RESEARCH&DESIGN

The Quarterly of the AIA Research Corporation
Spring, 1980 Volume II, Number 4

# Researching the '80s

## Conversations on the future of architectural research

# COMMENTARY

There is growing evidence that the gap between architectural research and the application of its results in design practice is narrowing rapidly. The indications are everywhere: a full-color spread on solar design in the late-February issue of Newsweek; Progressive Architecture's discussion of research in its January 1980 issue; Engineering News-Record's recent cover stories on energy design and wind-hazard research; the National Trust for Historic Preservation's new energy conservative retrofitting campaign for 1980, and, finally, the National Endowment for the Arts' recent recognition of the importance of applied architectural research.

In an address to the Association of Collegiate Schools of Architecture last month, the Endowment's director of Design Arts, Michael Pittas, spoke on this issue. In describing new policy directions for NEA in the Eighties and his own program's focus on design research, Mr. Pittas identified design exploration and research as one of three key areas for which NEA will provide funds. The other two areas are the support of excellence in design and the provision of funds for educational programs.

It is worth noting those specific research issues that are considered priorities for NEA in the Eighties. On Mr. Pittas' list are urban growth and revitalization, energy and the environment, disaster mitigation, health and safety, environmental conditions in the workplace, and the needs of special populations.

In its January 1980 issue, Progressive Architecture called architectural research "an emerging activity during the 1970s" and considered it "likely to mature as a segment of practice in the 1980s." In a projection of key influences for the near future, P/A stated that "energy considerations, beyond any doubt, will have a greater impact on architectural design in the 1980s than any other factor." P/A went on to say that "the value of user reaction studies, analysis of generic functional problems, and post-occupancy evaluation is established," adding that "ways to fund research and feed results back into design" may be key subjects of interest in the next few years.

Certainly the researchers we spoke with for this issue of Research & Design—and they are generally designers as well as researchers—believe that the gap between research and application is narrowing. Frequently, for them, research *is* design, and vice versa. They are active in many fields, from energy conscious design and redesign to materials development to climatic analysis to behavioral research. They know what is advancing in architecture today, and they have very firm opinions about where we will be advancing over the next ten years. As you will see when you read through this issue, they have very different opinions. Like Mr. Pittas at NEA and like Progressive Architecture, they have their own lists of priorities for research in the Eighties. But they do agree, and they agree on nothing more strongly than the notion that research and design should be closely linked. Since that linkage is one of the AIA Research Corporation's primary goals, I look forward to the Eighties with great anticipation of interesting new research and, more important, new and better design.

Charles R. Ince Jr.

*Charles R. Ince Jr.*
*President, AIA Research Corporation*

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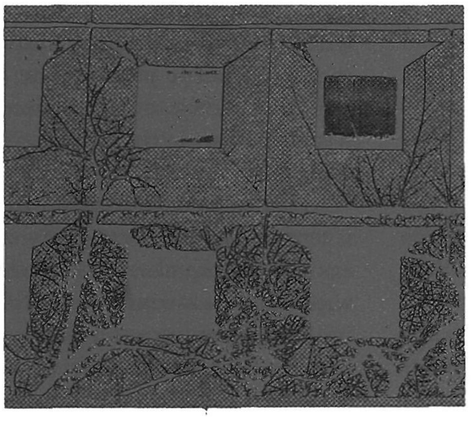
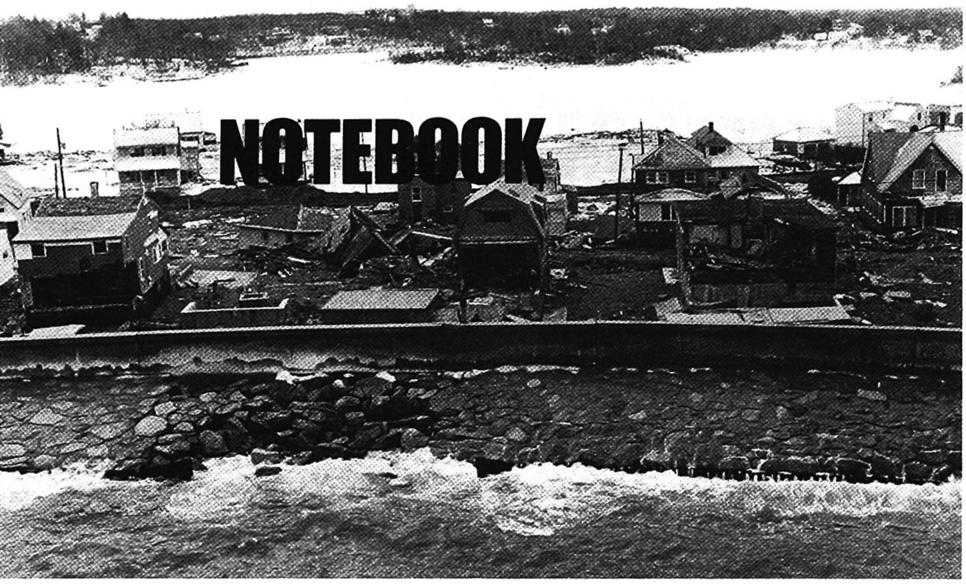






Research & Design is published four times a year by the AIA Research Corporation, and mailed free of charge to architectural libraries, deans of professional schools of architecture, and the professional architectural firms and architects working in government and industry who are listed as members of the American Institute of Architects. Additional subscriptions are available for $15 in the United States, U.S. possessions, and Canada, and for $30 elsewhere. Additional single copies are available for $4. Editorial and publishing offices are located at the AIA Research Corporation, 1735 New York Avenue, N.W., Washington, D.C. 20006.

**Cover:** Photograph by Fred H. Greenberg




## Hazards research expands with a new flood project and a study of earthquake and energy consciousness

In a year that may be remembered in the West and Midwest for the worst flooding in history, the AIA Research Corporation's hazards research program is expanding into some timely new areas.

Established to research design techniques for increasing life safety and reducing building damage from such natural hazards as earthquakes, fire, floods, and high winds, the program began in 1975 with publication of *Architects and Earthquakes: A Primer,* prepared for the National Science Foundation. The success of that introductory volume on seismic design led to a study of research needs in the field, also for NSF, and to a third project on the design of critical use facilities. That resulted in *Seismic Design for Police and Fire Stations,* a rigorous, technical design handbook aimed at ensuring uninterrupted operation of crucial emergency facilities during and after an earthquake.

Now AIA/RC's hazards research is moving into flooding, which has already wrought havoc at record-setting levels in the first months of 1980. Annual losses due to flooding, now set at $2 billion nationally, are expected to reach $5 billion by the year 2020. Second only to hurricanes and tornadoes in the threat they pose to buildings and people in the U.S., floods annually cause three times the property damage, five times the injuries, and twice the number of deaths that earthquakes inflict.

Under a new $187,000 project grant from the Federal Insurance Administration of the Federal Emergency Management Agency, AIA/RC is researching flood design issues, examining case studies, and working on a set of design process guidelines for architects who deal with flood-threatened sites.

The guidelines will cover not only the traditional architectural flood design issues, but land use planning, management, and other design-related issues pertinent to flooding on what project manager Don Geis calls "both the macro- and micro-levels."

Geis says the aim of the project is to "include the full array of issues that determine flooding hazards to design," from a site's climatic or topological inclination to flooding to the design decisions that affect the situation. The guidelines will give architects information on such conventional flood-control measures as dams and levees, such design techniques as elevating buildings and creating watertight enclosures, forecasting and preparing for flood emergencies, insuring against damage, and understanding the whole natural hydrologic system that flooding is inevitably part of. The project should add measurably to the architect's arsenal of weapons against the toll that flooding exacts every year.

Another new hazards project at AIA/RC is evaluating the complexity of designing against earthquakes, fire, flooding, and high winds simultaneously—and also optimizing building energy conservation.

Fire, floods, and high winds are nationwide hazards to the built environment. So, surprisingly, are earthquakes, which can occur with building-threatening strength in 39 of the 50 states. With the cost of conventional fuels now irretrievably high, energy conservation has also become a top priority for architects everywhere. And as if these challenges to designers weren't sufficient, the economy has forced clients into a cost-consciousness that taxes design to the utmost.

