number placed in lower left hand corner of envelope.
Ceramic tile floors and walkways are used in virtually all shopping malls in the U.S. And Gail Unglazed Brickplate has been used far more often for a combination of reasons:

- **Slip-Resistant** — Gail Unglazed Brickplate has an abrasive surface which helps prevent accidents;
- **Longer-wearing** — Gail Unglazed Brickplate outlasts others because the vitrified clay body withstands foot-traffic from millions of shoppers;
- **Economical Maintenance** — non-absorbent body resists acids, oils, chemicals, and other abuses... cleans quickly without heavy scouring or waxing;
- **Frost-proof** — patterns and colors can be coordinated, indoors and outdoors;
- **Widest Selection** — a myriad of natural, earthtone colors and sizes (2½ x 10, 4 x 8, 5 x 10, 8 x 8). For more than 85 years, Gail Brickplate has proven itself all over the world under the most severe conditions. For additional information or the name of your local distributor contact one of our four regional sales offices.

**Gail Ceramics**

1481 North Main Street
Orange, California 92667
Phone: (714) 997-9383

1201 Douglas Avenue
Redwood City, California 94063
Phone: (415) 365-6212

6265 McDonough Drive
Norcross, Georgia 30093
Phone: (404) 448-8304

388 Pompton Avenue
Cedar Grove, New Jersey 07009
Phone: (201) 239-7117

Circle No. 353, on Reader Service Card


3. Longview Mall, Vancouver, B.C., Canada: Architects: Dirassar, James & Jorgensen; Developers: Trizec Corp., Ltd.


You can count on a dependable supply of gas for the future. Because there's much more gas still underground than we've used so far—enough to last well into the next century. And new sources, like gas from coal, will add to the supply. Beyond that, new technologies are expected to provide efficient gas energy for generations.

Good reasons why more and more architects and engineers are specifying gas. And why most gas utilities are accepting new commercial customers.

Gas energy. It's the least expensive energy for space conditioning today, and it will continue to maintain this competitive advantage in the future.

Gas: The future belongs to the efficient.