
AIA JOURNAL

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Only E CUBE had the capability to confirm our analysis.”

That's the conclusion of Consulting Engineer Frank T. Andrews of Fullerton, California, who's had long experience in dealing with Las Vegas hotel complexes. When he was given the MGM Grand Hotel energy-saving assignment, Andrews knew that because of the many variables and intricacies involved, the job required a computer solution with a flexible input format and almost unlimited scope. After investigating several energy analysis programs, he selected E CUBE because it was the best way to:

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· Measure life cycle dollars saved by conserving energy.
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· Model exactly an infinite number of zones with complex exterior surfaces.
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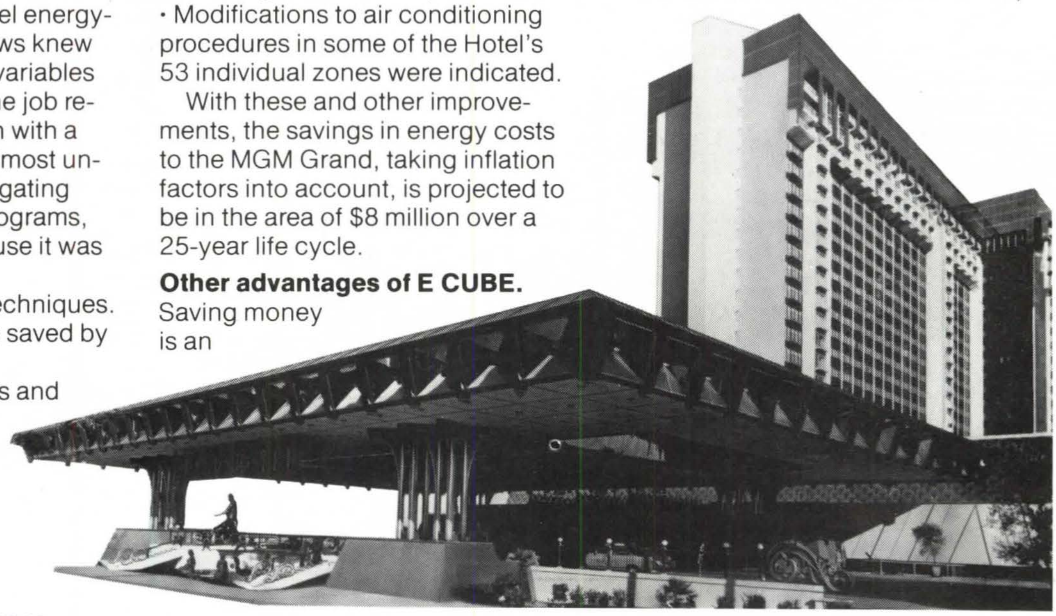
· Secure impartial results.

Future savings: $8,000,000.
In recommending the best program for MGM Grand, and simulating the most appropriate series of conservation options, Frank Andrews was able to verify that:

· Chilled water pumping horsepower could be increased to adequate size and controlled to reduce electric consumption.
· Oversized variable air volume system in low rise building areas was wasteful and should be renovated.
· Existing fan coil units for tower guest rooms were inadequate for optimum guest comfort.
· Economy cycle cooling for public spaces in conjunction with airside balancing should be implemented.
· Modifications to air conditioning procedures in some of the Hotel's 53 individual zones were indicated.

With these and other improvements, the savings in energy costs to the MGM Grand, taking inflation factors into account, is projected to be in the area of $8 million over a 25-year life cycle.



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CONTENTS

Cover: Three-dimensional graph of differential elements of sunlight on a cube (see p. 66). Photo by Ralph Knowles.

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PPG GLASS, ITALIAN GRANITE AND HISTORIC BOSTON. A FITTING COMBINATION THAT SAVES ENERGY.

Owner/Developer: Cabot, Cabot & Forbes, Boston. Architects: Skidmore, Owings and Merrill, Chicago.

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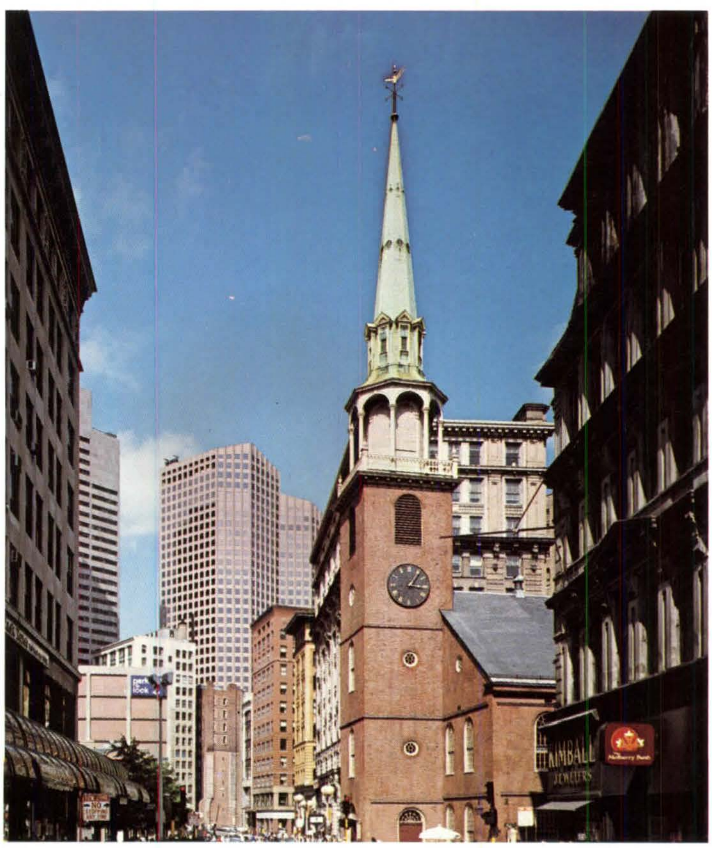

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EVENTS

Oct. 3-5: Minnesota Society/AIA annual convention, Radisson South, Minneapolis.
Oct. 3-5: National Passive Solar Conference, H. Roe Bartle Convention Center, Kansas City, Mo. Contact: Mid-American Solar Energy Complex, 1256 Trapp Road, Eagan, Minn. 55121.
Oct. 3-7: National Trust for Historic Preservation annual meeting, San Francisco. Contact: NTHP, 748 Jackson Place N.W., Washington, D.C. 20006.
Oct. 3-7: National Office Products Association annual convention and exhibit, McCormick Place, Chicago. Contact: NOPA, 301 N. Fairfax St., Alexandria, Va. 22314.
Oct. 5-8: National Energy Expo '79, D.C. National Guard Armory, Washington, D.C. Contact: Exposition Management International, Inc., (301) 424-3660.
Oct. 5-10: International Brick Masonry Conference, Hyatt Regency Hotel on Capitol Hill, Washington, D.C. Contact: Brick Institute of America, 1750 Old Meadow Road, McLean, Va. 22102.
Oct. 8-10: Course on Financial Management for Nonfinancial Managers, Cement and Concrete Center, Skokie, Ill. Contact: Portland Cement Association, 5420 Old Orchard Road, Skokie, Ill. 60077.
Oct. 9-10: National Institute of Building Sciences' Consultative Council annual meeting, Hyatt Regency O'Hare, Rosemont, Ill. Contact: NIBSCC, 1730 Pennsylvania Ave. N.W., Washington, D.C. 20006.
Oct. 9-10: Seminar on Energy Management in Buildings, San Francisco, sponsored by New York University. Contact: NYU Conference Center, 360 Lexington Ave., 20th Floor, New York, N.Y. 10017.
Oct. 10-14: Florida Association of Architects/AIA annual conference, Orlando Hyatt House, Kissimmee, Fla.
Oct. 11: Conference on Accessibility, Atlanta. Contact: Rita McGaughey, National Easter Seal Society, 2023 W. Ogden Ave., Chicago, Ill. 60612.
Oct. 14-17: Prestressed Concrete Institute annual convention, Hyatt Regency Hotel, Dallas. Contact: PCI, 20 N. Wacker Drive, Chicago, Ill. 60606.
Oct. 14-18: Architectural Aluminum Manufacturers Association annual convention, Hotel Del Coronado, San Diego. Contact: AAMA, 35 E. Wacker Drive, Chicago, Ill. 60601.
Oct. 15-16: Conference on Energy and the Economy, Stouffer's Greenway Plaza Hotel, Houston. Contact: Energy Bureau Inc., 41 E. 42nd St.. New York, N.Y. 10017.
Oct. 15-17: Architects in Industry Seminar, AIA headquarters, Washington, D.C. Contact: Michael Cohn, (202) 785-7366.
Oct. 16-18: Build Expo '79, McCormick Place, Chicago, sponsored by the Producers' Council. Contact: Build Expo '79, 331V Madison Ave., New York. N.Y. 10017.
Oct. 17-19: Michigan Society of Architects/AIA, annual convention, Long's Banquet & Convention Center, Lansing, Mich.
Oct. 17-20: International Conference on Urban Design, Philadelphia, sponsored by the Institute for Urban Design and the University of Pennsylvania. Contact: IUD, Main P.O. Box 105, Purchase, N.Y. 10577.
Oct. 18-19: Institute on Passive Solar Design and Construction, University of Wisconsin, Madison.
Oct. 18-20: Project Management Institute seminar/symposium, Peachtree Plaza Hotel, Atlanta. Contact: B. F. Jackson, DDR International, 33 North Ave., Suite 800, Atlanta, Ga. 30308.
Oct. 22-23: Architectural Management Conference, Brown Palace Hotel, Denver, sponsored by AIA practice management committee. Contact: Robert A. Class, AIA, Institute Headquarters, (202) 785-7257.
Oct. 22-26: American Society of Civil Engineers annual convention and exposition, Atlanta Marriott Hotel, Atlanta. Contact: ASCE, 345 E. 47th St., New York, N.Y. 10017.
Oct. 29: Entries deadline, Concrete Reinforcing Steel Institute design awards. Contact: CRSI, 180 N. LaSalle St., Chicago, Ill. 60601.
Oct. 29-31: World Energy Engineering Congress, Atlanta Biltmore, Atlanta. Contact: Association of Energy Engineers, 464 Armour Circle N.E., Atlanta, Ga. 30324.
Oct. 31-Nov. 2: Texas Society of Architects/AIA annual meeting, Shamrock Hotel, Houston.
Nov. 7-9: Conference on the Architect in the Public Sector, Tallahassee Hilton, Tallahassee, Fla. Contact: Architects in Government Committee, AIA Headquarters.
June 1-4, 1980: AIA annual convention, Cincinnati.

LETTERS

Setting the Record Straight: I found "Anecdotes about Celebrated Architects" in the January issue to be thoroughly enjoyable, but I detect an error on page 74.

The article attributes to Bruce Goff a tale about Frank Lloyd Wright at the time Wright received the AIA gold medal. I find it probable that Goff was not present and was told a garbled story by one of the many who did not like FLW. I was there.

It was 30 years ago, Mar. 17, 1949, at a dinner in the ballroom of the Rice Hotel in Houston. My wife and I were seated just below the head table, about as close as we could get to Wright and our friend, Douglas W. Orr, FAIA, the Institute's president, who made the presentation. If there were any stalling around about a check [the point of the published anecdote], it had to be so hidden that no one could notice.

Further, considering how very caustic Wright often was, his speech, in this instance, was mellow. Of course, he couldn't resist getting off a few remarks about AIA, and more about "Hooston," as he insisted on pronouncing the name of the city we were in, but we felt that he was genuinely touched at the honor and, for once, even a tiny bit humble!

Every year or so, I play the recording of the presentation and his talk. Over the years, it is amazing to notice, first, how what he had to say sounded "far out" in the beginning. Then, 15 years or so ago, he seemed to be saying what we all were thinking, and now it seems a bit passé. I recommend listening to that recording.

All this reminds me of a talk Wright made in Boston, probably in 1940, after which he fielded a few questions. To one, he answered, in his usual style, that he most certainly would not prostitute his art. At that, in the middle of a rather large hall, one of those proper Boston ladies (you find them nowhere else) got up and stalked from the room. Everyone, including Wright, I am sure, knew why, but no one laughed.

Hugh McK. Jones, FAIA
Guilford, Conn.

Our intention was to attribute to Goff only the remark that Wright used to refer to Skidmore, Owings & Merrill as the "Three Blind Mies." The source of the Houston incident was not Goff but Robert Norris, says Anthony C. Antoniades, AIA, author of the article in the January issue. Ed.

Information Wanted: I am looking for examples of original architectural ornament, using new or traditional materials, for publication in a handbook of architectural ornament, to be published by Van Nostrand Reinhold. I would appreciate a description, plus a sketch or photo. Full credit will be given.

Brent C. Brolin
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New York, N.Y. 10011

Corrections: In the Mid-May issue (p. 248), credit was not given to one of the firms involved in the joint venture for the Metrocentre Mall in Little Rock, Ark. Credit should have been given as well to Wittenberg, Delony & Davidson of Little Rock. In the July issue (p. 48), the author credited the tire canopy depicted to "student" Lary Birch. The work is Birch's, but he is a professor working with Martin Pawley. Says the author, "Professor Birch deserved much more credit than I gave him in the article, and the fault of this omission is entirely my own."

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It's ironic. When you're about to specify a floor, all you get to see are beautiful new samples. Which gives you absolutely no idea of what the floor will look like when it really counts. In the future.

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NEWS

Energy

Solar Development, Conservation Seen as Prime Answers to Crisis

Conservation and the use of renewable resources are the only viable solutions to the energy crisis, testified members of the Harvard Business School energy project before a House subcommittee. "To ensure economic growth for the '80s," they said, "the U.S. must use its energy more efficiently."

Robert Stobaugh and Daniel Yergin conclude that the outlook for conventional sources of energy is bleak. They maintain the following: If the U.S. relies on imported oil, the country is risking higher inflation and a major world recession. Deregulation of domestic oil and gas will at best enable production to remain at current levels. Producing energy from vast U.S. coal reserves would be costly in terms of environmental and health problems. Nuclear energy is being questioned for safety reasons and problems related with disposal of radioactive wastes.

The best hope for the next few decades, they conclude, lies in a balanced program of solar space and water heating and conservation: "The key to correcting our bias toward fossil fuels and nuclear power is by offering comparable incentives to solar energy and conservation."

Stobaugh and Yergin maintain: "If the U.S. were to make a serious commitment to conservation, it might well consume 30 to 40 percent less energy than it now does, and still enjoy the same or an even higher standard of living. The saving would not hinge on a major technological breakthrough, and it would require only modest adjustments in the way people live. Moreover, the cost of conservation energy is very competitive with other energy sources. The possible energy savings would be the equivalent of the elimination of all imported oil and then some."

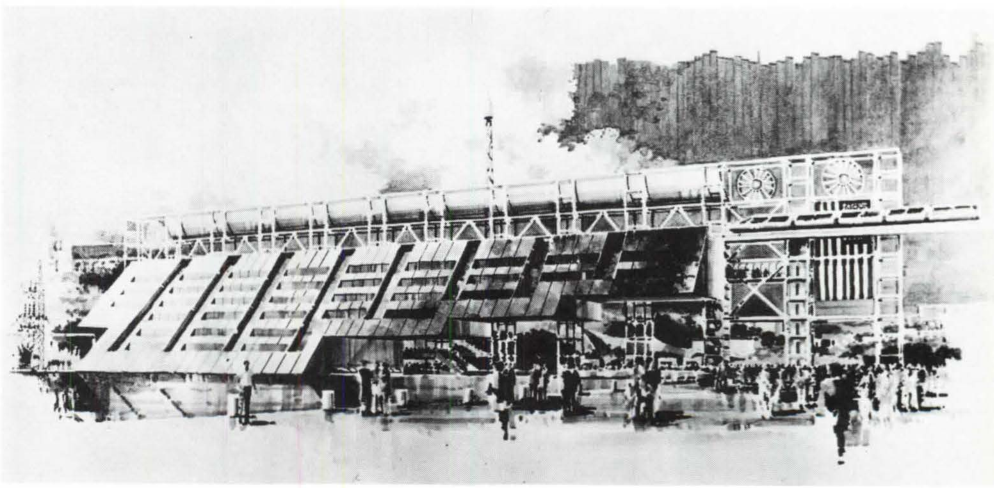
Conservation in the industrial sector can be achieved, they maintain, by housekeeping (furnace maintenance, adjustment of lighting, fixing of leaky steam traps, etc.) and cogeneration. They see "energy-conscious design" and retrofitting of buildings as major opportunities in conservation. They point to studies across the country that indicate that 25 to 50 percent reductions in energy use in the American housing stock are possible with relatively simple conservation efforts.

But there are problems to overcome. There is little or no constituency for both solar energy and conservation. Federal policies have supported and subsidized conventional fuels, and the small tax credits in the National Energy Act are insufficient, they maintain. They suggest conservation subsidies of 40 to 50 percent and solar subsidies of up to 60 percent to encourage use of both and to put them on equal footing with the conventional uses of energy. They feel too much of the present research is directed at "big solar" projects—high-technology projects such as the power tower and orbiting satellites. The authors maintain that solar space and hot water heating and passive solar designed buildings are the feasible alternatives.