In a project deceptively called "Multihazard Design for Seismic Safety," AIA/RC is exploring all these elements—multiple hazard mitigation, energy conscious design, retrofitting and new building construction costs—and identifying the conflicts that arise when such different demands need to be met. Site planning, conceptual design, structural design, form, materials, security, and interior layouts will all be studied in the complex, NSF-supported project.

Project manager Robert Sockwell has spent time on AIA/RC's earlier seismic research projects, where conflicts between design priorities first became apparent. "In the West and Southwest," he says, by way of an example, "heavy masonry construction is often good for energy conservation; the mass absorbs solar heat and reradiates it inside at night. But in an earthquake, that inelastic masonry may deform and cause damage that might not occur in a less rigid structure."

As architects across the country face the constraints of hazard-resistant design, the new challenges of energy consciousness, and the tightened belts of cost consciousness, the multidisciplinary approach of Sockwell's research should be particularly valuable.

## BEPS: More work on climate, life cycle costing, and ASHRAE 90-75R as the performance standards deadline approaches

Research is continuing on the federal Building Energy Performance Standards (BEPS) even as Aug. 14 approaches.

That's the deadline by when the U.S. Department of Energy (DOE) must submit to President Carter its final draft of the standards, its proposed implementation scheme, and its recommendations on what sanctions Congress should apply to encourage states to adopt the federally-developed standards.

Phase 2 of the BEPS research program, which encompassed the bulk of the building design research, concluded early this year with submission of the final research reports to DOE. The standards presented to the White House, including specific building energy budgets that designers could be required to meet, will be based on that research.

In the interim, the AIA Research Corporation and other research groups are exploring BEPS-related issues that could have major impact on the final standards.

AIA/RC's analysis of ASHRAE Standard 90-75R, which is the basis for building energy standards in more than 40 states nationwide, is already complete. Using complex computer simulations of energy performance based solely on design data, the analysis indicated that commercial buildings designed to comply exactly with ASHRAE's standard might be expected to improve on the energy performance of comparable buildings designed without energy in mind by an average of 17 per cent. The analysis compared actual buildings designed circa 1975-76 and energy conscious redesigns of the same buildings.

A second analysis of those buildings simulated a redesign in which only building components not in compliance with 90-75R were upgraded. Components surpassing the standard were left intact. Here, researchers found ASHRAE 90-75R potentially capable of improving energy performance by 30 per cent, on average.

During the earlier Phase 2 research, AIA/RC had identified the original A/E design teams of a sample of commercial buildings designed and built across the country in 1975-76. The designers were hired, under DOE funding, to redesign those buildings with energy conservation as their top priority, but without generating radical increases in design and construction costs. After running computer simulations of energy performance in both the original buildings and the redesigns, AIA/RC's researchers found the designers had achieved a 40 per cent average improvement in "designed energy performance" in their redesigns. Some had improved energy performance as much as 70 per cent, still meeting original program requirements and staying near or within original budget constraints.

AIA/RC recently rehired three of those original design teams to carry their redesigns even further in the first part of a life cycle costing (LCC) project aimed at determining the actual cost-effectiveness of a number of energy-conserving design strategies.

Invited to maximize their use of energy conserving strategies—including daylighting and 10°F-range deadband thermostats, two strategies not available to designers in the Phase 2 research—the designers were also instructed to disregard cost implications.

The design strategies were applied singly as well as in various combinations in the redesigns of the original buildings. For each single or combined application, the costs of the resulting design were examined in terms of a 40-year life cycle and a host of economic parameters set out by DOE.

The results: The redesigners achieved a 65 per cent maximum improvement in "designed energy performance" over their original '75-76 buildings this time around. The life cycle costs of the redesigned buildings, depending on which energy-conserving design strategies were applied, ranged from less than 2 per cent above to 4 per cent below those of comparable but non-energy conscious buildings.

The LCC study involved only one building type—large office buildings—and only three buildings in the research. Still pending are similar LCC studies on buildings in three other categories likely to have significant impact on the construction industry—warehouses, shopping centers, and high-rise residential buildings.

Also pending on the BEPS research agenda is some important climatic work that will largely define the energy budget formats presented in the standards.

To develop an energy budget for a specific building type in a specific location, BEPS developers need what researchers are calling a "weather package" that summarizes the climatic environment on that site. Such a weather package would be composed of digitized, hourly weather data on temperature, humidity, cloud cover, winds, and insolation for computerized energy analysis, as well as an abbreviated, simplified standard evaluation technique (SET) for a designer's estimation of his "designed energy performance."

Developing adequate climatic coverage for designers has been one of the problems of the BEPS research. There is no shortage of weather data; 300 weather bureau stations and 213 U.S. Air Force weather stations—at least—have been gathering accurate, pertinent data for decades. Accurately defining climatic regions around the country and identifying data that is "typical" of a region are the difficult tasks.

Researchers have already developed a two-dimensional matrix relating the BEPS energy budget levels to a region's heating degree days (HDDs) and cooling degree days (CDDs). Now facing them is the question of whether to base a nationwide grid of climatic regions on Test Reference Year (TRY) weather tapes, which present climatic data from a "non-extreme" year, and which have come under fire for inaccuracy from some solar designers. The alternative is to use Test Meteorological Year (TMY) tapes, which present statistically "typical" climatic data for a region. The choice between TRY and TMY weather tapes has yet to be made.

## Research update: Passive solar design

A brief update on current passive design research . . . In an exploratory DOE project, AIA/RC has launched a nationwide series of passive solar design workshops for practitioners. Held in Chicago, Atlanta, Dallas, Seattle, Los Angeles, Washington, Boston, and Denver, the two-day, mostly sold-out, $275 sessions focused on daylighting techniques as well as passive heating and cooling. They could become a regular offering . . . The final fifth cycle of the HUD/DOE Residential Solar Demonstration Program is underway. Close to 100 decidedly passive projects should result from the cycle's now-complete award process, including, for the first time, several multifamily residential retrofits . . . And a new *Survey of Passive Solar Homes* is now in production, under DOE funding, with 111 case studies of recent, completed projects.



## A timely tale in a timely form

One of the rewarding things about working in architectural research is the opportunity it affords to see what's happening on the "leading edge," and to see new and sometimes revolutionary ideas gradually become accepted and applied. That's one reason the AIA Research Corporation encourages practicing designers to get involved in applied architectural research.

It's in connection with such new ideas that we mention a series of TV commercials recently aired by the Mobil Corporation, which give, in the form of a fable, Mobil's views on the energy crisis.

We think the fable idea is a good one. That's why, four years ago, we came up with an energy crisis fable of our own for AIA's 1976 Convention in Philadelphia. Since the fable seems to be an idea whose time has finally come, we thought we'd reprint it for you here.

* * *

Once upon a time there was a rivered, canaled, and archipelagoed city called Energy, which was dependent on great motored boats to move all its goods and its good people across its waters.

Accustomed to clouds of belching black smoke and the ear-numbing tantrums of turbines **(Figure 1)**, the people of Energy were shocked by the sunny blue skies and the tranquil quiet on the day their country ran completely out of fuel and their boats stopped moving.

With an appropriate sense of urgency, the best and brightest scientists and engineers of Energy were marshalled together and charged with the task of finding an alternative way of moving the now useless vessels. Many of these brainy persons looked to the winds continually blowing across the rivers, canals, and bays of Energy. But try as they might **(Figure 2)** they just couldn't find a way to get the wind to push the pistons that moved the arms that turned the propellors of the great boats.

One day a young inventor named Conscious watched the breeze push both him and his coattails along the docks. Instead of trying to get the wind to turn the screws, Conscious invented a sail to catch the wind and push the boats directly.

The first sail was modest, and although it got the boats to move it didn't get them to move very fast.

The people of Energy, reasoning that if one sail worked a little then more sails would work a lot, then stuck scores of sails all over their boats **(Figure 3).**

They did move a little faster, but not nearly fast or efficiently enough; and worse, the boats became unmanageable.

Finally, a young architect named Design recalled, with that rare ability to perceive the obvious, that a horse with a very long neck is not a giraffe.

The task, he realized, was to rethink concepts. And the solution was not to make the old boats work without fuel but to design or redesign boats that didn't need any.

The new boat designed to forsake fossil fuels and move with the breeze was fast and free. And the people of Energy, to honor their boat and the process by which it evolved, named it, of course, Energy Conscious Design **(Figure 4).**

The End.

* * *

One final note about our sailing fable: According to Britain's Royal Institute of Naval Architects (RINA), new and highly sophisticated sailing vessels may be competing with and surpassing ocean-going tankers as a means of worldwide transport in the near future.

This winter, 150 British, American, and European shipping leaders met at a RINA symposium on commercial sail in London to hear that on certain routes, sailing ships can indeed be competitive with power-driven tankers.

Marine designer Michael Willoughby told participants that he is seeking U.S. backing to build a $15 million, five-masted, square-rigged barque, "Windrose," that he has designed for bulk cargo carrying.

The ship, which looks not unlike the clippers of the 19th century, would be equipped with a diesel auxiliary engine, do 14 knots at sea, be navigated by an on-board computer that selects the best route from data provided by weather satellites, and complete the Europe-to-Australia in just a week longer than a conventional tanker. Such recent and high-tech developments as ship-stabilizers and hydraulically controlled rigging would reduce the danger of rough seas. And the sailing voyage would cost shippers 20 per cent less than they pay today, even at *last winter's* oil prices.

Some fable, huh?

**Figure 1**

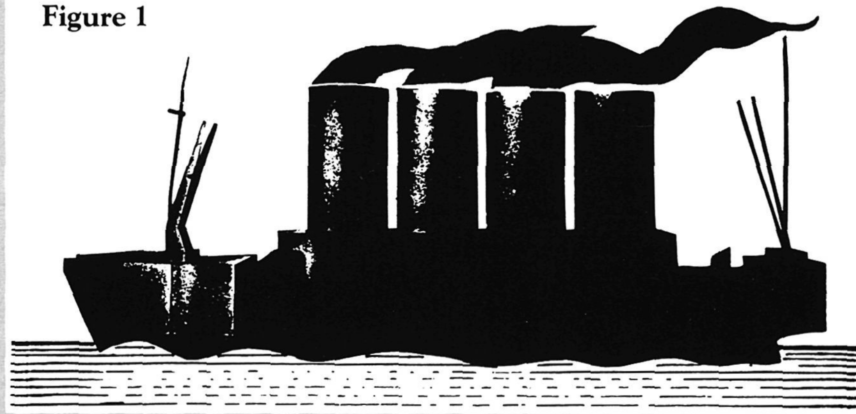


**Figure 2**

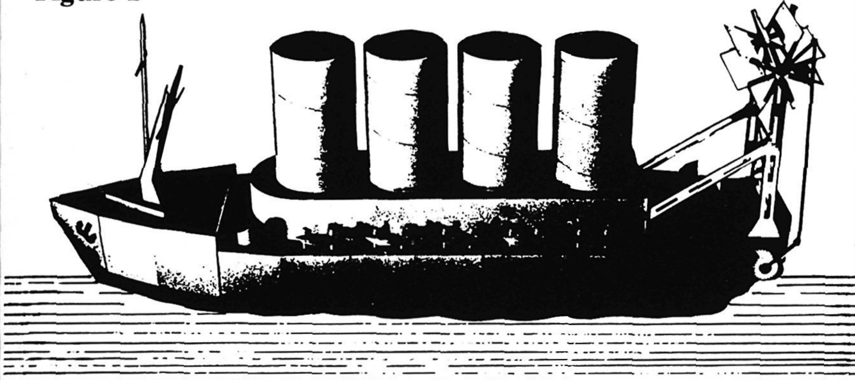


**Figure 3**

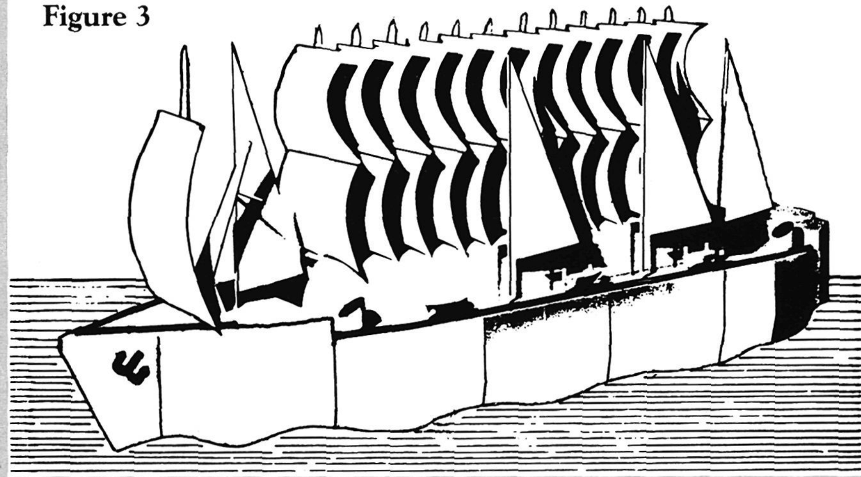
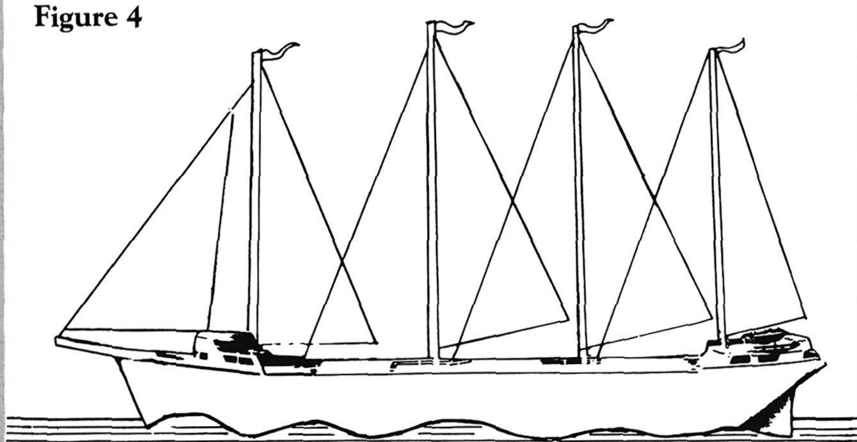


**Figure 4**




NEW DIRECTIONS
A BETTER WORLD

# Researching the '80s

**We talked to a score of the nation's leading design researchers about the past decade of architectural research and its directions for the next. Energy was much of the story, but far from all of it.**

Brilliant advances in such fields as genetics and electronics sweep our breath away. The world economy becomes unrecognizable. The new means of communication dazzle us. The nuclear family system breaks. Traditional political and economic theories seem increasingly irrelevant as, at every point, the centuries-old frame of industrialism is stretched or broken by the rise of the Third Wave."

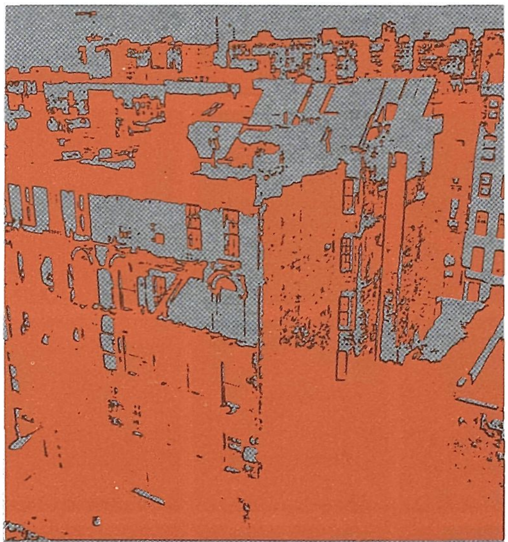
So Alvin Toffler describes the advent of the Eighties. In his newest book, *The Third Wave,* published this spring, the veteran prognosticator and author of the now ten year old *Future Shock* takes his decennial look around and, extrapolating from what he sees, looks ahead to the Eighties and beyond. His vision isn't as apocalyptic as it might sound; it will, in fact, "offer startling opportunities for a better life," according to the New York Times. Toffler's "Third Wave" is the rushing cultural and technological change that we live with, and that he believes is reshaping western civilization no less thoroughly than the invention of agriculture and the industrial revolution did, 100 and three centuries ago respectively.