These and other findings of the report are contained in *Energy Future: Report of the Energy Project at the Harvard Business School* (Random House), edited by Stobaugh and Yergin.

The case for renewable resources is

continued on page 16



Energy Expo '82—Finch, Alexander, Barnes, Rothschild & Pascal, Inc., of Atlanta has been chosen by the U.S. Travel Service (Department of Commerce) to design the U.S. Pavilion for the 1982 Knoxville (Tenn.) International Energy Exposition. The proposal calls for a prism-shaped building next to a reflecting pool which flows over a waterfall and under the pavilion. Overhead, a metallic solar collector would run the full length of the building. To the south would be an outdoor energy exhibit with a solar power tower. From the promenade under and behind the building, visitors would see indoor exhibits through a glass arcade. The building would be energy self-sufficient. Selection was made by an interagency architect/engineer and exhibit design evaluation board. The project is awaiting authorization by Congress.

Interstitial steel frame helps hospital achieve optimum space flexibility...

costs 20% less than competitive framing systems considered.

How do you design a full-range, 404-bed health care center, integrate it with a medical teaching curriculum, and blend it architecturally into the surrounding retail community? That was the problem facing the designers of Thomas Jefferson University's new Clinical Teaching Hospital, Philadelphia, Pa. The solution: A ten-story, steel-frame building arranged around horizontal and vertical circulation spines. The spines run from the basement to the penthouse and east-west through the center of the building. The conventionally framed portion of the structure is located north of two large 56-ft x 120-ft skylighted courtyards. This portion, fed vertically from the mechanical penthouse, contains all bedrooms and physicians' offices.

The interstitial section extends the length of the site on the south side of the spine. Odd-numbered floors contain diagnostic and therapeutic facilities; even-numbered floors include interstitial space framed with steel trusses 84 ft 5 in. long. The interstitial spaces house mechanical services for the intervening floors and are flanked by additional spaces for physicians' offices.

Economy points to steel

"Steel was the outright winner in cost savings against other structural systems," reports Charles C. Ang, chief structural engineer, D'Ambly, Inc., consulting engineers. "Considering material costs, fabrication, erection, and engineering time, we estimated that steel could save between 15 to 20 percent over other framing systems on this project."

Beyond this several other reasons for selecting steel were cited:

(1) "Rapid erection of the structural frame was critical to the building's fast-track construction schedule.

(2) "The program requirement for flexible space arrangement on the ancillary floors involved long, clear spans suitable only for steel trusses.

(3) "Longer than average spans and minimal ceiling cavity space required that deflection control be achieved with minimum-depth members. This was dictated by the mechanical services required in the patient care and physicians' offices."

Story-high trusses

Much of the steel frame is conventionally designed using steel columns, beams, and girders with spandrel trusses supporting the architectural curtain wall.

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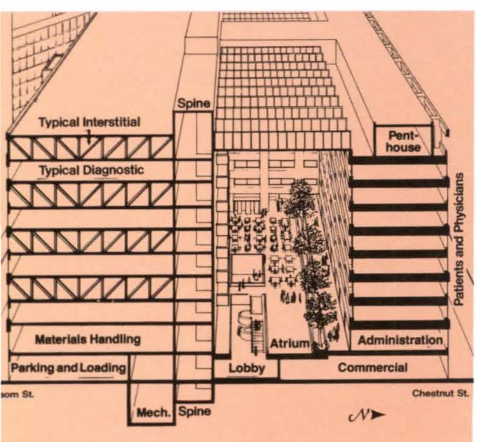

Cross-sectional view shows how patient rooms are separated from diagnostic areas by a building-high atrium.

(ABOVE CENTER) The 750,000-sq-ft Clinical Teaching Facility is essentially a series of smaller, administratively autonomous hospitals stacked vertically within one building.

(ABOVE LEFT) All ductwork, plumbing, electrical distribution, and large pieces of equipment are arranged within the interstitial spaces to permit future revisions to rooms without disrupting adjacent spaces.

(LEFT) A building-high atrium separates the patient care areas from the diagnostic and treatment areas. A dining area, located on the deck of the atrium, serves visitors, students, and staff. Glass-enclosed elevator lobbies overlook the center court.

(ABOVE RIGHT) A steel-framed bridge, utilizing curved beams to accommodate differences in floor levels, connects the new building with the existing hospital.

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Interior Design: Kenneth Parker Associates, Inc., Philadelphia, Pa.

Circle 9 on information card

Energy *from page 13*
also advocated in Barry Commoner's book, *The Politics of Energy* (Alfred A. Knopf). Commoner finds coal and conventional nuclear power unacceptable because of the risks they impose to the environment and because they are inherently uneconomical. The answer, he maintains, is to develop solar and other renewable resources. Using solar collectors for space and water heating is practical now. Other renewable resources could be economically feasible in the future if money were invested now, Commoner says.

What's Ahead on Capitol Hill For President's Energy Package

Congress made a slow start before its August recess on approving President Carter's $142.8 billion, 10-year energy plan. The House did pass a windfall profits tax bill and gave the President authority to establish a gas rationing program; yet a lot remains to be done, and a battle looms ahead.

All of Carter's proposals hinge on the enactment of a windfall profits tax. Tax revenues would be placed in an energy trust fund. From this fund, Carter proposed that $88 billion be used over the 10-year period for development of synthetic fuels and unconventional gas resources. Under this plan synthetic fuel production is expected to reach 2.5 million barrels a day.

The energy trust fund would also finance the following: a $1 billion program to provide a $3 per barrel shale oil tax credit; $1 billion for a 50-cent per thousand cubic feet tax credit for unconventional gas; $5 billion for grants or loan guarantees for utilities to convert oil fired boilers to alternative fuels; $2 billion for expansion of residential and commercial conservation programs; $3.5 billion for a solar bank to provide loan subsidies for solar projects, and tax credits for use of passive solar energy, solar process heat and woodburning stoves in homes; $2.4 billion to assist low-income persons, and $16.5 billion for mass transit and automobile fuel efficiency (see Aug., p. 13).

The House approved a 60 percent per-barrel excise tax on oil price increases, but did not specify how the money would be spent. The congressional budget office estimated that this would generate about $86 billion to $141 billion between 1980 and 1985. The White House estimates the windfall profits receipts for the 1980-90 period will range from $146 billion to $270 billion. (It is difficult to accurately estimate how large the fund will be since its size depends on how companies will finally be taxed and the future direction of world oil prices.)

The Senate is expected to weaken the windfall tax, thus reducing the amount available for the energy development program. There is a Republican effort, backed by both House and Senate minority leaders, to have part of the windfall profits tax revenues used for a $36 billion tax cut, including across-the-board rate reductions, a social security tax freeze and rapid depreciation for business.

Carter requested that an energy mobilization board be established to "fast track" key energy projects. Two House committees offered different directions for this board. The commerce subcommittee on energy and power gave broad powers to the board, allowing it to overrule any federal, state or local laws that stood in the way of an unlimited number of crucial energy projects. The interior committee moved to give the board only the authority to recommend that the President speed up federal procedures for 24 projects.

President Carter also requested that Congress give him the authority to adopt a gas rationing system in the event of a 20 percent shortfall of diesel fuel or gasoline. The House passed such a bill, but also gave either the House or the Senate power to veto the program.

The other portion of Carter's package that received congressional scrutiny was the proposed $88 billion for synthetic fuels development. The Senate energy committee agreed to proceed with synthetic fuels development, but only on an incremental basis. Under its plan, five or six synthetic fuel plants would be built over the next several years to see how feasible the conversion process is (conversion of coal to liquid or gas is an infant industry). Then the program would be reviewed for additional funding. The committee also requested an additional $300 million in budget outlays between fiscal year 1981 and '84 to fund conservation.

Before Carter's proposal, the House passed a $1.5 billion synthetic fuels program. Other bills include $2 billion for production of a diversified mix of synthetic fuels, while directing that environmental, conservation and fuel conversion policies be observed. And, a $25 billion synthetic fuels program is pending in the Senate banking, energy and governmental affairs committee.

Not all congressmen see synthetic fuel development as the main answer to our energy problems. An "omnibus" energy bill, introduced by Henry Jackson, chairman of the Senate energy committee, does not stress production goals and new government corporations, but orders the Department of Energy to take an aggressive approach toward soliciting and evaluating proposals to demonstrate a wide variety of nonnuclear energy technologies. Sen. Edward Kennedy proposed an energy bill which emphasizes conservation. It would provide direct cash rebates for residential insulation and other energy-saving improvements, 3 percent loans of up to $5 billion for commercial energy-conservation investment and incentives for industrial spending on savings, including direct grants of $15 for every barrel of oil saved during the first year after an investment is made. Kennedy estimates it would cost $58 billion over 10 years and save 4 million barrels a day of imported oil.

Outside the government, the reaction to Carter's proposal has been mixed. Business leaders see as possible a massive shift of private investment into public energy industries and an inflationary effect of higher energy costs, both adversely affecting the health of the economy. The National Manufacturers Association calls for greater use of coal (not in a synthetic capacity) and nuclear energy. The construction industry predicts a boom period, if Carter's program becomes a reality. New pipelines, port facilities, production plants, transmission lines, etc., would be needed in the development of synthetic fuels. The mass transit program is called a good move, but not as generous as some would like.

Environmentalists see shale oil and coal liquefaction and gasification as costly and damaging ventures causing environmental problems such as air pollution, land misuse from strip mining and consumption of great amounts of water for coal pipelines. In general, environmentalists would like more emphasis placed on conservation and development of renewable resources.

Meanwhile, Denis A. Hayes, an advocate of solar energy and chairman of the Solar Lobby, has been appointed as director of the Department of Energy's Solar Energy Research Institute, Golden, Colo. SERI has laboratories in Golden, Massachusetts, Maryland and Tennessee and manages all government solar research.

Before his appointment, Hayes was a senior researcher of the Worldwatch Institute and chairman of the Sun Day 1978. He is the chairman of the Center for Renewable Resources.

Thermal Energy Storage to Get Testing at '80 Winter Olympics

The nation's first experiment comparing four types of thermal energy storage will be conducted at five dormitories housing 1,800 contenders and officials at the 1980 winter Olympic games. The experiment is to determine storage methods and devices which can be compatible with and reduce costs of electric heating.

Located 1.9 miles from Lake Placid at Olympic Village (Ray Brook, N.Y.), the five identical dormitories are a redesign by Robinson, Green & Beretta Corp-

continued on page 21

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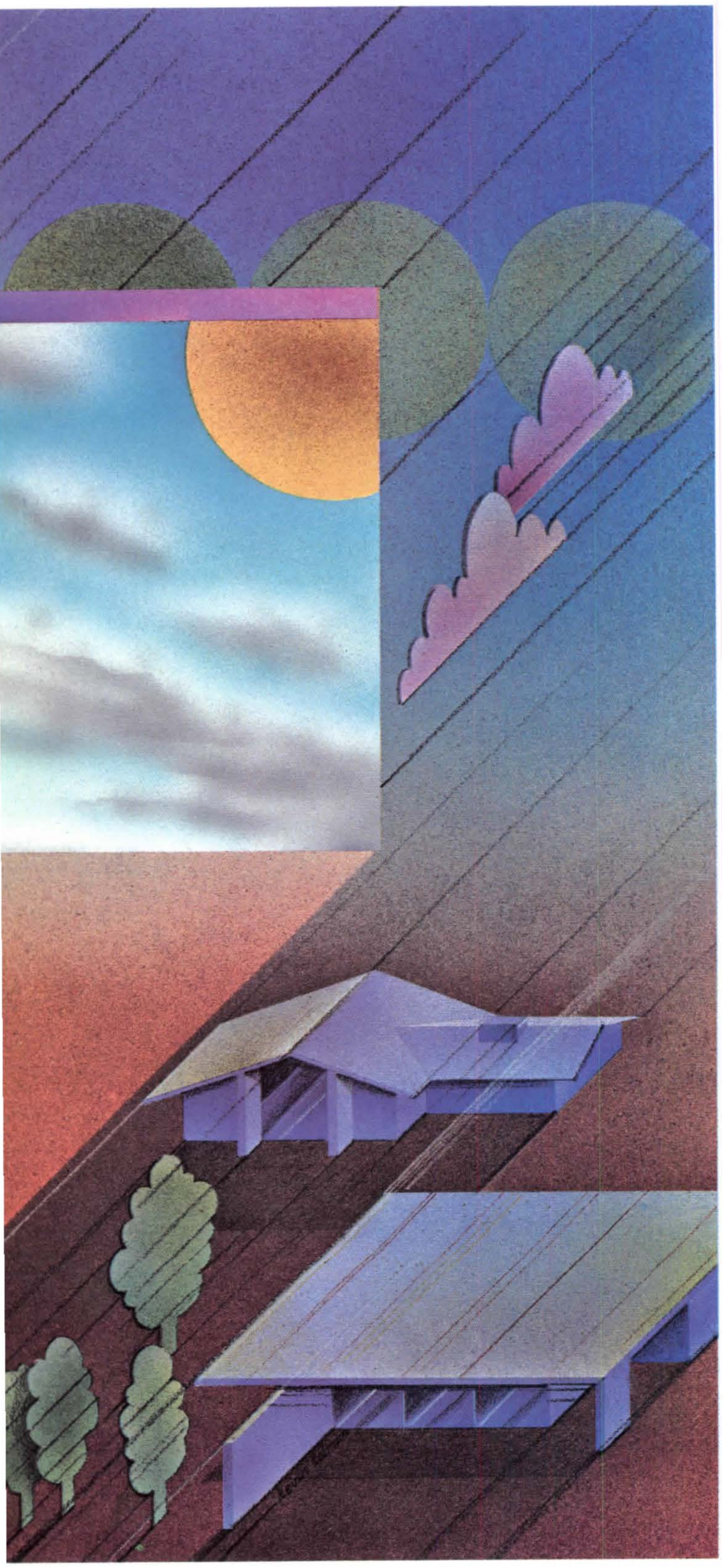

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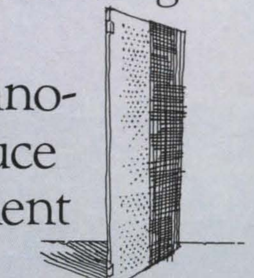

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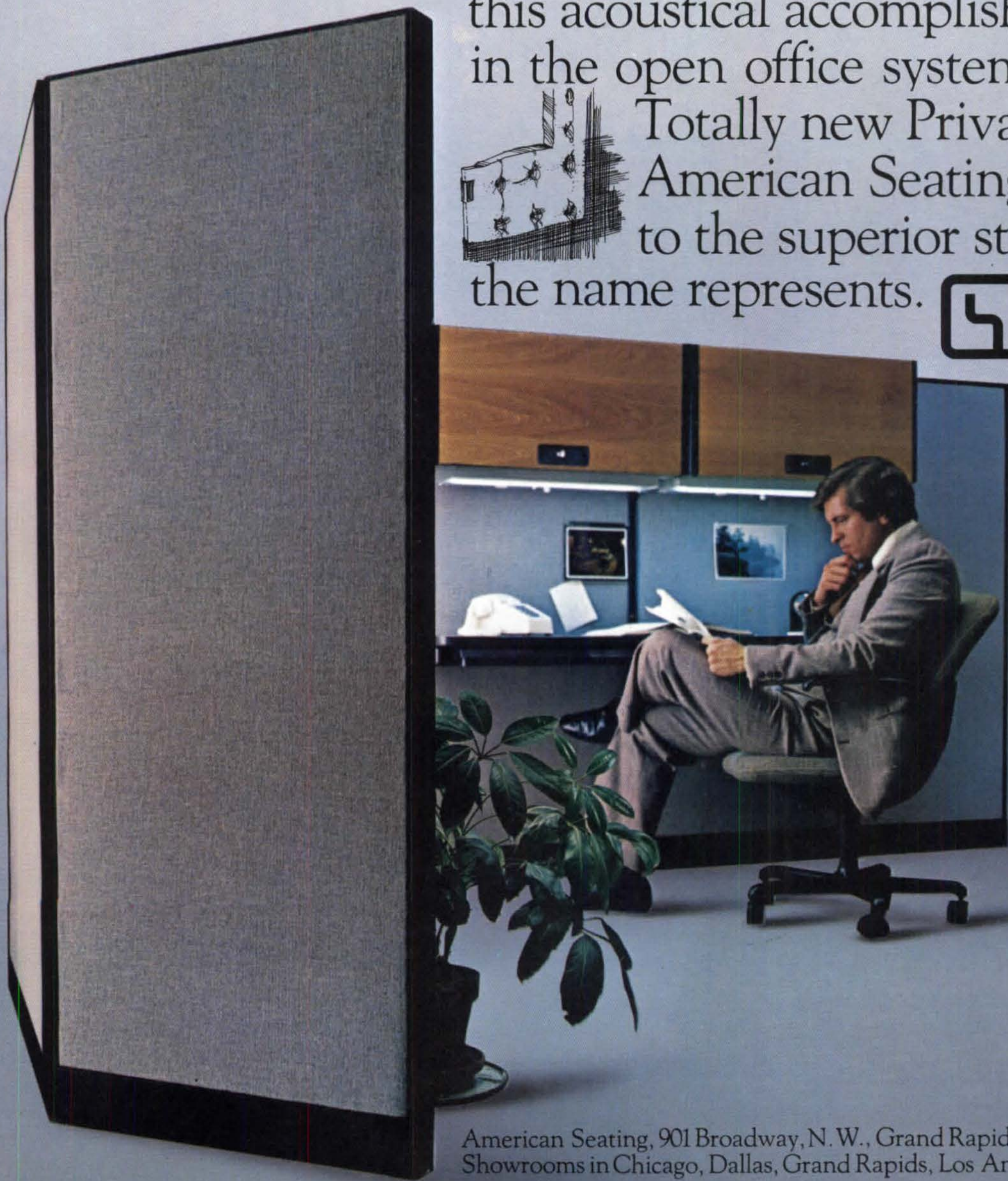

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Energy *from page 16*
oration, Providence, R.I., of prison dormitories in Memphis by Walk Jones & Francis Mah, Inc., Memphis. The original design has been altered to take into account upstate New York's cold winters. The new buildings are heavily insulated, and window exposure has been minimized. Each building has an administration area (with conference, classrooms and bath facilities), two, two-story recreation areas and "cell block" sleeping areas.

Because of the similarity of use among the five buildings, a concise comparison can be made between energy consumption and different storage devices. Storage of electric heat will be by ceramic bricks coupled with air handlers, water storage with heat pumps, water storage with air handlers and concrete slab storage. The fifth building will have no heat storage. Energy use will be monitored at each building and by the Electric Power Research Institute, Palo Alto, Calif.

After the Olympic games, the five dormitories will be converted to the Ray Brook minimum security prison operated by the Bureau of Prisons, U.S. Department of Justice.

The project is sponsored by the Niagara Mohawk Power Corporation, the Department of Energy, Oak Ridge National Laboratory of Union Carbide, New York State Energy Research and Development Authority and the New York State Public Service Commission.

The New Secretary of Energy

Charles W. Duncan Jr., the new secretary of the Department of Energy, intends to run DOE "in the best managerial style . . . to achieve the President's energy objectives." On the specifics of energy policy, Duncan has stressed that the "first priority should be to increase production" of domestic energy supplies. He said he would "tend to have a rather tough-minded attitude on mandatory conservation," and that nuclear energy "will continue to play a substantial role" in U.S. production. He supports solar and renewable resources development.

Duncan, who will be 53 early this month, made his reputation and a sizable fortune by managing large corporations. He was graduated from Rice University in 1947 with a degree in chemical engineering and studied management at the University of Texas. In 1948, he joined the Duncan Coffee Co., the family business, which became the Duncan Food Co. and merged with Coca-Cola in 1964. In 1970, he became executive vice president of Coca-Cola and in 1971 president. He left in 1974 to head the Rotan Mosle Financial Corporation. For the past two and a half years, he has been a deputy secretary of the Department of Defense.

Protecting Access to the Sun

Advice on how to ensure solar access in new residential development is offered in "Protecting Solar Access for Residential Development: A Guidebook for Planning Officials," researched by the American Planning Association and published by HUD in cooperation with the Department of Energy.

Protecting solar access, says the guidebook, means regulating development so that buildings and vegetation do not block sunlight and prevent solar energy use by neighboring buildings.

"To include solar access among recognized desirable land uses," says the manual, "planning officials will need to employ conventional planning of land uses, regulatory tools (height limitations, lot size and density requirements), street orientations, tree placement and the development and positioning of open areas. . . .

"For unless communities plan now for future development of solar energy, uncontrolled development could make it impossible for solar development to take place."

A second book, "Planning for Solar Access: A Manual for Residential Developers and Site Planners," is to be published this fall. Both will be available from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

Practice

The Registration Revolution: An Update on What's Happening

Architectural registration has been in the spotlight recently at both the national and state levels. The National Council of Architectural Registration Boards is reevaluating its exam (see Aug., p. 22); state legislatures are reviewing registration laws and boards under sunset legislation, and some are questioning the need for licensing at all.

Sunset reviews were completed this year in North Carolina, Florida and Montana. Legislators in those states conducted lively debates over the review commissions' recommendations but, in the end, reaffirmed the need for architectural registration laws.

In Tennessee, the legislature renewed the state's architectural registration law. But a major amendment, the "industrial exemption," could open up much state construction to unlicensed persons. Supported by the manufacturers' association, the exemption allows A/Es working in industry to call themselves architects or engineers without being registered by the state architectural board of examiners. The board of examiners has requested a written ruling by the state's legal office.

In Kentucky, a dispute has risen between architects and engineers over definitions. The Kentucky Society of Architects supports legislation stating that most building types require the services of an architect. The engineers would like that changed to "either . . . or"—either an architect or an engineer can design a building. And there is reportedly a group of homebuilders who would like design opened to them.

In Alabama, a registration law was passed which includes, for the first time, a definition of architecture. An individual must be legally qualified (registered) to perform any architectural services, except for buildings costing less than $50,000. All schools, churches, community centers and auditoriums, regardless of cost, require the services of an architect. Apparently, there had been an increasing number of engineers designing buildings in that state. And without a clear definition of architecture/architect in the registration law, architects had no legal protection against nonarchitects practicing design. The new law also states that a building permit cannot be issued by building or state officials unless it has the seal of an architect.

The Virginia board of commerce is studying the definition of the practice of A/Es in that state. Complaints reportedly have been made that the definition precludes certain tradesman from performing design functions for which they feel they are qualified.

In Oregon, a bill would exempt from the registration law building designed to be occupied by fewer than 20 persons at a time.

Meanwhile, AIA's registration law advisory task force, chaired by William C. Muchow, FAIA, set an ambitious goal. It plans to study the gamut of architectural registration: its history, license renewal, legislative guidelines, the definition of architects/architecture, legislative guidelines for states, educational requirements, composition of regulatory boards and reciprocity problems.

The task force will meet in San Francisco Oct. 12-13. Comments from AIA members on any aspect of registration are welcomed and encouraged, and should

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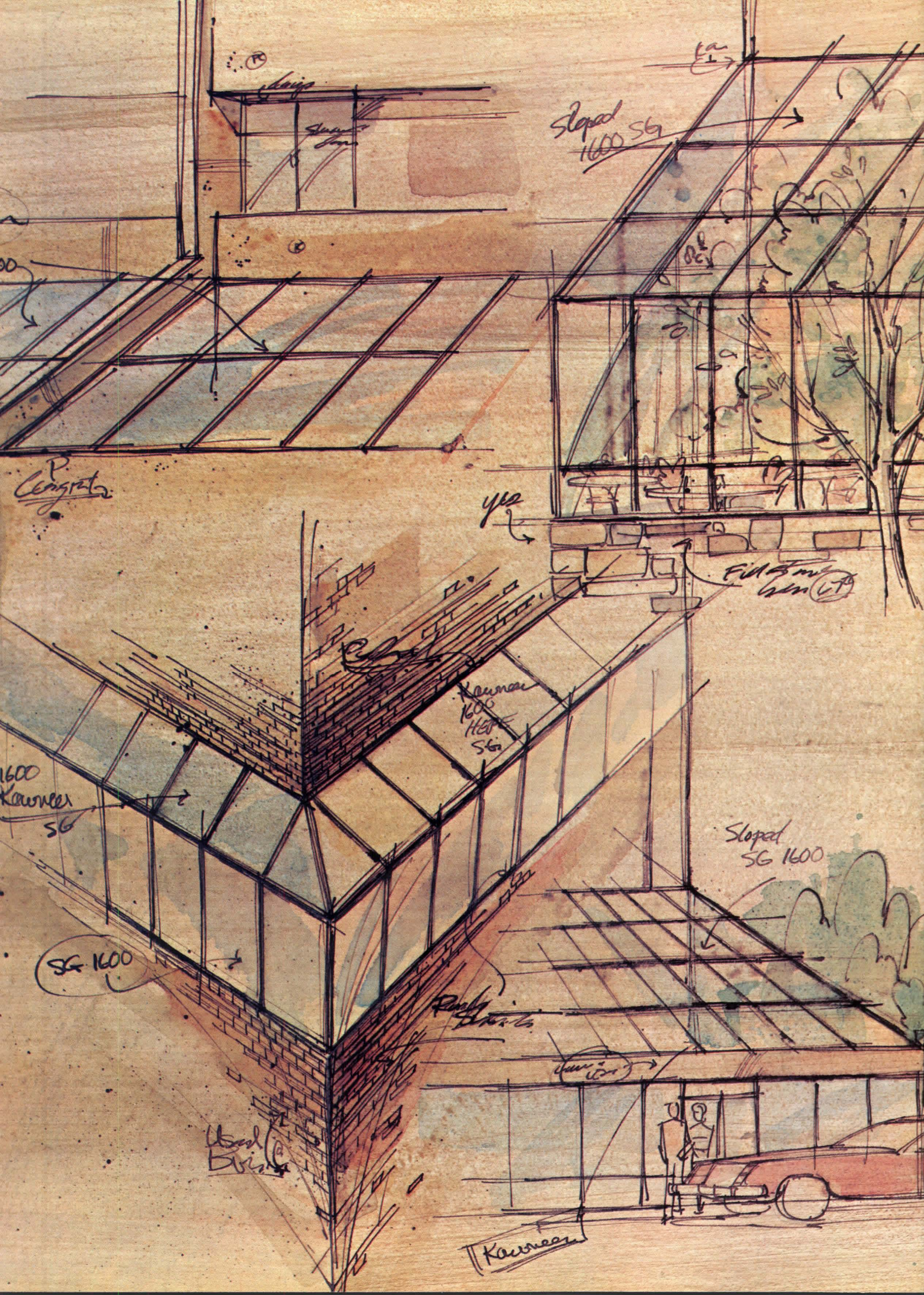
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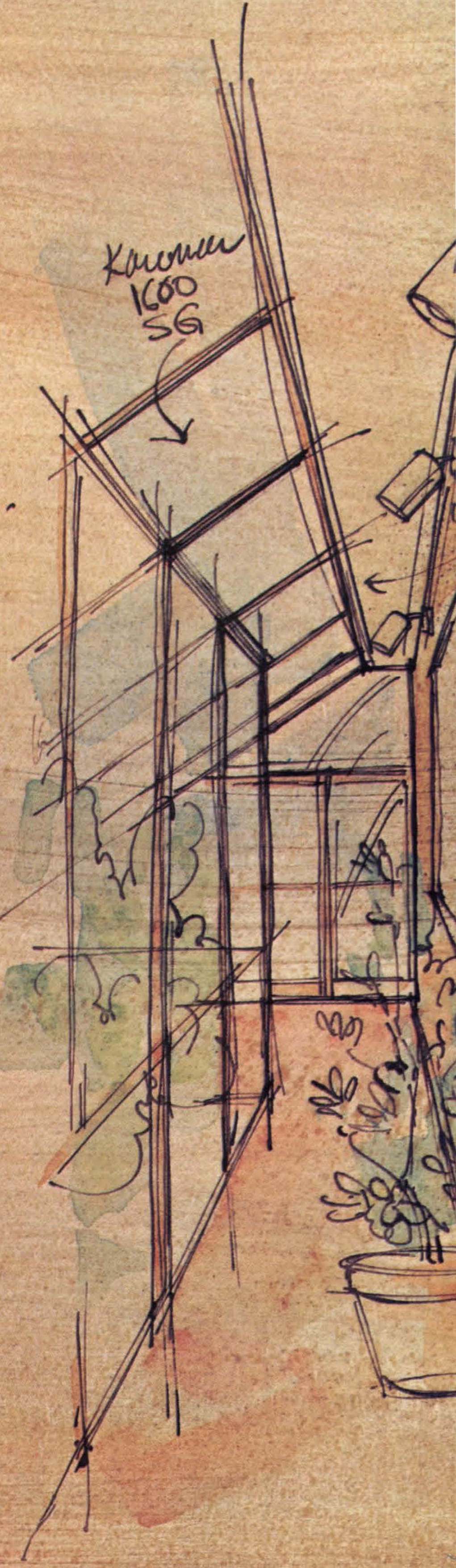

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Practice *from page 21*
be sent to Elizabeth Chalmers, state government affairs, at AIA headquarters.

In Wisconsin, the joint regulatory board (architects, engineers, land surveyors and designers) is debating whether to continue using the NCARB exam or design its own.

In 1973 and early 1974, members of the Wisconsin legislature grew concerned over what they called the abnormally high failure rates of NCARB examinees. The legislature ordered the exam cut in half. Such an exam was only given once—in December 1974. Since then Wisconsin has offered the NCARB exam minus the design portion.

The state hired a consulting group, National Evaluation System Inc., Amherst, Mass., to evaluate how the NCARB exam relates to the actual practice of architects in Wisconsin.

They found that less than 50 percent of the items on the NCARB exam matched a task list compiled by Wisconsin architects. Among items not included on the NCARB exam were acoustics, electrical systems, heating, ventilation, life cycle cost, lighting systems, site analysis for climate and urban development/city planning.

The Wisconsin Society or Architects/AIA supports continuation of the NCARB exam in light of the fact that that exam is being re-evaluated. Other reasons include the reciprocity ease of the NCARB exam and the fact that NCARB is recognized internationally. The joint regulatory board will make its decision this fall.

NSPE Drops Supplanting Stand, Alters Commission Agent Rule

In the wake of an interim order issued by the U.S. Court for the District of Columbia that prohibition of supplanting in AIA's ethical code is in violation of the Sherman Antitrust Act (see Aug., p. 21), the National Society of Professional Engineers' board has dropped the supplanting rule in NSPE's ethical canons. Earlier, AIA's executive committee had suspended the Institute's ethical rule on supplanting. Both actions followed the ruling by Judge John F. Sirica in the form of a partial summary judgment on the first of six counts brought against AIA and Seymour Auerbach by Aram Mardirosian.

NSPE's action took place at the society's annual meeting in July. NSPE also changed the language in its code of ethics which had strictly forbidden the employment of commission agents to help NSPE members procure work. The language is changed to say that payment of commissions or brokerage fees may be made to "bona fide employees or bona fide established commercial or marketing agencies" retained by an engineer.

Also at the annual meeting, S. F. Lee, chairman of the board of Mille, Wihry & Lee Inc., in Louisville, Ky., became president of NSPE.

In other matters pertaining to the ethical codes of professional organizations, the American Medical Association's house of delegates voted in July to send a new ethical code that would permit doctors to advertise to its state and local associations for comment. This will probably delay action until December 1980. If the delegates had voted to accept the new code, the final vote to make it official policy would have taken place in December of this year.

Meanwhile, U.S. District Judge Earl E. O'Connor has ruled that Kansas laws which prohibit advertising by doctors and other health professionals is unconstitutional. Relying on decisions of the Supreme Court in 1976 and 1977, Judge O'Connor said, "We find no distinction between lawyers and health care professionals in the area of advertising."

Four Share Top Shingle Honors; Ten More Earn Merit Awards

Four firms have won top honors in the 1979 Red Cedar Shingle & Handsplit Shake Bureau/AIA architectural awards program, and 10 other projects were given merit awards. The biennial event, initiated in 1973, honors architects and their projects "which demonstrate design excellence and significant functional or esthetic uses of red cedar shingles or shakes." There were 218 entries in the 1979 program, which the jury said "represented a remarkable wealth of design talent from architects in 42 states and two Canadian provinces."

The top winners are:

- Roger H. Newell, AIA, Seattle, in the single-family category for a residence in a Seattle suburb.
- The Architects, Inc., Cleveland, in the commercial/institutional category for the Hidden Harbor Restaurant in Pompano Beach, Fla.
- Short & Ford, Princeton, N.J., in the remodeling/restoration category for the restoration of Sandawede on the Massachusetts coast (photo below).
- Daniel Solomon & Associates, San Francisco, in the residential/multifamily category for the Pacific Heights townhouses in San Francisco.

Architects to win merit awards were: MacKinlay/Winnacker/McNeil, San Francisco for a mountain solar house in Lake Tahoe, Calif., and also Orindawoods in Orinda, Calif.; Larsen Lagerquist Morris, Seattle, for the Larsen residence in Seattle; Norman Jaffe, AIA, New York City, for a retreat house on Long Island, N.Y.; Bissell & Wells, New York City, for a residence in Nantucket, Mass.; John Blanton, AIA, Manhattan Beach, Calif., for the remodeling of a house in Manhattan Beach; Arne Bystrom, AIA, Seattle, for the Bystrom cabin on the Washington coast (an AIA 1979 honor award winner); Mithun Associates, Bellevue, Wash., for the Towerhouse Building in Redmond, Wash.; Sohl & Palmer, Santa Rosa, Calif., for professional offices in Santa Rosa, and Fisher-Friedman Associates, San Francisco, for Summit Ridge in Walnut Creek, Calif.

Jurors were William Turnbull Jr., FAIA, San Francisco; Richard Bergmann, AIA, New Canaan, Conn., and E. Fay Jones, FAIA, Fayetteville, Ark.