There are those who believe that architecture is on the verge of changes as sweeping, as all encompassing as those Toffler predicts for western civilization in the coming decade. That is likely more true of the research community than of design's mainstream, since research is something that happens on the leading edge of any field. So we have taken advantage of the advent of the Eighties to ask some of the nation's leading proponents and practitioners of architectural research if they would, in a sense, play Alvin Toffler for this issue of Research & Design. Like Toffler, these people are perhaps more aware than most of us of the hard and soft technological advances of our time. And they have been, in the Seventies, part of the emergence of architectural research as a forceful new influence on building design.

During the Seventies, architectural research came to embrace, as does Webster's definition of research, not only basic, scientific investigation but the "practical applications" of such basic inquiry. We have talked to some of the people who have forged the new connections between research and its application in design. We've asked about the changes they've seen over the past decade and the directions they foresee for the next, and their responses have been fascinating. Their responses have also been, at times, intriguingly redundant, crisscrossing frequently, forming a pattern of mutual interests and concerns that may set the agenda not only for the new research of the Eighties, but for a new architecture as well.

Ralph Knowles, UCLA-based designer, researcher, author, educator, is responsible for much of the leading solar architectural research of the past ten years. His *Energy and Form* is one of the key texts in what is generally acknowledged to be the most important field of architectural research today—energy conscious design—and his subject—architectural form—remains a primary area of inquiry for design researchers. He can sound, however, as though it's an issue well behind the frontier.

"Our energy research has taken energy and form as a point of departure," Knowles says. "I think we're getting to the point where these aren't sufficient. We need an ethical, esthetic, philosophic framework to hold our research."



Allen Freeman

**"Retrofitting should be our only research focus. The notion that 'new is better' has to be utterly abandoned in favor of energy conscious reuse, retrofitting, and rehabilitation."**

**William Mingenbach**

Yet Knowles still maintains that form is the critical issue in energy conscious design. "To put it a terribly simple way," he says, "we're seeing an unreal dichotomy between the 'posties'—post-modernist designers—and the 'mud-daubers'—solar architects. What we should be reaching for is a synthesis between the posties and the mud-daubers."

Like a great many architects, Knowles is looking for design solutions that respond equally well to both esthetic and energy considerations. His most recent research with daylighting models has generated extraordinarily different architectural forms in that context. But if form is the crux of the energy conscious design argument, the forms of indigenous American architecture are its icons.

"We're moving away from our European roots," Knowles says. "We're rediscovering the American heritage in architecture, and that's exciting. We inherited the architecture of another climate. Our climate is different. We're looking at *our* environment now, and out of that, a new architecture has to come. Our models have been around a long time, since the 18th and 19th centuries. We should be looking at them both as practical shelter and as communicators of form. As form-givers."

Harrison Fraker agrees with Knowles about the need to focus on form in architectural research. Fraker is a New Jersey architect, and a busy one, with students at the University of Pennsylvania, a design firm in Princeton, and a research firm, the Princeton Energy Group, all under his direction. He also does a great deal of consulting in energy, and he considers architectural form a primary issue for near-future research.

"We have to be concerned with the way in which energy conscious design techniques—natural heating, natural cooling, daylighting—become part of our design vocabulary," Fraker says. "Studying form is a way of accelerating the integration of those techniques into the design process. You translate technical ideas into form. You develop a good form to perform a certain task. We should conduct a lot of work in the development of formal form prototypes for different climates."

Texas designer George Way says much the same thing. Way is vice president of Houston's Tackett-Way-Lodholz and deeply involved in the firm's energy consulting and research. "We've begun to understand climate," he says. "We've begun to understand building energy consumption. Now I think we have to develop a new regional vernacular in design, based on those understandings."

Way's "understandings" are products of the burst of energy-related architectural research that came in the late Seventies, on the heels of the 1973-74 Arab oil embargo. Yet, with the exception of the most sophisticated and high-tech research of those years, his understandings were more the offspring of historical inquiry than scientific investigation, and the climatic information that Knowles, Fraker, and Way all cite in their discussions of architectural form is the best example.

Last year, the AIA Research Corporation hosted the first national conference to address questions of climate and architecture since AIA and House Beautiful magazine conducted extensive work in that field in the early Fifties. Sponsored by the U.S. Department of Energy and the National Oceanic and Atmospheric Administration, attended by architects, engineers, builders, and climatologists, the conference revived a research effort that lay dormant for nearly 30 years. Its key finding: The local climatic data that designers need to maximize energy conservation in their buildings has almost all been regularly collected and tabulated, on the local level, for decades. It needs only to be organized for presentation to designers—in forms that AIA and House Beautiful created nearly 30 years ago—and made available for dissemination.

The conference recommended that federal agencies develop such reports—called local building climatological summaries—and designed a standard format for them. It is a safe assumption that such climatic research and development will occur in the first half of this decade; in fact, it has already begun. The office of the state architect in California has developed local climatological summaries for state office building projects in San Jose and Sacramento, and architects at the Tennessee Valley Authority in Chattanooga have published summaries for nine small metropolitan areas within TVA's operating purview.

There is, climate-conscious researchers point out, new climatic research to be conducted even as existing data is correlated for the special needs of designers. The need is greatest where higher technology research has shown designers new opportunities. Says Harrison Fraker, "We need more data in several areas—the brightness of the sky in lumens/sf of horizontal surface, for instance. And we need more correlation of specific climatic data."

With more data and better techniques for applying that data to specific or prototypical design problems, Fraker believes a new architecture will begin to take shape. "Once we have the tools necessary to calculate the performance of formal form prototypes, we'll have the beginnings of a new design vocabulary. We have a form vocabulary now that we've drawn from a functional standpoint, a stylistic standpoint, and a historical perspective. The injection of an energy standpoint will reshape that vocabulary, in a way that is more or less prototypical."

**"We've begun to understand climate. We've begun to understand building energy consumption. Now I think we have to develop a new regional vernacular in design, based on those understandings."**

**George Way**

If the research of the Seventies has pointed new directions for research in the Eighties—especially in terms of Knowles' synthesis between posties and mud-daubers, Fraker's prototypical forms, Way's regional vernacular, and the correlation of climatic data necessary to those notions—it has also uncovered some very problematic areas in energy conscious design. One of those is natural cooling. Perhaps the most exciting design research of the late Seventies took place in the area of passive design. Passive heating in particular enjoyed tremendous interest and tremendous advances in its design technology, largely because the examples of indigenous architecture around the world provided ample proof that the warmth of the sun can be harnessed to remarkable effect without mechanical technology. While many designers still consider passive solar heating strategies "experimental," a great many researchers consider it a research problem basically solved. Not so with passive cooling, however.

Dennis Andrejko, one of the principals in the energy conscious SEAgroup design firm in Sea Ranch, Calif. and an experienced passive designer, calls passive cooling "the new challenge in residential design." John Yellott, Tucson researcher, educator, and one of the nation's leaders in solar design theory and practice, is more blunt. Natural heating, he says, "we have in control." Passive cooling has become "the most important issue in architectural research."

The question for architectural research in this decade is a simple one, Yellott says: "How can we accomplish, with a minimal expenditure of energy, the things to which we've become accustomed?" In Yellott's part of the country, people have become accustomed to air-conditioning, and that's going to pose tremendous energy burdens in the very near future. "A tremendous amount of housing is forecast for the Sunbelt," says Yellott. "Arizona's population is expected to double in the Eighties. That means an additional million people, most of them in the southern half of the state, where the weather is most comfortable most of the time but where it's hellaciously hot in the summer. Cooling," he concludes, "is going to be a real problem."

*Cooling is a real problem* for residential design in much of the South and West, where humidity and other climatic factors pose nearly insurmountable difficulties; for non-residential design, cooling is a problem throughout the country; in neither case can passive design solutions fully meet cooling needs. Thus, design research in passive strategies will be paralleled in the Eighties by more highly technological research in systems capable of picking up where natural strategies leave off. Says John Yellott, "Arizona is nearing completion on three nuclear generating plants, but much of their energy is contracted to go to California in return for funding required to build the plants. They won't meet half the demand that is forecast for the next ten years. So we're going to need intensive research and some real breakthroughs in absorption and refrigeration systems that don't consume tremendous amounts of electricity."