Communications Seen as Vital When Fire Strikes a Highrise

If you were in a highrise building when a fire broke out, would you trust your own senses that smoke was present and beat it to the nearest exit, or would you heed an announcement to wait where you are for further instructions? A recent study by Robert A. Glass and Arthur I. Rubin, "Fire Safety for High-Rise Buildings: The Role of Communications," prepared for the National Bureau of Standards'

continued on page 29


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Architect: Thompson Ventulett Stainback & Assoc., General Contractor: Ira H. Hardin Co., Atlanta, Georgia
UNISTRUT
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Circle 16 on information card

Practice *from page 24*

center for building technology, reports that ironically little is known about how people have actually behaved in past fire emergencies and "only speculation is now possible concerning what actions should be performed." It is known, however, that one important factor in emergencies in highrises is control of the occupants.

The researchers point out that design features such as open air spaces, movable walls, sealed windows and plastic furnishings contribute to the rapid buildup of heat and the spread of fire, once it is started. Where it is infeasible to remove the occupants, they conclude, voice communications systems can serve to keep people informed and to find safer areas of the structure. But the specifics of such a system have not been thoroughly investigated.

In a fire emergency, a person needs all the help he can get. There are visual signs and signals in nearly every building, but the researchers recommend that attention should be given to the design of voice communications systems and their characteristics. Such systems, they say, should be tailored to each building's specific requirements, should be audible over "background" noise and should be triggered by any of the building's automatic or manual fire alarms. Also, the occupant "needs to be considered as a component in a safety system, not merely a passive observer."

Designing Safety into Houses

Home accidents kill about 24,000 people a year, injure nearly 3 million others and cost nearly $7 billion in lost wages, medical expenses, claim settlements and fire damages, says the National Safety Council. "Home Safety Guidelines for Architects and Builders," prepared by the Buffalo Organization for Social and Technological Innovation for the National Bureau of Standards' center for building technology, gives some common sense advice on how design can alleviate the situation.

Design guidelines are given to prevent stair, door, window, bathtub and shower and ramp and floor accidents. For each problem, information on typical accidents is given and various examples of possible solutions are offered. Appropriate design details are shown in accompanying drawings and diagrams. Each of the "design ideas" has been rated as to effectiveness by a safety review panel.

In many cases, the study emphasizes, accidents are not caused by carelessness on the part of the victim, but are a result of "normal behavior in an unsafe home environment." For example, treads on stairs that are too shallow to accommodate the length of the foot may cause overstepping and a fall; projecting windows can interfere with walkway circulation and injure passers-by; round-edged grab bars in the bathtub/shower area are far better than soap dishes and towel bars not meant to support body weight.

The booklet costs $7.25 a copy and is available from the National Technical Information Service, Springfield, Va. 22161 (order number: PB292-928).

The Institute

Mitchell Sets Up Panel to Probe Long-Span Building Technology

Growing public and professional concern over long-span roof failures (Rosemont Stadium, Kemper Arena and Hartford Coliseum) spurred AIA President Ehrman B. Mitchell Jr., FAIA, to recently form a blue ribbon panel to review long-span building technology.

"To the best of our knowledge," Mitchell said, "these structures were designed to conform to operative state and/or local codes and standards—yet the failures have occurred. We believe it is imperative that AIA respond to the growing public concern." The panel will study the documentation of the recent failures and consider the consequences of long-span construction in order to recommend to the AIA board appropriate policy or program options.

The latest failure occurred on Aug. 13 when the Rosemont (Ill.) Horizon stadium roof collapsed while under construction. Five construction workers were killed and 15 were injured. At this writing, investigators say that the partially completed long-span wooden roof could not withstand the "gust cycles" of wind. It is speculated that wind gusts might have pushed up under the western end of the roof that was covered with decking and weakened the trusses. The wind could have put pressure on bolts connecting the spans to concrete buttresses snapping the bolts and causing the trusses to collapse. The $8 million, four-story stadium, located near O'Hare International Airport, was designed by Anthony R. Rossi to seat 19,400 people and was to open in late December.

Less than three months earlier, the roof of the Crosby Kemper Memorial Arena, Kansas City, Mo., collapsed during a severe thunderstorm—and during the AIA convention. The 424x310-foot arena, designed by C. F. Murphy & Associates and completed in 1974, housed the 1976 Republican national convention. Investigation by engineer James L. Stratta revealed that the 42 bolted connections supporting the suspended roof were weakened by fatigue to as little as 20 percent of their original maximum load-carrying capacity. Stratta found that recurrent movement, or rocking, of structural members in the wind subjected the A490 bolts to dynamic loading that they were never intended to carry. The failure began, says Stratta, the day the roof went up. The arena was empty when the roof fell.

The roof of the Hartford (Conn.) Civic Center Coliseum, designed by the Kling Partnership, collapsed in January under the weight of snow and ice. The problem there, according to the investigator, Lev Zetlin Associates, was a design error in the miscalculation of the buckling or load capacity of top chord compression members and certain diagonals in the space frame. Code violations, construction problems and inadequate inspection also contributed to the collapse, according to Zetlin. The calculation of axial compressive capacities was based on the assumption that all top chord members were braced at their midpoints. In the completed structure they were unbraced for their entire 30-foot lengths. Also, primary roof loadings were carried to midpoint subpanel points on the north-south top chords, causing unanticipated bending movements.

Three New Documents Available; Ten Others Are Due This Year

In March 1978, the Institute's board of directors authorized a comprehensive review and update of AIA documents. About 75 percent of the documents are involved in the current program. "The initial products of this massive program are three completely new documents aimed at making the architect's work more efficient and providing a written record of certain authorizations," says Robert Packard, AIA, director of the documents division. Three other new documents will be available in the near future (including A117, "Short Form Owner-Contractor Agreement, Cost Plus a Fee"), and seven others are scheduled for publication before the end of the year.

The first of the three new documents now available is G604, "Professional

continued on page 32

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Owens-Corning Fiberglas Furi®	✓	✓	✓		✓	✓			✓
Perlite								✓	✓
Urethane				✓	✓	✓			
Composites									
Wood Fiber								✓	

Circle 17 on information card

The Institute *from page 29*

Services Supplemental Authorization." It is intended to formalize the procedures for authorizing supplemental professional actions such as expanding the scope of basic services, incurring reimbursable expenses or proceeding with certain additional services.

G604 should be used to record actions authorized in accordance with an earlier agreement for professional services. As a written record, the document will give the architect and owner particulars of activities, time spans and compensation involved in supplemental authorizations. The document is flexible and may be used by the owner to authorize the architect to take a specific action or it could be used for agreements between architect and engineer, between architect and interior designer or in other relationships. Packard says that basically G604 is a document which provides a method for recording changes "in an organized manner."

Document G710, "Architect's Supplemental Instructions," may be used to issue supplemental instructions or interpretations or to order minor changes in the work, as described in A201, "General Conditions of the Contract," 1976. Packard warns that none of such changes authorized by G710 should involve a change in contract sum or contract time. Used with the third new document, G713, G710 replaces "Architect's Field Order" (G708).

G713, "Construction Change Authorization," was developed as an authorization form for changes in the work which, if not processed expeditiously, might delay the project. Frequently, the architect must make instant decisions at the construction site. If the architect cannot immediately contact the owner, this document will provide the architect and the contractor with a record of the authorization by the owner's representative to proceed with a decision that could save the owner time and money.

Such changes must be followed by an official change order, Packard says. The architect must be sure that the owner's representative who executes the document is legally empowered to authorize additional funds and that the amounts do not exceed the representative's monetary authorization.

The three documents are available in packets of 50 copies each for $3. Orders may be placed with AIA publications distribution division at Institute headquarters or with an authorized local distributor of AIA contracts and forms.

Speakers, Programs Lined Up For Four Fall Conferences

Four AIA-sponsored conferences of sinificance to architects nationwide will take place in October and November.

On Oct. 15-17, AIA's architects in industry committee (Thomas Sutton, AIA, chairman) will sponsor a conference at Institute headquarters in Washington, D.C., on "Building Technology: Present, Past and Future." New applications and current building technology will be used to point the way to economic and energy efficiency in the construction industry.

The keynote address on Oct. 16 will be given by Porter Driscoll, AIA, chief of design and construction technology application, center for building technology (CBT), National Bureau of Standards. He will speak on "Technology Applied." After his address, the participants will go to CBT for an overview of recent technological advances. Scientists, engineers and psychologists will discuss new solar technology and advances in environmental design.

On the evening of Oct. 16, there will be a reception at the Pension Building, at which time Cynthia R. Field, president of the committee for a national museum for the building arts, will give the conferees information about the proposed new museum. Later, Carl W. Condit, professor of history, art history

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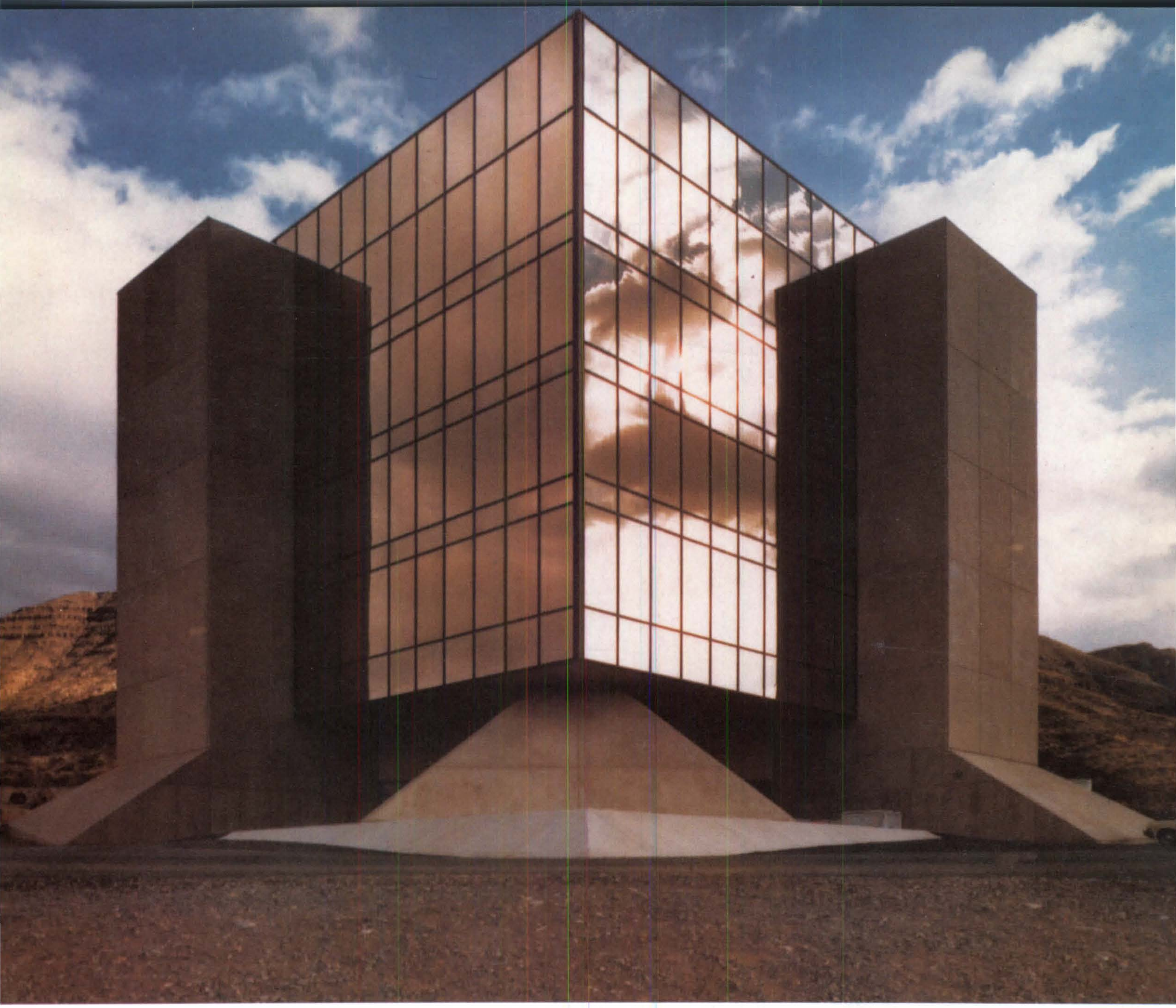

Architect: Charles E. Nolan Jr. & Associates, Alamogordo, New Mexico

Hold a meeting

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Problem There's never been a construction job that didn't require some mid-course adjustments in design, schedules, or materials. And since several parties are involved, to discuss and agree to the changes, a meeting is often needed.

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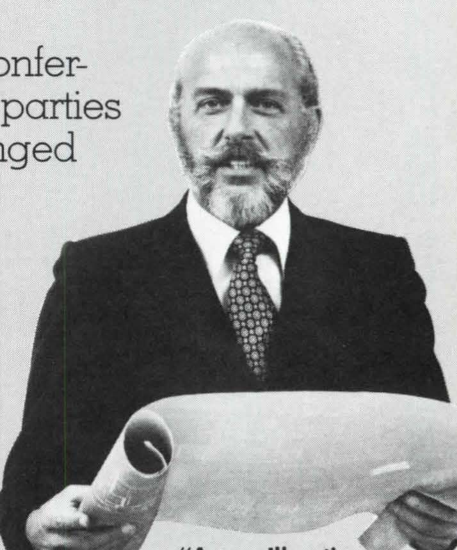

"As you'll notice in Figure 4..."

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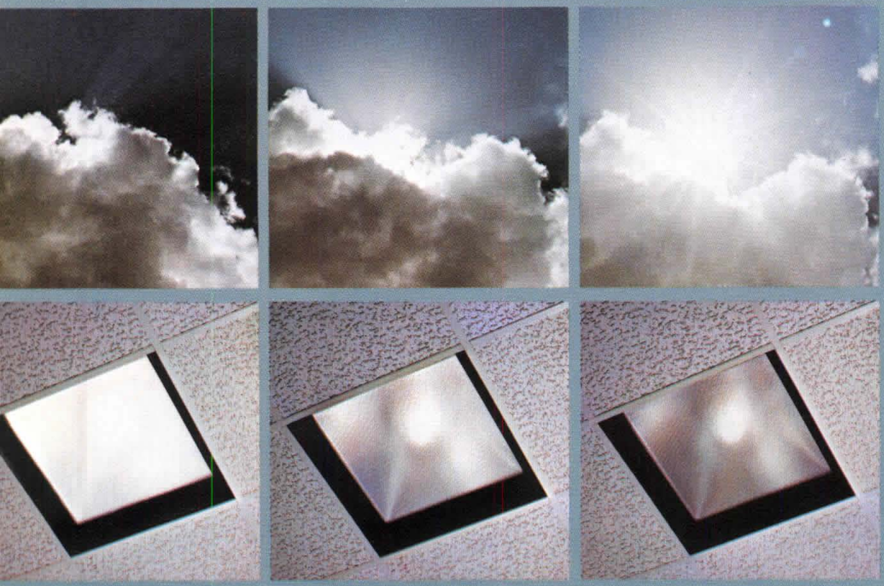

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The Institute *from page 32*
and urban affairs at Northwestern University, will discuss the effects of past innovations on building technology.

On Oct. 17, in-depth case studies will be presented to show how industry projects have used new technology in solving specific problems.

Information about this conference may be obtained from Michael Cohn at AIA headquarters, (202) 785-7366.

Meanwhile, more details have been arranged for AIA's first national conference on architectural management, to be held on Oct. 22-23 in Denver (see Aug., p. 22). Moderator of the conference, whose purpose is to better prepare the architect for the highly competitive climate of the 1980s, will be Nancy R. McAdams, AIA, chairman of the practice management committee.

Michael R. Hough, editor-publisher of *Professional Services Management Journal,* will discuss "How to Develop a Strategic Plan." The topic of a discussion on "How to Manage Growth in Your Practice" will be led by Howard G. Birnberg, architect/design business consultant, and Frank A. Stasiowski, management specialist, will speak on "Profit Planning in Architectural Practice."

Michael P. Buckley, AIA, will outline steps in the creation of a marketing plan in a speech entitled "Competitive Marketing in the '80s." Thomas C. Moreland, AIA, chairman of AIA's project management task force, will discuss "The Strong Project Manager," and Spencer W. Jue, AIA, will speak to the topic of "Profiting from New Techniques in Production." Also, Richard F. Floyd, AIA, will examine "The Impact of Project Management Systems," and Richard L. Christianson, a Denver mortgage expert, will speak on "The Economics of Practice in the '80s."

There will be workshops during the two-day conference, which is sponsored by the AIA practice management committee. For registration, information and details, contact Robert A. Class, AIA, at Institute headquarters, (202) 785-7258.

Special skills and responsibilities of public architects, city planners, chief design executives and educators will be examined at "The Architect in the Public Sector," a design management conference scheduled for Nov. 7-9 in Tallahassee, Fla. Sponsored by AIA in cooperation with Florida A&M University's school of architecture, the conference is part of the Institute's Celebration of Architecture. Governor Robert Graham will give the keynote address.

Workshops will be offered in such areas as design management techniques, managing capital improvements, education for design administration, federal and state design considerations, designers as chief executives and social and environmental objectives.

To register for the conference, contact Mark G. Hall, assistant director of federal agency liaison program, at AIA headquarters, (202) 785-7384.

AIA members are invited to attend an urban planning and design committee meeting in Boston, Oct. 22-24. The meeting will be aimed at developing an urban design agenda for the '80s. Speakers will include James Marston Fitch, Richard Stein, FAIA, George Notter, FAIA, David Wallace, FAIA, Percival Goodman, FAIA, Anthony Pangaro and John Zuccotti. For more information, contact John Gaillard, director of design and environment programs, at AIA headquarters.

AIA-Air Force Design Program

For the first time, AIA and the U.S. Air Force are collaborating to improve the four-year-old design awards program which recognizes excellence in Air Force projects. "With AIA participation, our program will achieve higher levels of professional recognition," said Brig. Gen. Clifton D. Wright, commander of the

Air Force engineering and services center, Tyndall Air Force Base, Fla. AIA Vice Presidents Robert C. Broshar, FAIA, and James M. Harrison, FAIA, have been named jurors of the 1979 design awards program which recognizes the "achievement of excellence in architectural and engineering design by the military and professional community."

Also, the Department of Defense has reactivated its design awards program which was discontinued in early 1977. Ehrman B. Mitchell Jr., FAIA, president of the Institute, has pledged AIA's support of DOD's efforts to recognize design professionals "who meet and exceed the challenge to produce quality architecture for the Department of Defense." R. Randall Vosbeck, FAIA, Institute vice president, has been appointed to serve on the jury for the DOD program.

For more information about either awards program, contact Steve Biegel, director of the AIA federal agency liaison program, at Institute headquarters, (202) 785-7382.

Institute Opposes FTC Proposal On Standards and Certification

AIA has joined several organizations in the building industry in opposing the Federal Trade Commission's proposed trade rule on standards and certification as it relates to the design professions and the construction industry. AIA recommends that action on the proposal be "*deferred* until such time as a more detailed investigation of the relative frequency of standards abuses, the availability of less restrictive alternatives and the economic impact on the construction industry has been accomplished," said David Olan Meeker Jr., FAIA, executive vice president of the Institute in testimony on behalf of AIA before the FTC. "We believe," he said, "that there is insufficient justification on the record to date for the proposed rulemaking in its present form on all of these counts."

The proposed rule would establish strict notification, participation and appeals procedures in standards-making and would impose heavy penalties for noncompliance. According to the rule, "it would establish prohibitions and requirements for standards developers, certifiers and persons who reference standards or certification in the marketing of products." It would apply to both the development and use of standards and would establish a "general right" to participate in all phases of standards proceedings. It would further establish a "redress system that private parties can use to challenge unfair, deceptive or anticompetitive standards." The rule would be enforced, on a case by case basis, through cease and desist orders, civil penalties and consumer redress.

Meeker said the "rule's challenge provisions will result in a weakening of product standards, in the name of removing competitive market restrictions, which will not ultimately serve the public interest. In reality, it will allow the owner or developer to save some initial procurement costs, while subjecting tenants, users or subsequent purchasers to deteriorating buildings, environmental discomfort and increased operating, maintenance, repair and replacement costs far in excess of someone else's savings." He emphasized that federal policy should promote the selection of products and materials that take into consideration life cycle costs rather than "giving additional weight to the immense market pressures for using lowest initial cost solutions."

Meeker said AIA was particularly concerned that the rule "represents proposed federal intervention in an area of commerce without having first built a substantial case for regulation." He pointed to FTC's "insufficient understanding of the construction industry, standards development, product selection behavior and market interactions." Also, he said that an economic impact analysis had been overlooked.

Meeker said neither AIA nor its members "have a financial stake in standards, nor is AIA in the business of standards-making. Our interest is to be able to better serve the owners and users of the buildings we design." He said that AIA "has serious doubts" regarding the extent of the problems that the rule purports to address and whether it would "improve decision making by or on behalf of the consumer of building products." He said that FTC should not abandon its investigation of competitive injury and consumer deception coming from codes and standards. "Such charges deserve investigation, and more aggressive enforcement of the laws, using existing powers, may be required."

The rule has also been opposed by the National Institute of Building Sciences because of the fear that it might interfere with voluntary standards-making. Also on record in opposition to the rule are the American Consulting Engineers Council, the Associated General Contractors of America and the National Society of Professional Engineers.

Meeker said in his testimony that AIA "strongly favors" an approach taken by the Office of Management and Budget that would require broad representation on standards-making groups and a uniform policy on the use of voluntary standards. "AIA is relying primarily on cooperative efforts by the industry . . . rather than on a government decree," he said.

Government

Second Block Grant Evaluation Applauds New Targeting Formula

Has HUD's community development block grant (CDBG) program placed funds in the nation's neediest communities? Does the federal or local government have control over individual projects? Are the projects under CDBG different from the previous categorical grants program?

These and more questions are answered in "Decentralizing Community Development," compiled by the Brookings Institution and recently issued by HUD. It is the second of four evaluations of the CDBG program. The first emphasized distributional issues and recommended modifying the allocation system.

The Housing and Community Development Act of 1977 authorized $3.7 billion to the CDBG program over three consecutive years for grants to help revitalize hard-pressed cities and to provide more decent housing for low- and moderate-income people. The law is a continuation of the 1974 act, but has a different formula for the computation of federal funding levels in calculating how much money each city will receive.

The new formula was chosen to bring more benefits to older, deteriorating cities of the East and Northeast by giving greater weight to the age of a city's housing stock and to population growth lag. The original formula weighed population at 25 percent, overcrowded housing at 25 percent and the percentage of residents below the poverty level at 50 percent. The new formula weighs population growth at 20 percent, poverty at 30 percent and age of housing at 50 percent.

Using a sample of 61 jurisdictions (30 cities, 10 urban counties, 12 suburban cities and 9 nonmetropolitan cities), the Brookings survey found that the shift to the "dual formula allocation system" has significantly improved the targeting capabilities of the program. With the use of the new formula oriented toward older

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from top

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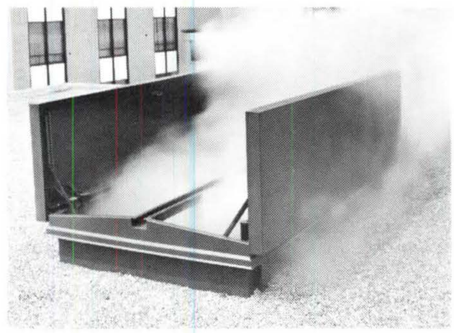

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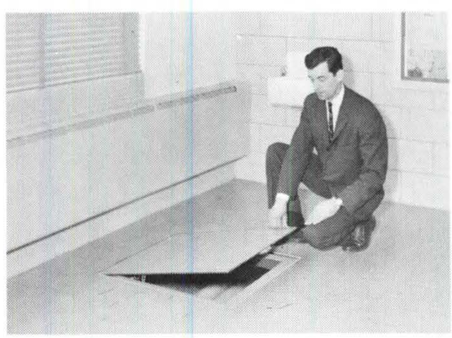

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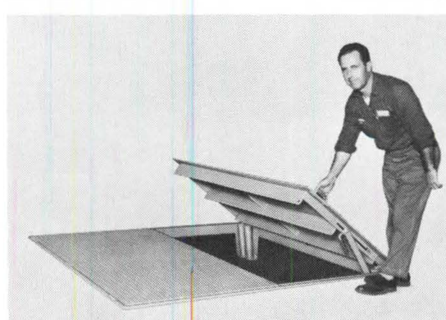

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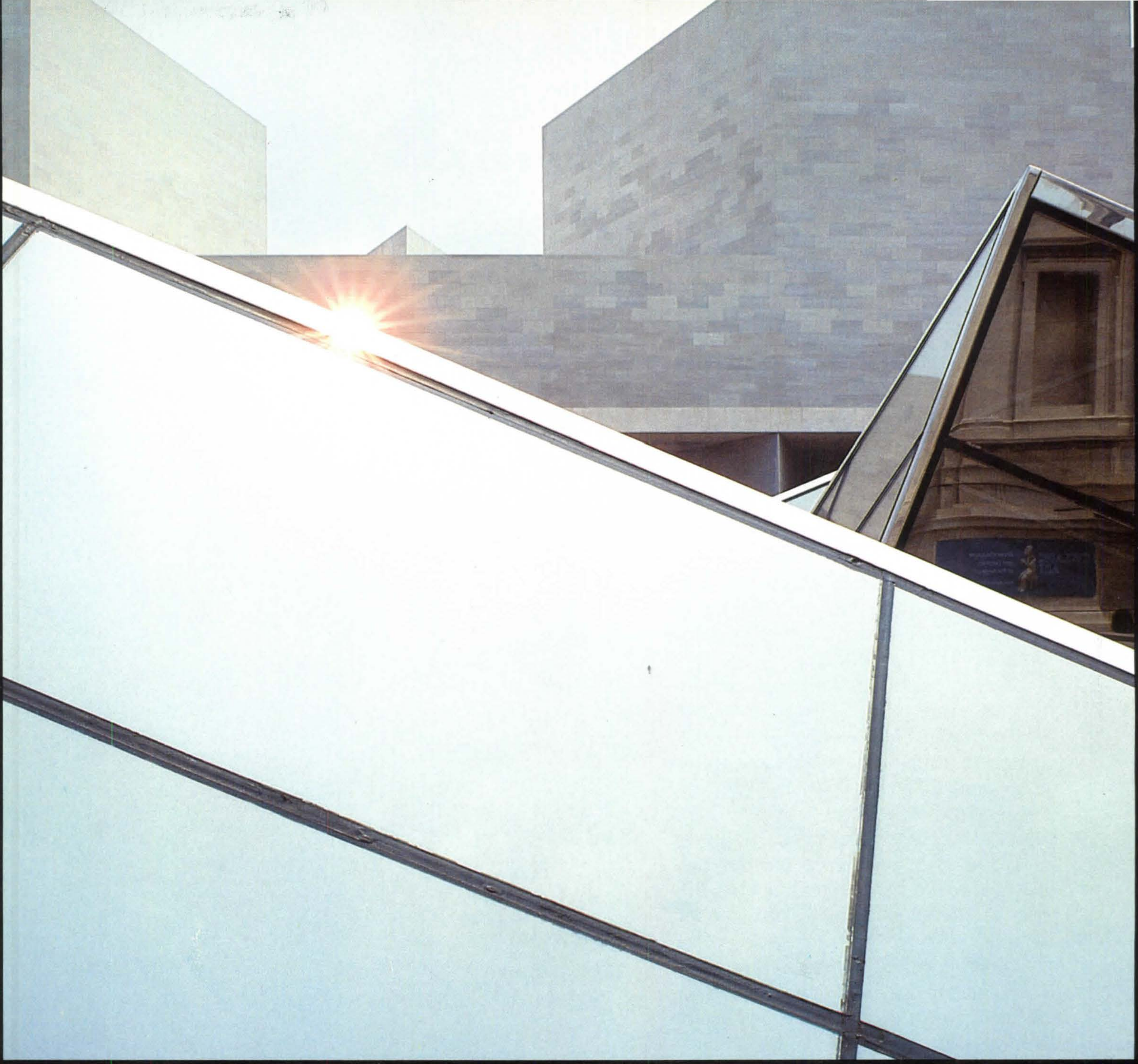

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Government *from page 38*
and more distressed cities, said the report, "a significant amount of additional funding is going to what we find to be the neediest communities." The Northeast's share of funds increased from 49 to 58 percent, while the Southern and Western share declined from 51 to 42 percent. Central cities have benefited the most (an increase of 43 percent). The report concluded: "We see efforts to achieve better targeting as an important part of urban problem-solving. We also see such efforts as likely to meet with resistance from those concerned about other programs, such as the programs of growth areas and the needs for rural development."

The block grant concept (1977 legislation) was adopted for community development to answer complaints about the priority-setting role of the federal government under the categorical grants program (1974 legislation). Under the categorical grants approach, the competition for urban aid was largely between communities. Under the block grants the competition is primarily within the community. Thus, concludes the report, "This political rearrangement has had the effect of substituting local preferences for federal preferences," allowing more control by local officials over community development. And there has been an increased involvement of local legislatures and citizens in the decision-making process.

Decentralization has allowed communities to design their own programs. A large number of relatively hard-pressed areas (mostly central cities) have shifted to a mixed program of community development, according to the report. In the "better-off" communities, CDBG funds are more often concentrated in a single program.

The report poses these questions about the future: "Will decision making become routinized with the process closing up and coming under the domination of one set of participants? Is the relatively great involvement of citizens in the early years of the CDBG program a burst of initial enthusiasm that has peaked and will decline, or has citizen influence become an established part of local decision making?"

Housing rehabilitation, which in the original CDBG legislation was considered an "incidential" activity, has emerged as one of the major CDBG undertakings of local governments. Some communities use CDBG funds only to bring housing units up to various building code standards, while others go further allowing funds to be used for structural and external repairs.

A copy of the in-depth, 261-page report may be obtained from the Division of Product Dissemination and Transfer, Office of Policy, Development and Research, HUD, Room 8124, 451 Seventh St. S.W., Washington, D.C. 20410.

Meanwhile, the 1977 legislation authority expires September 1980. HUD plans to announce any suggested changes in the law this month. Robert Embry, HUD assistant secretary for community planning and development, said he expects HUD to recommend reauthorization of the program on a multiyear basis; the funding level will not increase significantly and there will be no major changes in the program.

Landrieu Helped to Formulate Cities' Revenue-Sharing Program

Moon Landrieu, President Carter's choice for secretary of HUD served two terms as mayor of New Orleans (1970-78), and was prohibited by law from running for a third term.

As mayor, he fought for rehabilitation of the French Quarter and the center city commercial district (site of the $163.5 million Superdome), construction of a riverside mall and inclusion of blacks in the city government.

As a member of the U.S. Conference of Mayors and as its president in 1975, he helped formulate the federal revenue-sharing program for cities. He is now chairman of two of the conference's committees—transportation and urban de-

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Government *from page 42*
velopment. He is also a member of the National Urban Coalition steering committee.

Popular with the nation's mayors, Landrieu was called by Tom Cochran, deputy director of the U.S. Conference of Mayors, a "man from the trenches." Cochran said that the conference is "elated that President Carter has recognized Mayor Landrieu's ability."

The HUD nominee was born Maurice Edwin Landrieu, but made his childhood nickname of Moon official when he ran for mayor of his home town. He studied law at Loyola University in New Orleans, was a partner in the law firm of Landrieu, Calogero & Kronlage, a state legislator and a city council member before his terms as mayor. After his service as mayor, he became president of Joseph C. Canizaro Interest Inc., a real estate development firm with projects in downtown New Orleans.

During his political life in Louisiana, Landrieu was a controversial figure. He was criticized for the Superdome project, among other things, but he managed to survive the criticisms. His fellow mayors consider him a champion of urban programs.

Confirmation hearings will take place after the congressional recess this month.

HUD Documents Discrimination Against Blacks in U.S. Housing

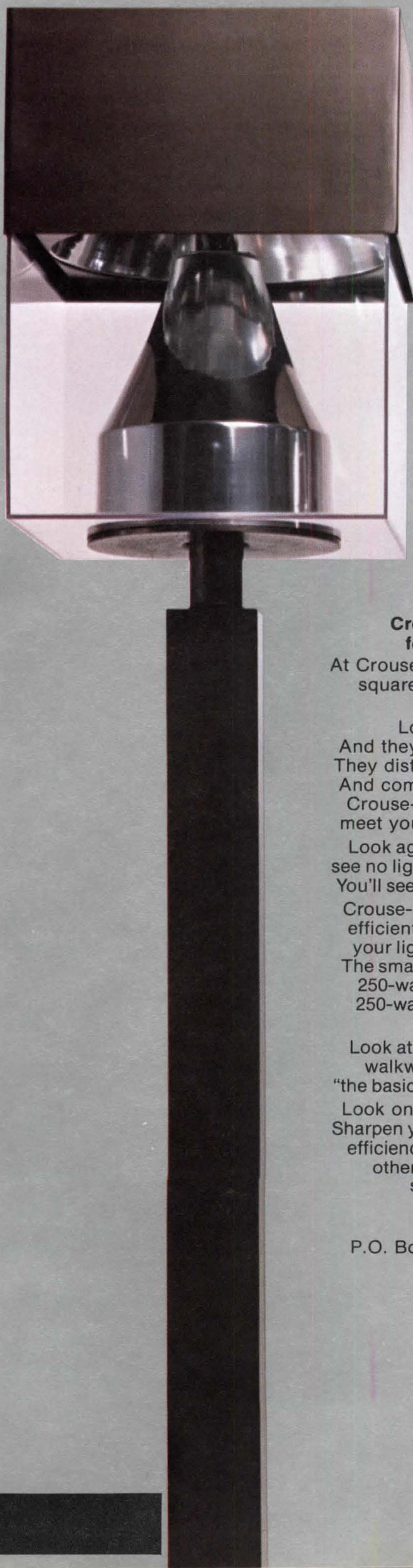
What HUD calls the "first formal report on a nationwide study of discrimination against blacks in the sale and rental of housing" reveals a disturbing fact that the "collective conscience prefers to ignore": There is "significant" racial discrimination in the housing market, both direct and indirect.