The hybrid approach to heating, cooling, and lighting buildings—blending passive design strategies and energy efficient mechanical systems—will be characteristic of design and the focus of research in this decade. Already the best new examples of natural cooling on the commercial scale, TVA's 1.3 million-sf Chattanooga office complex and California's Site One and San Jose office/commercial building projects, are sophisticated blends of climate-sensitive design and condition-adaptive active mechanical systems. The moving elements of such buildings respond to an automated climate-control system that is constantly reading environmental conditions and balancing solar gain against building-generated heat, artificial lighting against daylight bounced and diffused throughout the building, thermally-stored night air against air-conditioning, to achieve optimal energy-conserving building performance. These are what John Cable, head of DOE's conservation and solar applications division, calls "smarter buildings." He thinks the further refinement of such automated systems, "in which the building itself is conceived as the system," will be one of the key research tasks of the Eighties. So, he says, will be the development of computational tools that will enable better systems analysis. What is now an incredibly complex field dominated by a few firms specializing in energy engineering will within ten years be part of the practice of every designer of commercial buildings. Handbooks and design guidelines setting out standardized calculation techniques and computational charts will be on every architect's desk. And the tool that will bring these changes about is, not surprisingly, the computer.

**"Our seismic research started out to make buildings safe. Now that we have that pretty much in line, we're out to reduce building damage."**

**Jack Scalzi**

"Who would have dreamed, back in the Fifties," says one of IBM's newest ads, "that in less than 30 years this would be an industry that has installed more than 500,000 computer systems in the U.S. alone?"

Who, indeed. The last ten years, let alone the last 30, have surprised even IBM with untold new applications of computer technology in untold fields. Design has been no exception. Yet the next ten years promise to be the real decade of the computer in architecture.

"I've known two firms in the last two months, in Houston alone, who've gone to computers for business management," says George Way. "Another firm has just decided to get one for spec writing, energy simulation, and office management."

Way clearly sees more than a few applications for the computer in research and design. "The computer," he says, "can give you many answers to make a decision from. It's fast. In building energy simulation, in the time it takes to do one hand calculation for a building, you can do six, eight, ten calculations on the computer. And that's only part of it. In programming, the computer can do the tedious work. We can go through a programming matrix option-by-option with a client. We enter the matrix in the computer, which weights options in relative priority, and get a room-by-room answer listing in descending values of importance the issues to be faced in the design process. The computer can list those issues in terms of some factors or all factors. We can take a committee, including, say, representatives of maintenance, secretaries, and executives, each with a different perspective on their needs, and look at them individually or together. The computer can consider issues in terms of space-to-space relationships, or space-to-activity, or activity-to-environment, or environment-to-disturbance." (Way explains that a disturbance might be solar overheating through glazing.) "The control system breaks out disturbances. It highlights the problems, so that decisions can be made more readily." Will we reach the point where computers can make design decisions? Way thinks not. "The computer," he says, "can't take away the decision-making process."

Harrison Fraker puts it another way. "We're using microcomputers and hand-calculators to answer a lot of questions now," Fraker says. "I design things and ask the computer to run the daylighting program, or the solar fraction program." These are the "detailed, simplified performance prediction techniques" that Fraker would like to see further refined for calculating the performance of prototypical energy-conscious forms. "But we won't see the computer taking over," he says. "It can be—could be—a great aid. All you do is pump in the form. You act as the synthesizer, and it evaluates. Design is analysis and synthesis, and *designers* are the synthesizers. The computer cannot store design solutions."

Or can it? Murray Milne, a UCLA researcher, says, "I'm trying to turn the computer into a good, smart draftsman." Such a statement implies that the computer may indeed be capable of storing design solutions, and that may indeed be what Milne is after.

"Eighty per cent of the energy issues in a building are solved at the schematic level," he says. "I'm developing computer-based design aids for schematic design. I'm trying to turn the computer into a good, smart draftsman to whom I can give the square footage of a project, the building type, and its climatic environment, and who will then block out the building graphically, right down to general dimensions and glazing percentages.

"It's a matter of communicating," Milne believes. "We all recognize the importance of graphic communication in design. Here, it's a problem of communicating between the architect and the computer, and it's much easier to train the computer to talk to the architect than the other way around."

Milne firmly believes that architects will have essentially turned the tables on computers in the next few years, that we'll have moved from "computer graphics," where the computer visualizes a programmed-in design, to the point where the computer evaluates data and generates its own solution, albeit basic. And Milne believes that coping with this turnabout is something the profession will have to learn to do in fairly short order. "Small, sophisticated computers will be as effective as draftsmen in three to five years," he predicts, adding, "They're cost-effective today."

Says George Way, "The only thing preventing widespread use of computers in practice is the shortage of software—good programs. Actually, a great deal of software exists now, but it's proprietary—developed by a firm for the firm's own use. Once it becomes apparent that the market is there, we'll see competition."

If energy is launching a new decade of design-related computer research, that relationship is symptomatic of a larger phenomenon, and that is the increasingly interdisciplinary nature of so much new research.

Jack Scalzi heads the hazards research division at the National Science Foundation, where basic, rather than applied, research is usually undertaken, and where much of the nation's research into mitigating the threat of natural hazards to architecture and its users has been conducted. That research has altered significantly since NSF funded the AIA Research Corporation's *Architects and Earthquakes: A Primer* in 1976.

> ***"We're moving away from our European roots. We're rediscovering the American heritage in architecture, and that's exciting. We're looking at our environment now, and out of that a new architecture has to come."***
>
> **Ralph Knowles**

"Our seismic research started out to make buildings safe," Scalzi says. "Now that we have that pretty much in line, we're out to reduce building damage. We see lots of cases where buildings suffer 60-75 per cent non-structural damage, and in those cases you just tear out the inside of the building and start over." Scalzi says the hazard design research of the next few years will focus on the mitigation of damage from all natural hazards—fire, floods, hurricanes, high winds. And the interdisciplinary nature of such research will grow. NSF is sponsoring an AIA/RC research project now that focuses on the complex problems of designing earthquake-resistant buildings that also provide protection against the hazards of fire, flooding, and high winds—and are energy-efficient as well. As an area in which more new, cross-disciplinary research is needed, Scalzi names high winds. "We still don't have a good gradient of high winds moving upward around tall buildings," he says. Such a gradient could be useful, he feels, because winds may be valuable "in terms of updrafting and downdrafting. There may be an energy application for those buildings, or a pollution application."

Other recent examples of interdisciplinary research lend credence to the belief that this kind of work will proliferate in the Eighties. Fred I. Stahl, an architectural researcher at the National Bureau of Standards, recently published a paper in the scholarly Journal of Architectural Research, evaluating existing design standards for emergency access and egress against the needs of the handicapped. On a related subject, Paul Muldawer, the Atlanta architect who designed President Carter's solar-heated viewing stand for the 1976 inaugural, makes novel linkages—and cites contradictions—between barrier-free design considerations for the handicapped and the results of current energy conscious design research. Revolving doors that are energy-conservative, he points out, may be impossible for the mobility-impaired to operate, just as operable windows may also present difficulties. And the reduced lighting levels suggested under some daylighting proposals and cost-cutting schemes could seriously inconvenience the visually handicapped. Jack Scalzi touches on another subject that could be as volatile as it is interdisciplinary, in connection with last year's El Centro earthquake in California.

"I went to El Centro," he says, "and visited a building that suffered a partial collapse of 10 or 11 stories." Told by witnesses that the panicky egress of the building's users bore little relation to the building's emergency egress planning, Scalzi says, "People simply followed their instincts when they exited." Then he asks, "Did the designers take those instincts into consideration?"

Taking instincts into consideration has, at least since the Sixties, and at least in the research community, been the bailiwick of the behavioral scientists—if you ask the behavioral scientists. Architects have often been of a different mind.

"There is a disenchantment left over from the Sixties," says Harrison Fraker, "when sociology was thought to be the new key to architecture. It wasn't the key. It resulted in more paperwork and higher costs."

Robert Shibley, formerly architect in the office of the chief engineer at the Army Corps of Engineers and now at DOE, helped write the architectural research prospectus for the Corps. "In the Seventies," he says, "we did tough-minded, rigorous research on user needs, measures of those needs, standards to be met, and methods for meeting them. It was new, very interesting, high-tech, and fairly academic. But it made no difference in the way we build buildings."

In fact, the joint experiences of architects and behavioral scientists in the Seventies were frequently less than euphoric. The decade ended with the two professions less inclined to work together than when it began, and, as psychologist Robert Sommer put it in the April 1980 AIA Journal, with behavioral research "more the exception than the rule in architectural practice." Yet Sommer also noted that the two fields "can still come together as circumstances permit," and there is considerable evidence to prove that behavioral research and environmental design will still go very much hand in hand in the decade to come.