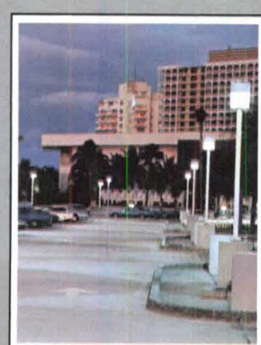
The report, "Measuring Racial Discrimination in American Housing Markets," presents definitive evidence that blacks are systematically treated less favorably with regard to housing availability, are treated less courteously and are asked for more information than whites.

The study, a $1 million project conducted by HUD in conjunction with the National Committee Against Discrimination in Housing, was designed to measure national and regional discrimination and not the specific levels of discrimination in each of the 35 metropolitan areas. The actual level of discrimination for a particular area exists "somewhere over a fairly wide range of values." The level of discrimination reported in one area, for example, is 30 percent, but the true level of discrimination "could be as low as 3 percent or as high as 57 percent."

continued on page 116

The basic forms of light.





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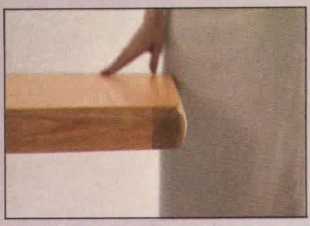

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AIA JOURNAL

Natural Light

Natural light has provided a perceptual dynamic to architectural design since its inception. The creation of the artificial has been enhanced by its relation to the natural and gained vitality in response to solar rhythms. Masters of architecture may frequently be cited as masters of light.

The fascination with sunlight derives from our most fundamental biological, as well as esthetic, needs. Orientation in time and space is critical to our survival and well-being. Sunlight is predictable in its direction and cycles of day and season; daylight is unpredictable in its varying patterns of weather, reflectances and shadows. Daylight design carries with it the assurance of orientation and the excitement of diversity.

The play of natural light on a building facade and its entry into a building challenges the design and technology of architecture. The issue is one of relation. An object in direct sunlight may be a million times as bright as in moonlight, yet we perceive both clearly; except at the extremes of perception, absolute values are less important than relational ones. Visual perceptions are formed not only by actual illumination, but by analogy, expectation and experience. The designer relies on context as well as light itself.

The practical aspects of sunlight had, until very recently, been neglected for 20 years and the thermal implications were rediscovered before those concerning illumination. Much of the daylight design of practical

Santa Sophia, Istanbul

John Desmond, FAIA

intent was accomplished in this country before the 1950s. Many early office buildings have narrow sections and large windows to admit daylight. Rockefeller Center limits interior spaces to 27 feet between perimeter and elevator core to take advantage of natural light. New York City decades ago developed setback zoning to ensure natural light amid urban density.

Daylight design lends itself particularly well to buildings with intense daytime use, such as office buildings and schools, where an early theory was that natural light was good for growing things and people. The task requirements of such buildings benefitted from the high quality of natural light, its pleasant modeling effects and variations, its superior color rendition and design employing sidelighting to reduce the veiling reflections caused by conventional overhead luminaries. Warehouses and retail stores are also frequent subjects for daylight design, with ambient light the focus for warehouses and marketing appeal the focus for retail stores.

Implicit in daylight design is the opportunity for views and experiential contact with the outdoors. Residences that gain few energy benefits from daylight can draw from it amenity and psychological rapport with the outdoors as well as a more effective visual environment.

One of the most interesting experiments in daylight design occurred in California during the 1940s and early 1950s when a large number of schools were designed and built to rely almost entirely on daylight. These buildings became classic examples of unilateral, bilateral and trilateral daylight design; documentation of their quality and performance remain important references even today (see pages 69-71).

The schools still exist, but the daylight design has been wasted. When the schools were built, the form and location of the buildings with their large window areas and high ceilings provided not only good lighting, but natural ventilation and other thermal comforts for that climate. Over time, however, conditions changed. Pressure built for higher light levels, and fluorescent lighting was installed. With the higher, artificial illumination came a buildup of internal heat. The warmer classrooms then required airconditioning, and it was installed. Soon,

Míkonos, Greece

Richard Peters

the windows that had provided heat, light and ventilation became burdensome to the new mechanical systems and so many were covered and blocked off. A tour of many of these schools today provides only faint clues to their original daylight design.

Early approaches to energy conservation recognized that daylight could reduce the need for artificial and therefore electrical light. But embedded in the conservation concepts was a reliance on mechanical systems that put daylight design at odds with efficient thermal system design. Early conservation checklists suggested the designer include daylight in one place and, in others, would suggest the designer reduce window areas, make the building more compact and reduce perimeter exposures.

More recent interest in energy conservation has focused on a complement between changing environmental cycles and building design, urging the designer to integrate building and nature, rather than isolate them from each other. The location and form of the building have become the focus of energy-conscious design rather than mechanical systems. And, with increased interest in natural ventilation, passive solar energy and dynamic design responses to climate, daylight design is again rising to the fore.

Natural light has long been accepted as a form issue in architecture and therefore undeniably the province of the architect. It is perceived as an esthetic concern related to the quality of an environment. The concern with numbers is a newer one that must be addressed, but does not overwhelm the fundamental human and esthetic factors for architects. The numbers are an index to performance and therefore important, but light is still first and foremost a perceptual and qualitative issue.

The performance aspects of daylight are now receiving the most attention in an era of energy concerns. The Union Carbide building in New York City is being retrofitted for daylight. Energy research now addresses the illumination aspects of solar energy along with the thermal. The classical approaches to daylight design are being enhanced with new knowledge about ways to make the light more useful, farther into a building.

In this issue we explore the formal implications of natural daylight, from the poetic to the analytical, and from the esthetic to the practical. Daylight design may at last bring the blend of design and technology that good architecture suggests and wise architecture fulfills. *Marguerite Villecco. A former senior editor of* Architectural Forum *and* Architecture Plus, *Ms. Villecco subsequently was a senior research associate at AIA Research Corporation. She served as consulting editor for this issue of the* JOURNAL.*—Ed.*

Photographs by Richard Peters

Masters of Light: Alvar Aalto

Achieving 'just the right amount of light' in a singular climate. By Richard C. Peters, AIA

The magic of light and architecture is nowhere more eloquently expressed than in the work of Alvar Aalto.

Most of his major buildings are in Finland, a climate zone in which there is almost no daylight during the long winter months and continuous daylight during most of the summer, a condition that demands a careful blending of natural and artificial light.

A low-angled soft light—I call it "lemon light"—only peeks over the horizon for a few minutes during winter months, while during the endless days of summer it seems to float high above you in the sky—seemingly always perpendicular.

Aalto understood the distinction between the lighting requirements for the winter and summer and developed a system or language of "light-giving devices" that are utilized in all his buildings. Rooftop lighting, clerestories, screened windows and lighting scoops are quite consciously made major design elements. They are used to crown or accent spaces, to denote movement from place to place in light, or to punctuate activities in controlled light. Light is always carefully considered in relation to the human functions it illuminates. Be it as simple as a hallway or as complex as a reading room or church interior, it is *putting light where you want it* that is the important lesson to learn.

Aalto's use of light is not overwhelmingly dramatic, nor at all theatrical. Yet his spaces are replete with patterns of sunlight, shadows and reflected light, always combined one with another, providing "just the right amount of light" to enjoy the experience of the beautiful interiors.

An important realization from the exterior is that one can virtually "read" Aalto buildings. The exterior forms directly relate to the interior spaces. They are buildings that are expressive of their function. Windows, for example, are never arbitrarily placed into a facade just for effect, but are designed to bring light into the building exactly where it is wanted and where it is needed.

Other important characteristics of the buildings are their modeling and plasticity in daylight. They take on different values and colors by the direction, movement and quality of sunlight and the sky conditions in relation to their surfaces. Dark blue

The Polytechnical Institute at Otaniemi (above) whose faculty committee room (left) has southfacing light scoops admitting glareless light.

ceramic tile turns silver gray under overcast skies; red brick takes on a bronze orange glow in the winter light and the long summer sunset, and white marble reflects the hue of the everchanging light of the day; from soft purple in the early morning to the bright white of midday to warm pink at twilight.

Because sunlight is treasured in Finland, Aalto maximized the use of "articulated" daylight. However, he was equally sensitive in the use of artificial illumination, particularly important in regions where in the winter there is minimum daylight. Aalto designed the lighting fixtures for each building and saw them as an integral design element. As with his modeling of daylight, Aalto filtered and screened artificial light by using baffles, reflecting brass and painted surfaces, always with the intent of spreading "warm light."

The interweaving of the buildings' forms, surfaces and openings with the elegantly orchestrated artificial illumination shows that Aalto loved his buildings and what they could mean to the people who used and experienced them. To me, the work of Alvar Aalto says "architecture is light." □

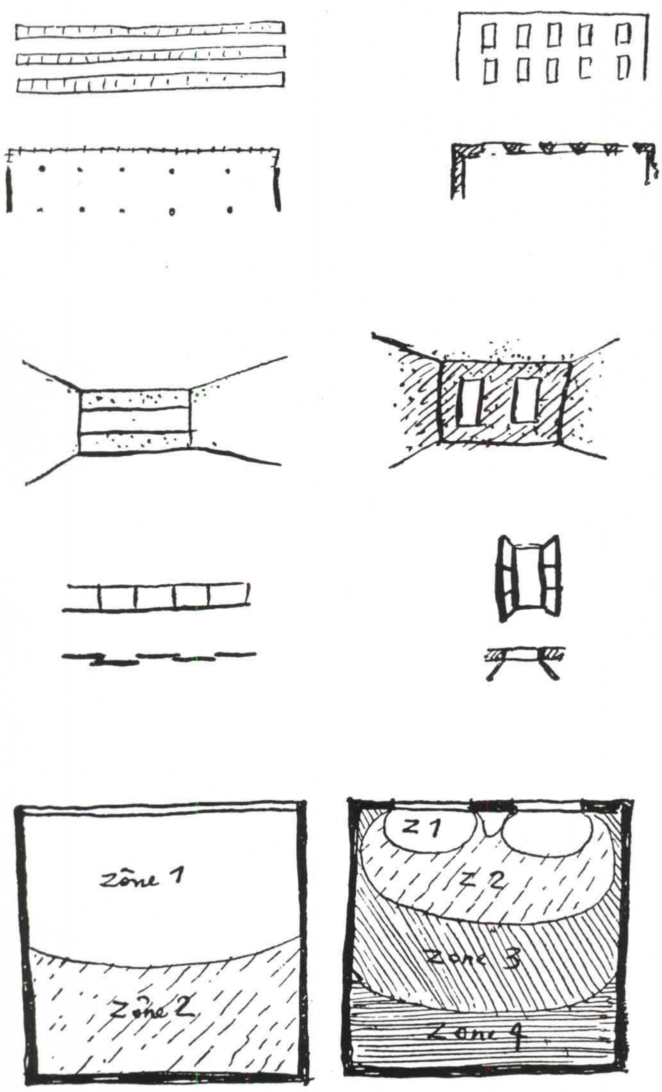
Mr. Peters is a professor of architecture at the University of California at Berkeley, and a partner in the San Francisco firm of Peters Clayberg & Caulfield.

The National Pension Bank headquarters building in Helsinki is a large, four-story volume ringed with offices. The triple-glazed skylights that project high above the roof and far below the ceiling are used in a conscious attempt to create a sunny, warm indoor environment in this harsh northern climate. Because each of the skylights is canted and rises from a one-story high coffer, light is diffused and reflected from vertical surfaces above the ceiling before entering the building's interior spaces. It is then bounced off reflective, white walls. The result is shadowless light without glare. Similarly, artificial light coming from fixtures hung in the skylights is reflected from vertical surfaces from two sides and reaches horizontal working spaces at an angle. This eliminates glare.

A view from the north of the Polytechnical Institute at Otaniemi in summer and winter (above) shows how quality and quantity of light change according to season. Stockman's bookstore in Helsinki (left), with three crystalline skylights floating above a three-story hall clad in reflective white marble, is similar in concept to the National Pension Bank headquarters building.

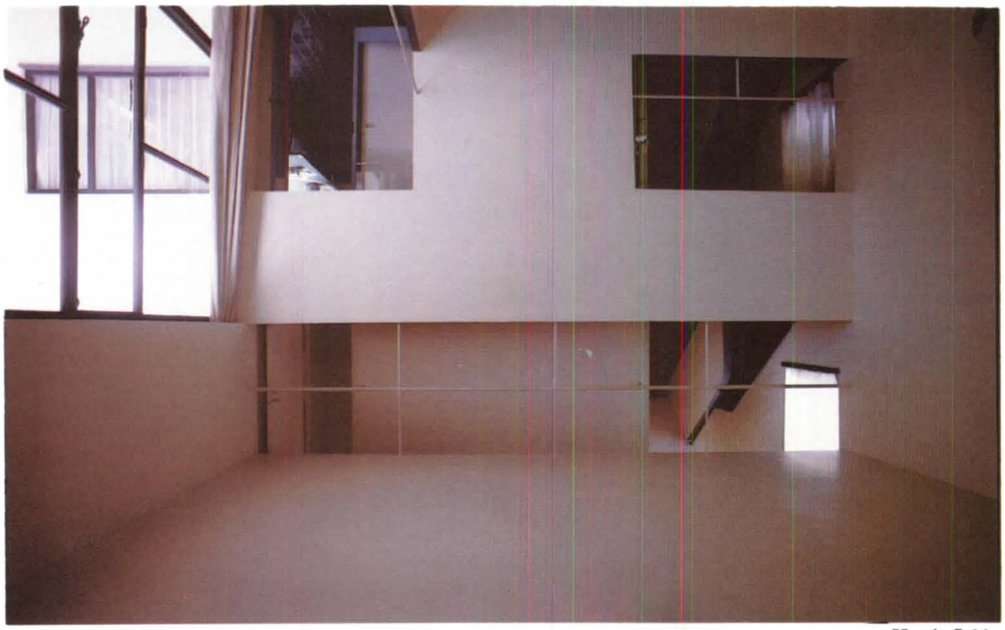
Masters of Light: Le Corbusier

He moved from Purist typology to a poetic use of light. By Harris Sobin

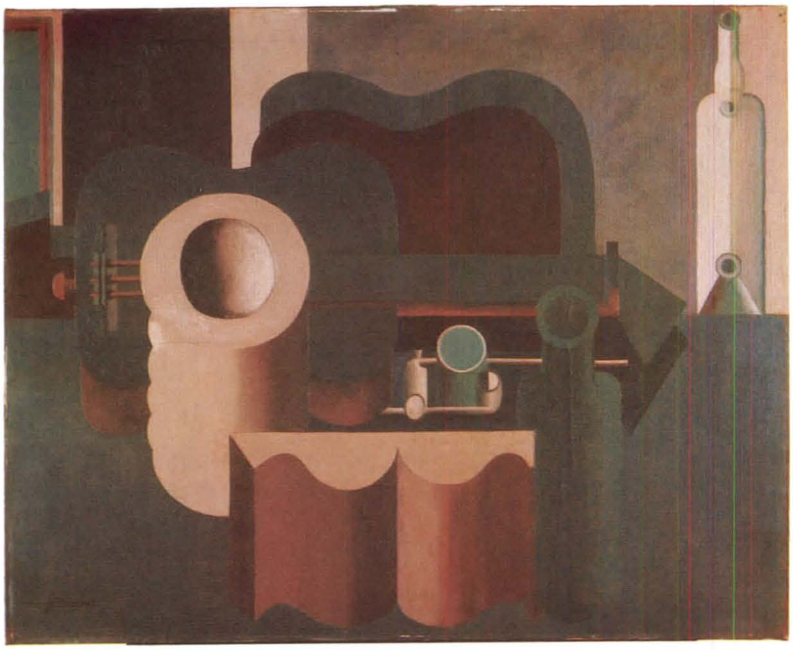


Above, Le Corbusier's graphic window analysis (1926), comparing daylight performance of equal areas of the fenêtre en longueur *or ribbon window (left) with that of the widely spaced vertical openings of the classical tradition (right). Conclusion: The ribbon window delivers a substantially higher average level of illumination while providing a more even distribution of light in rooms. At right, the street facade of Le Corbusier's Villa Jeanneret (1923) under typical overcast Paris sky conditions. Four Purist window types can be seen: the* pan de verre *(upper right), the 'vertical slot' (top center), the 'hole-in-the-wall' (top left) and the* fenêtre en longueur, *(second floor).*

Harris Sobi



Harris Sobin



Above, the triple height entrance hall of the Villa La Roche (1923) in Paris. This Purist period interior is illuminated by the soft, diffuse daylight from a large area of pan de verre *on the left. The elegant forms of Le Corbusier's early Purist paintings, such as* Nature Morte à la Pile d'Assiettes *(1920) at left, are defined by a light as soft and nearly shadowless as the one which permeates the interiors of his Purist architecture of the same period.*

By the early 1920s, use of the "rational" skeleton frame in Europe had made possible the use of thin, lightweight exterior enclosures fully independent of a building's structure. This new facade could be fully glazed, fully opaque or anything in between. New freedoms soon led to new problems: In designing the emancipated window, a new "rational" ordering principle was needed to replace the *ordonnance* of classical convention. The choice of International Style practitioners, central as it was to prevailing ideas of health and modernity, was natural light. "Light is the key to well-being," Le Corbusier announced. "Windows are made to give light, not ventilation. . . . The facade fulfills its true destiny; *it is the provider of light.* It can provide light with *100 percent of its surface. . . . Walls of light!* Henceforth the idea of the window will be modified."

This early polemical stance led Le Corbusier by the end of the 1920s to invent and employ an entire typology of windows. Each was a "word" in the new architectural language of Purism. When used in the "sentence" of a building facade, each window type was intended to symbolize a particular range of human activity, and at the same time was specifically designed to deliver the correct amount of natural light thought to be associated with that activity. For ceremonial spaces, such as entrance halls, or for rooms containing functions requiring the greatest degree of illumination, including offices, hospital rooms, workrooms and studios, Le Corbusier utilized the *pan de verre* or window wall, an area of full height glazing, often supplemented by substantial areas of toplighting. For spaces such as kitchens or living rooms requiring average light levels evenly distributed throughout the room, he borrowed from contemporary industrial practice for what he called the *fenêtre en longueur*. This was a "ribbon" or lengthwise window, running continuously across the entire length of a space between blank side walls. From graphic analysis of its daylighting performance, Le Corbusier concluded that the ribbon window would guarantee four times the average interior illumination produced by the narrow vertical openings of classic *ordonnance,* and also greatly improve the distribution of that light. Where daylighting needs were modest, as in bedrooms or corridors, narrow vertical slots, square "hole-in-the-wall" openings or small skylights were utilized, spaced widely apart in large expanses of opaque, canonically white surfaces. The entire spectrum of this Purist

Mr. Sobin is a professor of architecture at the University of Arizona. This article, copyright © 1979 by Harris Sobin, is part of his forthcoming book on the evolution of Le Corbusier's concept of energy conservation, based on research carried out at the Fondation Le Corbusier on a senior Fulbright-Hays award.

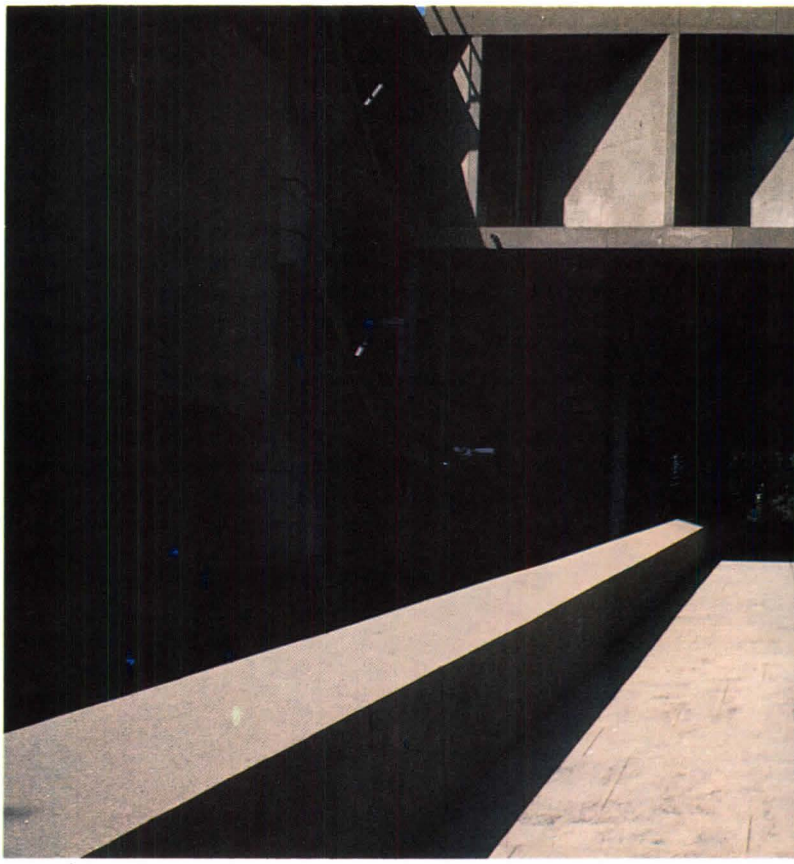
"vocabulary of light" reached a fully developed form as early as 1922-23. The result: highly legible combinations of window arrangements on planar white exteriors, giving rise to a luminous world in which the use of natural light created a wide range of interior environments, from relatively closed, secluded and dim to softly glowing, to bright, transparent and open. Effective in its first appearances around Paris, this window typology did not always travel well, responding best to the architect's intentions under the cloudy sky conditions of northern Europe.

An increasingly obsessive concern with providing natural light soon induced Le Corbusier to reduce his use of isolated openings and move toward larger and larger areas of fully glazed walls. At the end of the 1920s, several major projects were under design at the atelier using areas of continuous full-height glazing across their entire multistory facades. But as soon as one of these buildings was actually put into use, the limitations of unprotected fully glazed walls in buildings lacking in high-tech airconditioning systems became abundantly clear: They caused serious summer overheating problems.

This environmental failure coincided with Le Corbusier's series of visits in the mid-1930s to North Africa. In the region's traditional architecture he discovered a wide range of non-mechanical techniques capable of creating livable indoor environments even in a hot arid desert, through the use of massive building envelopes and small openings. These vernacular control concepts of mass and shade became, in Le Corbusier's hands, the basis for a whole new second architectural "language." From this point onward, the role of light in his architecture radically changed. The provision of unlimited amounts of natural daylight was rejected as the major determinant of the design of the building envelope. Overcoming the heat which came in with the light now became the major environmental goal. The architect's first step toward achieving it was his invention and development, in connection with several projects for North Africa, of layered screens made up of opaque fins and overhangs for systematic solar shading of the window wall. Introduction of this second wall, called the *brise-soleil* or sun-breaker by Le Corbusier, marked the beginning of a whole new enclosure typology based on shade, mass and ventilation. Despite its eventual use in several different climatic zones, this new language frequently seems to have been created to work best, both figuratively and functionally, under clear skies and strong sunlight.

While reducing direct penetration of solar heat into a building, the *brise-soleil* also inevitably and substantially reduced the amount of daylight which could enter its interior. Powerfully sculptural, of great visual force and densely coded for thermal control, the exteriors of these later buildings often enclose dimly lit spaces, in which the frequent absence of adequate overall daylighting actually heightens the impact of dramatically placed washes of light. These luminous accents, symbolically underscoring crucial issues of circulation, structure and illumination, originate in brilliantly colored interior curbs of skylights, ceilings adjacent to clerestories, or the glowing inner surfaces of the sun-breakers themselves.

Le Corbusier's use of light as a design element had gone through a major transformation. In his youthful, utopian vision, architecture operated as a Cartesian "light-delivery system," with light *itself* as the major physiological/environmental/functional subject and purpose of that architecture. In the later projects his work evolved toward a more plastic, evocative and, in many ways, more traditional conception, in which light plays a decreasingly "objective," and increasingly symbolic, mysterious, poetic role, delineating and intensifying volume, space and architectural meaning. □



Harris Sobin

Below left, the east facade of the Carpenter Center for the Visual Arts at Harvard (1961-64). Typical of Le Corbusier's late works, it has massive, deeply sculptured concrete brise-soleils *at upper studio levels protecting a full-height, all-glass window wall at the ground floor office level. The brightly colored inner surfaces of the* brise-soleils *(left) lend drama and excitement to the Carpenter Center's studio spaces. Below, the brilliantly colored recollections of the carafes and bottles of Purism intermingle with a linear human figure of his post-Purist iconography, but the visual center of Le Corbusier's* Femme sur fond rouge, *a tapestry of 1965, is the image of a square lantern. Here, this Purist icon has been transformed from its pale origins, by the use of intense values of black and white, into a sunbreaker bay from Le Corbusier's later career, seen in slanting, strongly directional sunlight.*

Harris Sobin

Photographs by Marshall D. Meyers

Masters of Light: Louis Kahn

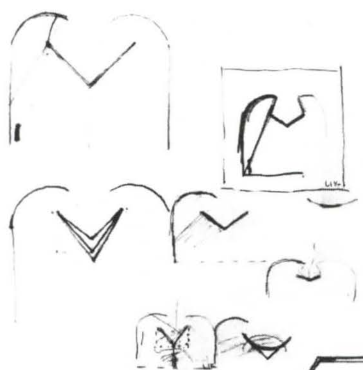
The development of the Kimbell's 'natural-light fixture.' By Marshall Meyers, AIA

"We were born of light. The seasons are felt through light. We only know the world as it is evoked by light, and from this comes the thought that material is spent light. To me natural light is the only light, because it has mood—it provides a ground of common agreement for man—it puts us in touch with the eternal. Natural light is the only light that makes architecture architecture." Louis I. Kahn.

He liked to call it a "natural-light fixture," that particular "harness-like looking thing" that spreads daylight onto the underside of the Kimbell vault. He believed "so much in the wonder of natural light, that it resulted in an invention of a shape which one could never get to by just playing around with shapes you like." But the path to get to something, Kahn once said, is a difficult one, and the first step began late in 1966 with the choice of Kahn as architect for Fort Worth's Kimbell Art Museum by its director, Richard F. Brown. Brown's sympathies corresponded to Kahn's. In his prearchitectural program the director wrote:

"Natural light should play a vital part in illumination. . . . The visitor must be able to relate to nature momentarily . . . to actually see at least a small slice of foliage, sky, sun, water. And the effects of changes in weather, position of the sun, seasons, must penetrate the building and participate in illuminating both art and observer. . . . We are after a psychological effect

Mr. Meyers, a partner in the Philadelphia firm of Pellecchia & Meyers, was Louis Kahn's project architect for the Kimbell Art Museum. His present firm was commissioned after Kahn's death to complete the design and construction of the Yale Center for British Art.



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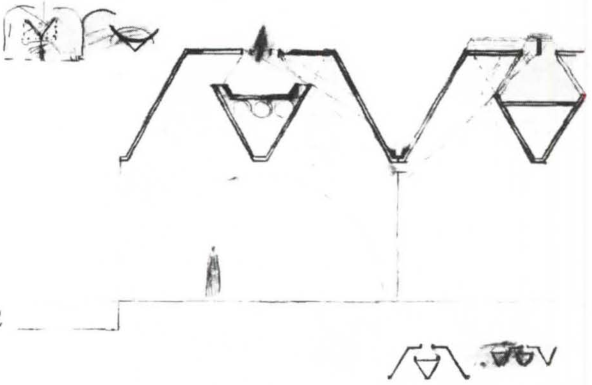


2

Kahn's first sketches: The roofs were too high and contained too much volume.

through which the museum visitor feels that both he and the art he came to see are still part of the real, rotating, changeable world."

Kahn made his first proposal for the building in March 1967, and it contained the basic elements he would keep throughout the entire development of the design: a repetitive series of shed-like structures with roof-top light apertures interrupted by open courts. His first sketches for the section of this element show several studies of the narrow roof aperture with a reflector shape hung below (1 and 2). He investigated many roof shapes, including one that was semicircular, but all these early schemes had the same failing in the eyes of Brown: The roofs were too high; they contained too much volume. In most cases their height was equal to the height of the columns supporting them, making the space too august and monumental for the relatively small objects to be exhibited.

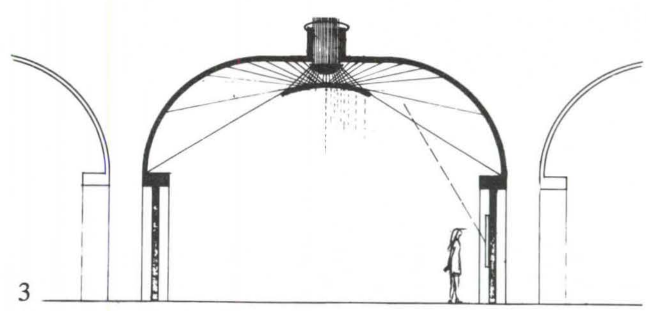
Attempts to reduce this volume proved awkward at first. A drawing I made for Kahn in September 1967 (3) showing quarter circles with a flat roof was an initial effort to reduce the scale. This drawing also illustrated a novel possibility for the reflector: that in addition to its ability to reflect daylight onto the ceiling, it could be made to simultaneously *transmit* some light down to the observer. This small spark of an idea was not too unusual. Optical devices called "beam splitters" existed to divide a beam of light and send it off in two directions. A partially mirrored prism in a single-lens reflex movie camera sends some light to the eyepiece and some to the film. What was unique was the proposal to apply this principle to something the size of an architectural element in order to make the reflector disappear, to give the illusion of dematerialization and transparency so you could see through it. By doing this it was hoped to avoid the heaviness of the conventional opaque reflector where its dark underside is seen highly contrasted against a brightly lit surface.

Kahn once said that an idea wasn't an idea unless you knew how to make it. The means of making the reflector did seem to be at hand. It would be a transparent one-way mirror; glass with a vacuum-deposited aluminum or chrome film, thin enough to see through. Kahn liked the novelty of the idea and presented it to Brown, calling it a "new kind of window." Within weeks of this decision the cycloid curve was selected as a possible lower profile for the roof and confirmed as structurally feasible by the engineer, August Komendant. Now the first sections were drawn incorporating both the cycloid shell and the transparent reflector (4).

Work on the reflector continued slowly into the construction phase of the project and several times the problems that came up seemed insurmountable. During 1968 small mockups were made in Kahn's office. Reflector shapes at one-half inch equals one foot were heat-formed of thin Plexiglas sheets and lightly mirrored by the Kinney Vacuum Co. These were inserted in a wood model of a typical bay to observe the effect of the light. But the high estimated cost of bending glass to a precise curve, the unsolved problem of how to protect and care for the thin delicate layer of aluminum, and the code restrictions on glass suspended overhead, all appeared to hinder development.

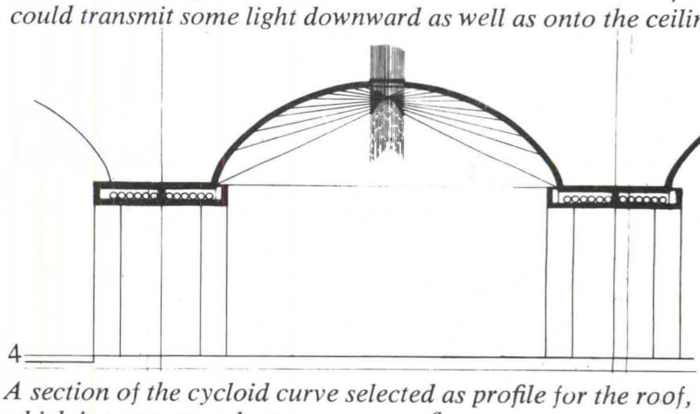
In 1968, Richard Kelly, the lighting consultant, was working with Kahn on the Phillips Exeter Library project and Kahn showed him the scheme for the Kimbell. Kelly liked the idea of the transparent reflector, saw the promise in it, and Kahn asked him to help. At our first meeting, Kelly suggested switching from glass to Plexiglas as the reflector material, and the Rohm & Haas Co. was called in for recommendations. But there were problems in supporting thin sheets of Plexiglas in curves other than a catenary. In early 1969, the Kimbell trustees increased pressure on everyone to begin construction as soon as possible because of rising costs, and it was decided to negotiate a construction contract with the Fort Worth firm of T. S. Byrne, Inc., and begin construction before final completion of the architect's construction drawings.

Kelly provided two necessary breakthroughs in February 1969. First, he proposed that the reflector be made of aluminum, the type used for electric light fixture reflectors, a highly specular sheet material chemically polished on one surface, and that this material be perforated to give the required degree of transparency. Second, he drew a freehand curve that experience told him would mirror the diffuse and scattered light of the open sky and reflect it onto the surface of the cycloid shell. Almost



3

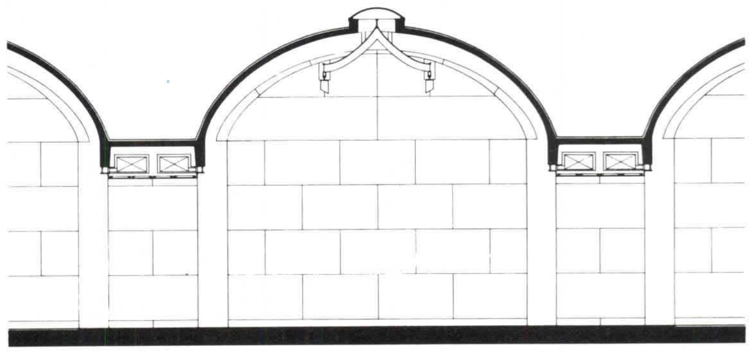
Meyer's initial effort to reduce the scale showed that the reflector could transmit some light downward as well as onto the ceiling.