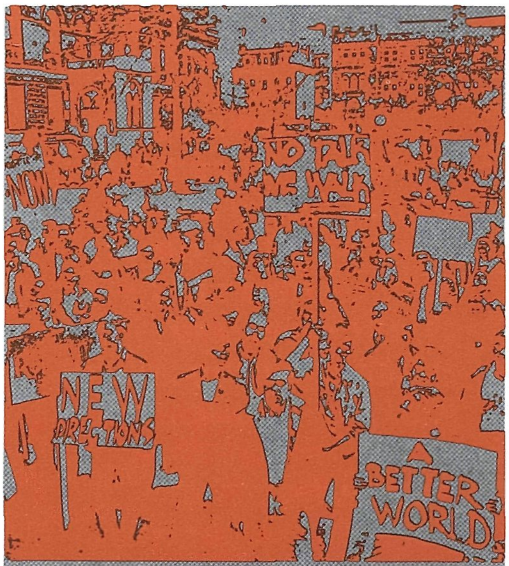
Donald Watson is one of the leading solar designers in the country, a dedicated proponent of energy conscious design research in the Seventies and the only solar architect asked to join Philip Johnson, John Portman, AIA President Charles Schwing and a few other architects in a special energy/design meeting with DOE Secretary Charles Duncan this spring. Asked almost rhetorically whether he would name energy as the key research issue of the Eighties, Watson says, "Energy alone isn't a sufficient criterion for design. My priority would probably be to research human-value questions. Not simply functional requirements, but psychological requirements."

Says Harrison Fraker, "Social science is valuable for analyzing programming. It can go after more than simply circulation patterns. It can go after the 'hidden rituals.' It's anthropological research that takes building users as a kind of primitive tribe, and asks whether the building will represent these people on a qualitative, symbolic level. This is what [Christopher] Alexander and [Constance] Perrin are going after. I don't know whether a new paradigm will come out of it. But I know that the interesting work will come when good designers work with good sociologists."

That a new paradigm won't arise from the confluence of sociology and design was probably the main lesson of the experiments of the Sixties and Seventies. If nothing else, the economic realities of architectural practice argue against such a revolution. As with energy conscious design, clients aren't interested in behavioralism unless there is a palpable payback for them, and neither are their designers.

Ezra Ehrenkrantz, whose New York firm, The Ehrenkrantz Group, is engaged in both research and design, and whose comments on the subject are brief, sums the challenge to architectural research up neatly. "We have to be able to predict what's going to happen in a building, in an environment. We deal with very few knowns. And we have to deal with clients."

But these realities may be what bring designers back to behavioral research in the Eighties, if the products of that research can be proven to be beneficial to the clients who must pay for it. Robert Shibley thinks that's a matter of designing a building that the client won't constantly have to redesign for less than crucial reasons. "The design process doesn't stop," he says, "when the design team leaves. The process goes on. But it's not headed by an architect; it's headed by a layman." The layman to whom Shibley refers is frequently a management consultant. "You pay an architect a fraction of what you pay a management consultant," he says, "to develop essentially the same information, which is 'how the place works.' And then you throw it away. Architects must give away their knowledge of organizational development through their design. We have to help users discover for themselves their own needs, and how to communicate those needs to designers. And we have to hold ourselves accountable for understanding them and meeting their requirements. Otherwise, the architect will only come back when the situation is so bad they need him to change it."




**"Energy alone isn't a sufficient criterion for design. My priority would probably be to research human value questions. Not simply functional requirements, but psychological requirements."**

**Donald Watson**

Shibley, who believes that architects are almost as adept at dealing with managerial systems, in organizational design terms, as with structural systems, isn't alone in calling for more behavioral interest in the profession. At least two voices at the National Endowment for the Arts, generally thought of as esthetics-oriented, are saying the same thing. Charles Zucker is deputy director of NEA's Design Arts Program. "Measuring consequences" is his primary research goal, he says. "On people, on health, in social terms, in psychological terms." Design Arts Director Michael Pittas agrees with that emphasis, as he agrees with Princeton's Fraker about there being both "some disillusionment" about behavioral applications in architecture and a definite need to pursue the field in the coming decade.

"Architectural schools in particular are reducing their social/behavioral staffs. Some of the leading schools have purged those departments," says Pittas, who came to NEA from Harvard. "This leads to the Pruitt-Igoe syndrome; we don't know whether the people or the environment are causing the problems."

Then where should the profession direct behavior-oriented research in the next few years?

"Worker productivity and interior environments," he says without hesitation, touching on a subject that could well become a leading contender for dollars spent on architectural research over the next ten years. "Lighting, accoustics, behavior, and productivity."

Productivity is a subject Michael Brill has thought about. Brill heads the Buffalo Organization for Social and Technological Innovation, which has lately been researching productivity in the workplace as a function of environmental design.

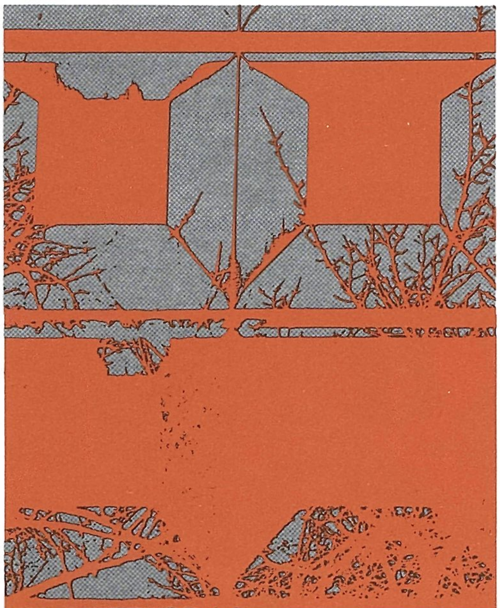
"The environment," Brill says, "makes a difference in people's capacities to achieve their goals. We're trying to measure the extent to which environment does that—the extent to which it affects behavior, satisfaction, and productivity."

Brill's productivity research is interesting. For one thing, he is concerned with productivity in the office, an issue that impacts more designers than factory productivity might. For another, his concerns are larger than one might think.

"All of the time and motion studies conducted early in the century were in factories and assembly lines," he says, "You could see the results immediately, and measure them quickly. In the office, things get more complicated. All that management insight tends to fall apart when you're dealing with knowledge workers, because when you make changes, the results are distant in time and space. How do you measure *their* productivity?

"People are just beginning to realize," Brill says, "that the productivity problems of the nation lie at the doorstep of the office. In this century, the ratio of increases in productivity by factory workers to increases by office workers is 20 to one. Now that information handling—which is another way to say office work—has grown to be more than 50 per cent of the GNP, is it any wonder that American productivity has stalled?

"How do we design for office productivity?" Brill asks. "How does the environment affect office workers? We have to find ways to measure these things. When you ask a management consultant to improve productivity, his solution is to redesign jobs, rather than redesign the environment. Management consultants treat office systems like assembly lines, and they start tinkering with reward systems and work schedules." Brill feels that such job redesign can put office workers at odds with their environment, citing as an example the flexible working schedules that have become popular with the onset of the energy crisis. "With flex-time," he says, "someone may work only four days a week. Every two weeks, that's eight days on and six days off. When it gets to be seven and seven, we'll be at the point where one work station will be able to serve two people. That's when the connection between environmental design and job redesign will become clear."



> **"We have to be able to predict in advance what's going to happen in a building. We deal with very few knowns. And we have to deal with clients."**
>
> **Ezra Ehrenkrantz**

What could propel questions of productivity and design to the forefront of research in the Eighties is the growing importance of productivity as a national issue. The nation's recessive economy and lagging productivity are headlines daily. As Mike Brill points out, government deals with problems like these from a "Manhattan Project" approach; when the problems get serious enough, researchers are given all the money they can possibly spend and instructed to solve the problem. If the nation's energy research fit that description in the late Seventies, productivity could become the big issue for design in the Eighties. Brill, for one, thinks 50 per cent of the nation's design research dollars should go into such behavioral research. The 85 per cent of those dollars that he estimates are now spent on energy questions should be reduced to 15 per cent, he says, and "pinpointed accurately."

The irony in Brill's evaluation of expenditures—and there are other researchers who agree with him—is that energy shows signs of growing as a design research issue in the Eighties, rather than shrinking. The research to date has indeed been reductive, narrowing to focus on such design issues as building form and such specific problems as natural cooling and daylighting. Pinpointing research to address those questions is a viable and perhaps the probable course for the next ten years. At the same time, though, new and substantially larger questions have emerged pertinent to energy and design. Among them are land use planning, energy consumption in the construction process, and the thermal performance of building materials.

Materials research has captured the imagination of more than a few energy conscious designers. Dennis Andrejko thinks the Eighties will see a host of "new materials that can be used to improve thermal characteristics: substitutes for glass, thermal storage materials, sun regulation devices." He also sees fabrication and systems integration revolutions on the horizon. "I can see an eight-by-eight-foot box," he says, "that contains all the materials for an energy conscious shell: all the structural elements, all the thermal elements, the weatherskin. . ."

DOE's John Cable says the federal government is interested in the same things. At the National Bureau of Standards in Gaithersburg, Md., DOE is building its first facility capable of full-scale dynamic thermal testing of eight-by-eight-foot wall sections. DOE plans to test full wall sections in the field for the first time too, says Cable, as well as conducting new insulation and envelope systems research.

More excited about materials research than either Cable or Andrejko is MIT's Tim Johnson, who helped design and now monitors the experimental Solar 5 house on the MIT campus in Cambridge, Mass.

"Building products research is going to be the biggest action of the decade," Johnson says. "We're entering a materials revolution. In the Fifties, it was a revolution of materials strength. Today, it's the thermal performance of materials. And it's being supported by private enterprise; corporations and building product manufacturers are already doing it.

"What we're up to here," he explains about Solar 5, "is research into the physical properties of materials, to accomplish thermal and visual comfort in energy conscious design. We're into second and third generation products." In the Solar 5 test house, Johnson is researching and demonstrating three new building materials for passive solar design.

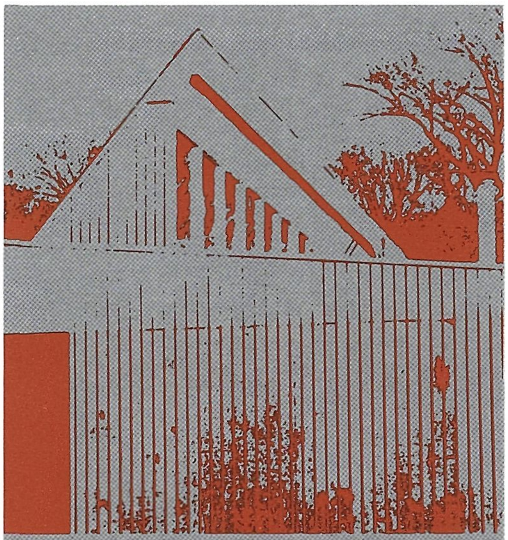
"One," says Johnson, "is heat-mirror glass, coated with a solar-transparent, infrared-reflective surface. The glass is double-pane, with a half-inch airspace between the panes, and it has a slightly green cast to it. It reduces night-time heat loss to within five percentage points of thermopane backed with one inch of foam insulation." Which, says Johnson, gives users "the comfort of moveable insulation with none of the hassle."

The second product being tested is a system of "half-inch louvers, reflectively coated only on the upside of the blades, installed between the panes of the heat-mirror glass. The louvers bounce sunlight up to the ceiling, with no glare and no pools of light on the floor."

The third element is ceiling-mounted thermal storage. Johnson is testing "two lightweight thermal storage ceiling systems" to store the solar heat bounced upward by the louvers. One system features inch-thick ceiling tiles hung from T-bar supports; the other consists of ¾-inch-thick plastic pouches resting on a ceiling of fire-rated drywall sheets. Both the ceiling tiles and the pouches are filled with a phase-change storage material capable of storing the reflected solar gain.

According to Johnson, the three materials are performing well both at MIT and in a 1,300-sf house in Mattapoiset, Mass., on Buzzards Bay, where 60 per cent of heating needs are met passively and the remaining 40 per cent with an off-peak electric system—all for no extra construction dollars, no oil furnace and no distribution system. That may be why Johnson, who is currently consulting on three other, larger design projects, waxes optimistic about materials research in the Eighties.

"We are going to see whole new rainbows of building products," he says, "including thermally efficient wall boards and masonry elements. And we're going to see whole new rainbows of glass technologies for both residential and commercial use, including glass coated with a very thin, solar-transparent, infrared-reflective surface—highly transparent glass that reflects heat before it gets in."



***"People don't buy solar houses. They buy good houses which may happen to have solar on them. But people's perceptions of what a good house is will change."***

**David Moore**

New York architect Richard Stein is also interested in energy-related materials research, and from a larger perspective.

"The fundamental purpose of my research," he says "is to learn more about how buildings operate, how materials operate, and how these things affect design in the context of human and programmatic requirements."

Stein has led the field of energy research, and he clearly sees energy as the foundation of a new architecture. Which may be why he is thinking about human requirements and other design issues that spin off from considerations of energy performance.

"In the last couple of decades," he says, "architecture has seen a sharp veering off of the issue of appearance, divorced from the issue of performance. There is a lack of correlation. Research in that time has had an effect on design, an enormous effect. ASHRAE 90-75 has made designers look at buildings in an entirely different way. But the appearance of new buildings going up in New York City hasn't changed. That will change as designers get into new building shapes, facades, natural lighting, natural ventilation. That's near future.

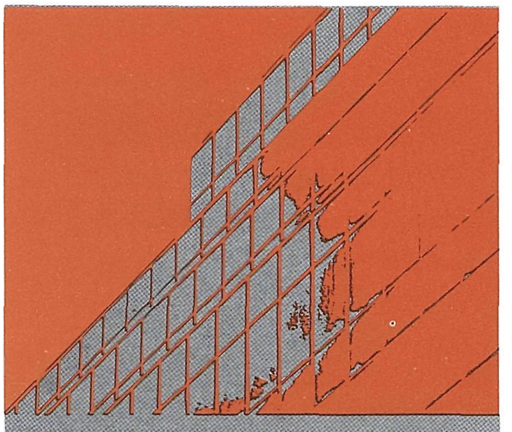
"What we should have now is an evaluation of the whole energy content of buildings. So far we've been interested in building performance; we figure 33-34 per cent of the nation's energy goes to heating, lighting, and cooling buildings. What about construction? Construction consumes about 10 per cent of the nation's energy. What about the energy cost of producing materials? The building industry is the nation's largest user of high-energy materials—materials that are very expensive to produce in terms of energy consumed."

Stein talks about a comparison study conducted on a 30-by-30-foot building bay, the same bay constructed three ways, with concrete, steel, and composite construction. The concrete construction had an energy cost 60 per cent that of the steel construction. This kind of awareness, he believes, will radically influence design over the next few years. Another radical influence, he says, will be a full understanding of the energy investment in the infrastructure—the context of services and facilities in which a building will exist.

"The energy investment in the infrastructure is huge," says Stein, "and vital to energy considerations. If the density of New York City's CBD increases beyond the capacity of the infrastructure—sewer, water, communications, transportation—then existing systems won't meet needs." In reference to a new reservoir constructed in Westchester County to serve Manhattan's water needs, Stein says, "It's already happening to New York's water supply." The energy cost of such corollary construction has to be figured into the development of already crowded urban settings, Stein says, and alternatives have to be examined. "The South Bronx," he points out, "has a rotten building inventory. But it has a tremendous amount of slack in the infrastructure." Stein believes that such realizations will affect not only building design in the near future, but land use planning, urban zoning, and all the processes that determine how and where the nation's cities will grow.

Stein's research interests are shared by numerous designers and researchers, some of whom are convinced that perhaps cities should not grow at all.

Bill Mingenbach, principal of The Architects Taos in Taos, N.M., is fairly terse on that subject. "Retrofitting should be our only research focus," he says. "It's fun to build new things, but we can't rebuild the whole country."



***"Building products research is going to be the biggest action of the decade. We're entering a materials revolution. In the Fifties, it was a revolution of materials strength. Today, it's the thermal performance of materials."***

**Tim Johnson**

Mingenbach is active as both a designer and a researcher. He has been and continues to "build new things" from a decidedly energy conscious approach. His research interests are also advanced. He is working with a Taos neighbor's vacuum furnace to deposit gold, silver, and other coatings on glass and other substrates, researching glazing. And he is building a test room with high infrared reflective, low infrared emissive walls, into which he plans to introduce low radiant energy and "bounce it around." Yet Mingenbach is convinced this research may be best applied in the redesign of existing buildings, rather than in new construction. "The notion that 'new is better' has to be utterly abandoned," he says, "in favor of energy conscious reuse, retrofitting, and rehabilitation."

It should come as no surprise that the National Trust for Historic Preservation concurs with this attitude. The Trust has launched a new campaign for 1980 keying preservation to energy conservation, with no little evidence to support its cause. Among its citations are three-year-old DOE survey results which show post-1945 office buildings in New York City consuming considerably more BTUs/sf than comparable structures designed and built before World War II. Also cited are research data indicating that the complete renovation of an existing building may carry as little as one-fifth the energy cost that construction of a comparable new building carries. Add these to the energy investment in the infrastructure and the energy-intensive materials saved in a renovation, and the Trust's preservationist instincts begin to look prophetic of a larger attitude in the Eighties.

Not opposed to new energy conscious design solutions but well seasoned in their evaluation is David Moore, who manages the U.S. Department of Housing and Urban Development's Solar Heating and Cooling Demonstration Program, the longest and largest federal solar architecture program going.

"One of the things we've found over the years, says Moore, "is that people don't buy solar houses; they buy *good* houses which may happen to have solar on them. But people's perceptions of what a good house is will change."

Moore has watched attitudes change since the inception of the demonstration program in 1974, especially among architects. "Our first program opportunity announcement in 1975 yielded just 22 solar systems worth demonstrating," he says. "Now we have over 900 solar product manufacturers listed with the National Solar Heating and Cooling Information Center and over 5,000 professionals—architects, engineers, builders—qualified to do solar work." Moore has been in as good a position as anyone to watch research emerge as an influence on mainstream residential designers. His program has evolved from an emphasis on high-tech active solar systems to a high interest in passive technology—all in the context of marketable housing design.

"Our early interest was in active solar systems," he says, "because product manufacturers were the only ones interested; they were looking for builders to try their products out. Architects were designing solar houses only on a custom basis for private clients, and we couldn't fund that kind of work. Few builders were willing to take a chance on selling a solar home. And it wasn't until recently that research came up with solid numbers on passive performance, on the solar contribution. Only in the last few years have practitioners understood the ramifications of passive solar design. And only in the last two years have we learned to really measure passive performance."

How will HUD respond to these developments in the Eighties?

"We've trained a dozen guys in HUD field offices around the country with calculation techniques" for measuring passive performance, Moore says. "We're going to push the residential building industry as hard as we can to do energy-conserving work." Then he adds, "From the architect's point of view, a lot will depend on clients. If a client is willing to try something new, I know a lot of designers who are willing to try it. The practitioner has to be on the cutting edge. He has to analyze the alternatives and decide which one is right. Solar isn't always right. Conservation always is. I think designers are going to have to design for energy conservation—if you aren't doing that, why waste time and money on a solar system? Designers will have to incorporate passive solar design. They'll have to incorporate an active or hybrid system if it's appropriate, and it often is. And we'll see final testing of things like phase change materials."

> ***"I'm trying to turn the computer into a good, smart draftsman."***
>
> **Murray Milne**

Energy, far and away the dominant topic in our conversations with researchers around the country, will dominate the research of the next decade. But the directions that research will take are clearly many. Ralph Knowles, Harrison Fraker, George Way, and many other energy conscious designers and researchers have come out of the Seventies preoccupied with questions of architectural form which will doubtless receive much attention. The esoterically inclined of this community will concentrate on prototypical forms; practicing designers in regions where climatic demands are significant will likely evolve what George Way characterizes as "a new regional vernacular" rooted in energy consciousness. And the climatic data essential to such approaches will be correlated and published in a form pertinent to design and easily accessible for designers.

More highly technological research will be conducted in the areas of thermally-efficient building products and energy system components, at universities, manufacturing corporations, and in publically-funded laboratories. The likely subjects of focus include new thermal window systems, phase-change materials and other thermal storage elements likely to impact natural heating technology, and a wide array of natural cooling systems, including sophisticated new radiative surfaces and dehumidification systems capable of handling the latent heat problems of hot, humid regions. Work in those areas is already underway. Hybrid applications of high-tech systems and passive design will increase, as will the design of automatic building control systems meant to monitor the blend of mechanical and natural heating, cooling, and lighting. And computers, while not essential to the operation of such automatic control systems, will shortly be generating calculation data that will make the design of such complex systems a matter of handbook consultation for most architects. Computer applications in specification production, energy simulation, management, schematic design and a host of other fields will continue to increase with characteristic mind-boggling rapidity.

Any obsession with things new will be balanced by a retrofitting and reuse trend that has already, as Progressive Architecture recently noted, "grown far beyond the preservation movement that spawned it." A revived interest in city living, AIA's national honor awards program for "extended use" of buildings, the National Trust for Historic Preservation's proclamations of energy conservation and the findings of Richard Stein and other energy conscious investigators will combine to make retrofitting an active field for both research and design in the Eighties. Held in this balance of old and new will be HUD, whose essentially conservative interest in new energy conscious design demonstration will focus more on passive technology than ever before and, at the same time, remain in the "builder's home" harness.

Research into the mitigation of natural hazards will be active, but not likely to see any breakthroughs. The interdisciplinary nature of new research in the field—evaluating hazard mitigation design considerations against user behavior and energy conscious design—will be characteristic here and elsewhere in research. Environmental behavioralism may prove to be the liveliest component of this interdisciplinary approach. The topicality of such issues as office productivity should propel more designers into a field that is already growing, if slowly. And post-occupancy evaluation could have a powerful new impact as more novel energy conscious solutions crop up in non-residential design.

What is probably the most important trend in architectural research, however, is already well underway. The gap between research—architecture's pragmatic avant garde—and design practice is rapidly narrowing. Particularly in energy, where the demand for energy conservative design solutions increases in direct proportion to the cost of conventional energy, designers are applying the results of yesterday's research today. By the advent of the Nineties, that gap may not only have diminished; it may have disappeared.

*—Kevin W. Green*

# Acknowledgements

The following individuals contributed to the development of the article on research directions for the Eighties presented in this issue, and the AIA Research Corporation gratefully acknowledges their assistance.

**Dennis Andrejko,** SEAgroup, The Sea Ranch, Calif.; **Michael Brill,** Buffalo Organization for Social and Technological Innovation, Buffalo, N.Y.; **Thomas O. Byerts,** University of Illinois, Chicago, Ill.; **John Cable,** U.S. Department of Energy, Washington, D.C.; **Ezra Ehrenkrantz,** The Ehrenkrantz Group, New York, N.Y.; **Andrew Euston,** U.S. Department of Housing and Urban Development, Washington, D.C.; **Harrison Fraker,** Princeton Energy Group, Princeton, N.J.; **Tim Johnson,** Massachusetts Institute of Technology, Cambridge, Mass.; **Ralph Knowles,** University of California at Los Angeles, Los Angeles, Calif.; **Murray Milne,** University of California at Los Angeles, Los Angeles, Calif.; **William Mingenbach,** The Architects Taos, Taos, N.M.; **David Moore,** U.S. Department of Housing and Urban Development, Washington, D.C.; **Paul Muldawer,** Atlanta, Ga.; **Michael Pittas,** National Endowment for the Arts, Washington, D.C.; **John B. Scalzi,** National Science Foundation, Washington, D.C.; **Roger Schluntz,** Association of Collegiate Schools of Architecture, Washington, D.C.; **Robert Shibley,** U.S. Department of Energy, Washington, D.C.; **Richard G. Stein,** Richard G. Stein and Partners, New York, N.Y.; **Marguerite Villecco,** Washington, D.C.; **Donald Watson,** Donald Watson, AIA, Guilford, Conn.; **George Way,** Tackett-Way-Lodholz, Houston, Texas; **John I. Yellott, M. E.,** Arizona State University, Tempe, Ariz.; **Charles Zucker,** National Endowment for the Arts, Washington, D.C.

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