4

A section of the cycloid curve selected as profile for the roof, which incorporates the transparent reflector.

Kimbell before and after the reflectors (left). Below, a section incorporating reflectors.

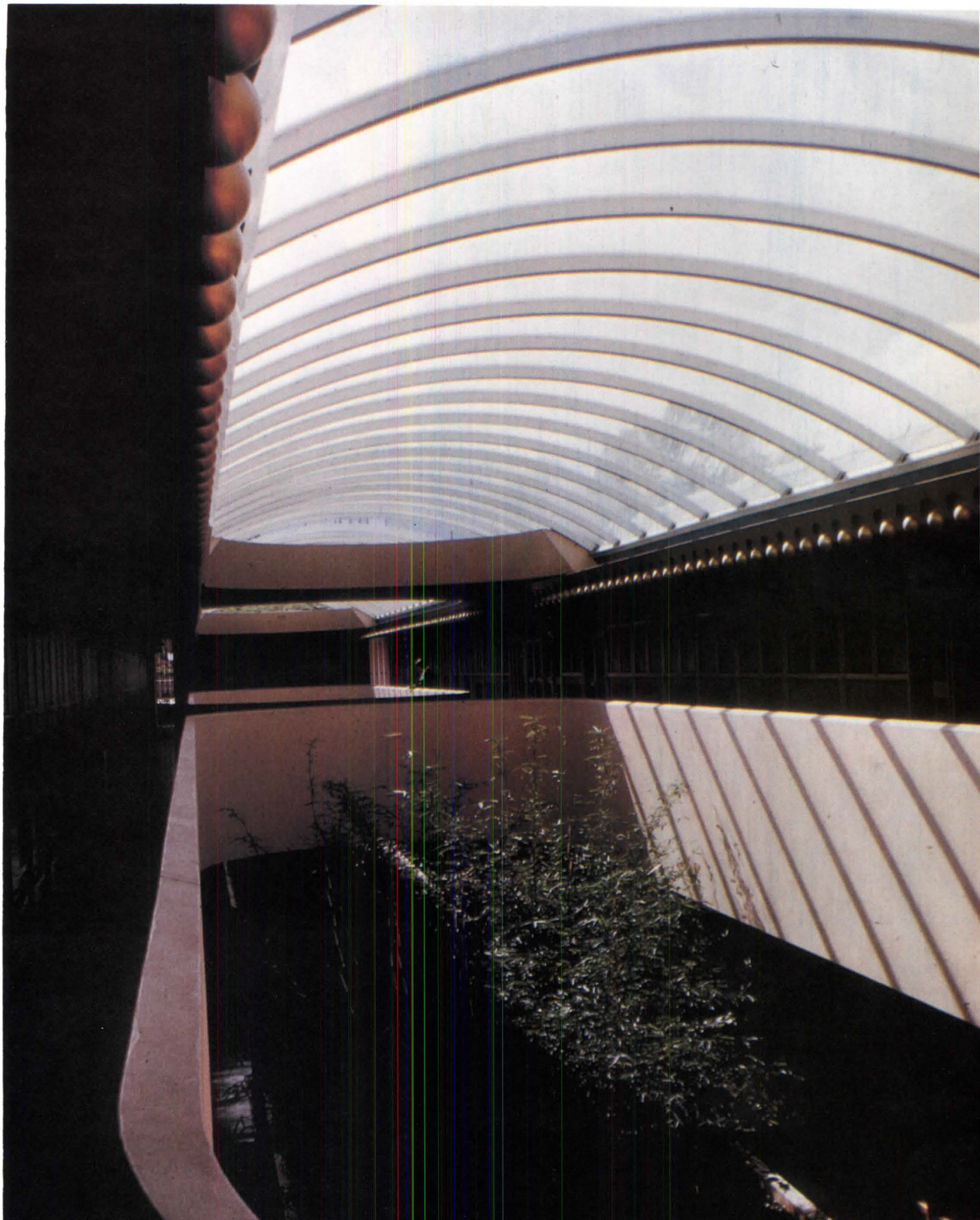


another year elapsed before Kelly enlisted the mathematical and engineering skills of Isaac Goodbar, an associate of Edison Price in New York City, to prepare and run a computer program which would give us precise coordinates for the reflector curve and footcandle readings of the reflected light to be expected along the cycloid.

The printout refined Kelly's very accurate assumption for the correct shape of the curve, but a final decision on the size and spacing of the perforations would have to wait another year and a half, until the middle of 1971, when the poured concrete structure at the site would be ready for full-size mockups. Kelly at first proposed a large hole for the perforations in the belief that this would prevent the accumulation of dust. When a sample of the reflector sheet punched to this specification and shaped to the correct curve was installed at the site, it was immediately obvious that the reflector returned the light to the ceiling as predicted. But the holes recommended by Kelly were too coarse. And worse, when the sun was at its zenith, the fully perforated reflector permitted too much sun to enter the gallery, injurious rays that would strike any south-facing exhibit wall for several minutes at noon in the completed building. The virtue of transparency was no virtue at all, in Richard Brown's mind, if the curators and staff had to be prevented from displaying sensitive works of art on walls with this orientation. A second mockup was tried with a sheet only sparsely perforated (like stars in a night sky) and almost no transparency, but this too was rejected. At this point, only a year away from the projected completion date, Kahn was ready to abandon the idea of a transparent reflector by eliminating the perforations entirely. Just when all seemed lost, a compromise solution came from Frank Sherwood in Preston Geren's office (associate architect) in Fort Worth.

Sherwood suggested making opaque only that part of the reflector directly beneath the two-foot, six-inch wide opening in the roof and leaving the remainder of the reflector perforated. This would stop the sun's penetration at noon, but it meant that the slice of sky to be seen through the reflector would be blocked. All that would remain of the original idea was a reduction in contrast where the edge of the perforated reflector could be seen against the ceiling. In the end what finally saved the idea was the realization that not all spaces in the building had the same restrictions as to direct sunlight. The public spaces, entry halls, auditorium, banquet area, bookstore area and library mezzanine could tolerate the fully perforated reflectors. Kahn and Brown quickly accepted, even welcomed, this variation which allowed for a subtle increase in light intensity in these spaces as well as the hoped for view of the sky above.

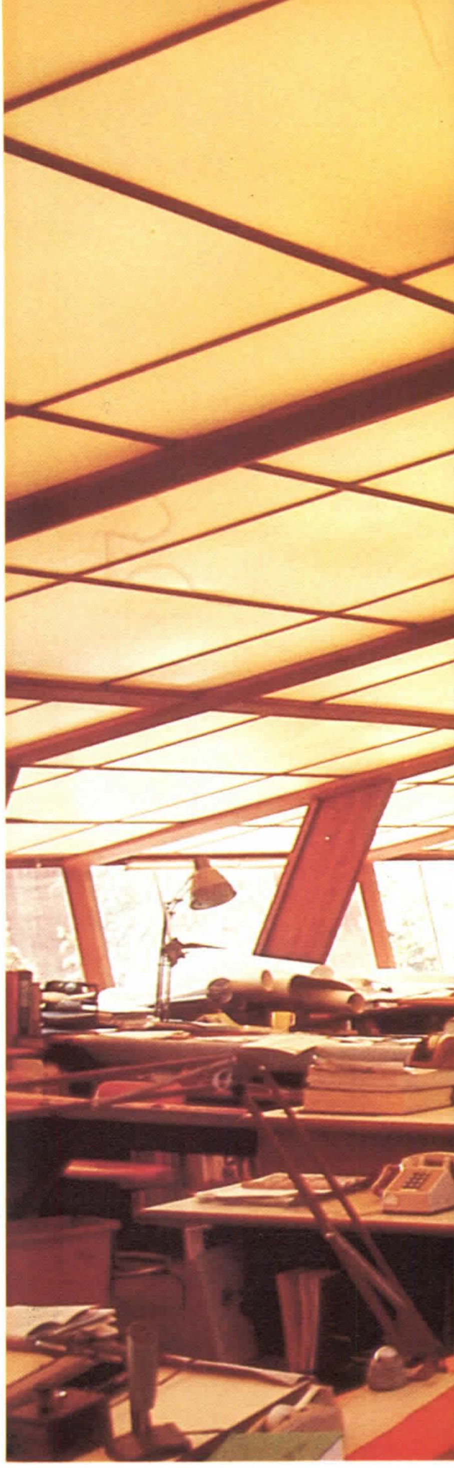
Another suggestion from the field, and an incredibly smart one, solved the last remaining problem: the size of the perforations. If the diameter of the holes was similar to the thickness of the metal and spaced closely, the reflector itself would be able to provide a 45-degree cut-off for certain angles of the sun's rays. The aluminum sheet was .040 inches thick, a function of curvature and span, and a .050-inch hole on 3/32-inch staggered centers was selected for the final mockup. Seen from below, the fineness and frequency of the perforations presented a diaphanous window to the sky and, as Kahn had predicted earlier, bathed the concrete cycloid in a translucent glow. As he had said: "This light will give a glow of silver to the room without touching the objects directly, yet give the comforting feeling of knowing the time of day." □



Courtesy The Frank Lloyd Wright Foundation

Masters of Light: Frank Lloyd Wright

A prophet of glass and a passionate advocate of sunlight. By Don DeNevi



Hedrich Blessing

"More and more, so it seems to me, light is the beautifier of the building."—Frank Lloyd Wright.

From his earliest designs on, Wright integrated light within the overall building concept, rejecting the hole-in-the-wall concept of the window. For example, virtually all of the Oak Park residences employ combinations of ribbon windows, electrostatically leaded stained glass panels, corner windows and often clerestories. Unity Temple, a massive, textured concrete structure designed with light, illustrates how the architect allowed daylight to pour through high walls and ceilings.

Almost entirely a skylight, Unity's main ceiling creates a great brightness, a "Unitarian feeling." Thus, the fenestration during Wright's early years was so developed as an integrated part of the architectural form both in terms of its interior and exterior that the changing patterns of light naturally became a part of each ensemble.

By 1910, Wright was already prophesying uses of glass which, although not applicable during his lifetime, one day would be, technology permitting. "With the advent of inexpensive glass as a modern material," claimed Wright, "the contemporary architect can employ thick, thin, colored and textured glass to delight and fascinate. Light diffused, light refracted, and light reflected will be used for their own sake, shadows aside. Shadows have always been the brush work of the traditional architect when he modeled his traditional architectural forms. But by humanizing the prism, a new experience awaits architecture. Lighting at last will become an integral part of the structure itself. No longer will appliances and appurtenances be needed."

Also important to each Wright structure was a very consciously designed relationship between artificial and natural lighting sources. Visible lighting fixtures were avoided as much as possible. Often, artificial light came from the same sources as natural light. Not only did most of the Oak Park homes contain such elements, but so did Wright's later buildings such as the V. C. Morris Shop in San Francisco and the Johnson Wax Company buildings in Racine, Wis.

Light control devices freely employed included broad roof overhangs and open trellises. The overhangs softened light, while open trellises served as transitions between interior lighting and

Mr. DeNevi is director of community services, Merritt College, Oakland, Calif., and teaches courses in psychology of creativity, imagination and genius. His dissertation for the University of California was on the educational philosophy of Wright.

Courtesy The Frank Lloyd Wright Foundation

Wright's Marin County administration building (page 63) has a linear mall with continuous arched skylights. At Unity Temple (left) light pours in from both the high ceiling and wall openings. In the drafting and living rooms at Taliesin West (above), broad roof overhangs and translucent fiber coverings for ceilings admit subdued, diffused sunlight.

the outdoors. Translucent coverings for ceilings and roofs further subdued and diffused light. Excellent examples of this are the drafting and living rooms at Taliesin West.

In other works, Wright ventured to sheathe buildings in translucent skins, such as the Beth Sholom Synagogue, an entire tower of translucent glass, and the Johnson Wax laboratory tower which was enclosed completely in shimmering translucent tubing.

Other lighting techniques highly developed by Wright include use of the grand interior open space, a concept which predates by half a century the current popularity of Hyatt hotel designs and other multistory buildings. The Larkin Building, with its skylighted inner court, and the Johnson Wax administration building, where apertures between the tall dendriform column capitals were filled with iridescent geometrical skylights of Pyrex glass tubings, are examples. In 1957, the design for the Marin County administration building and hall of justice developed a linear extension of the same concept, a "mall" lit with continuous arched skylights.

Perhaps the most striking examples of Wright's innovative concepts of light and structure are two designs never built. One is the 12-story central atrium hotel designed in 1946 for Rogers Lacy. The other is the design for the Huntington Hartford play resort, which was to have been a massive concrete tripod carrying three cantilevered glass enclosed clubrooms, capped by shallow glass domes. The domes were to have been constructed of stainless steel tube-rings and glass tubing. Within that design, everything would have contributed to a balanced space, an equilibrium of greater and lesser volumes.

For Wright, it was by sunlit spaces that the human spirit could be elevated to the highest order. He once said, "The more we desire the sun, the more we will desire the freedom of the good ground and the sooner we will learn to understand it. The more we value light, the more securely we will find and keep a worthwhile civilization to set against prevalent abuse and ruin. Because of light, the cave for human dwelling and work, for play and toil, is at last disappearing." □

The Sun's Rhythms as Generators of Form

A research project graphs the effects of light and gravity in three dimensions.

An investigation of the potential of the sun's daily and seasonal rhythms as the generator of form was initiated in 1962 by Ralph Knowles as part of a design research project supported by the Graham Foundation. The research was concerned with illustrating the force effects of natural phenomena, specifically sunlight and gravity, on form.

These forces are clearly reflected in the growth and patterns of nature. The sunny sides of slopes exhibit different plants and animals than shady slopes. Natural structures, such as sand dunes, reflect the forces of wind and gravity. Buildings are subject to the same natural forces that have caused differentiation in nature, but rarely acknowledge them in built form.

The research, which was conducted in a fifth-year design studio at Auburn University, had several phases. The first phase was concerned with graphing the impact of sunlight on form; the second with the impact of gravity, and the third with the combined forces of sunlight and gravity. The fourth phase sought to apply the concept of form differentiation to a simple program for an office building.

The geometric forms studied were a cube, an ellipse, a tetrahedron, a prism and a hyperboloid of revolution. While not actual building forms, their geometry provides an architectural idiom for analysis.

The rules of the experiment called for students to build models of selected geometric forms to serve as three-dimensional graphs. Then they were instructed to shield the surface from direct sunlight by devising a system of projecting planes that were geometrically consistent with the basic form. The students would then hold the number of planes constant, but vary their dimension to control the sunlight, which is a technique applicable to daylight design. A similar technique was used to model the impact of gravity.

The graphs have both static and dynamic components. The planes are themselves static, but the forces they respond to are dynamic. The sun produced asymmetrical, horizontally differentiated graphs for a 30-degree north latitude location. Gravity loads were applied to the surface of each form in such a way that they affected each point at the same elevation equally, which resulted in symmetrical, vertical differentiation.

Although there may be a hierarchy of force actions, buildings are rarely affected by a single force. Light and gravity were therefore combined into single graphs. Students were allowed to vary either the number or the dimension of the planes, or both. Longer or more numerous planes therefore indicate greater force effects. An ideal solution was a system of double-acting planes that would provide for both sun control and gravitational loads.

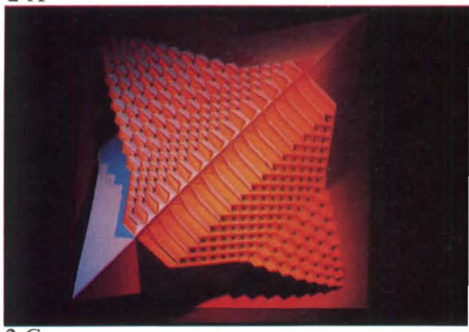
The final phase of the research sought to correlate the light and gravity studies with a highrise building problem. The program called for a concrete office building with public spaces on the top and street levels, and with smaller private spaces in between.

The implications of the work for architectural and urban design are now being rediscovered. The concept of a building as an ecological form that is differentiated in response to natural forces points to a new esthetic based on rhythm. Buildings that are undifferentiated pay an energy price and result in illegible environments that isolate people from natural clues to time, space and orientation.—*Marguerite Villecco*

1. Ellipse: (A) Plan view of light graph, with north up. Horizontal planes control sun at midday, but not sunrise or sunset. (B) View from southeast with equally spaced vertical planes which control sun at sunrise and sunset but not midday. (C) View from the southeast with both vertical and horizontal planes for all day control. (D) Gravity graph with north up.

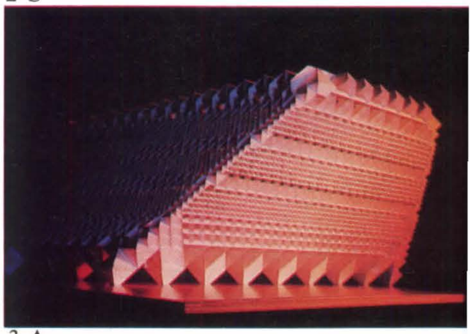
1-A

2-A

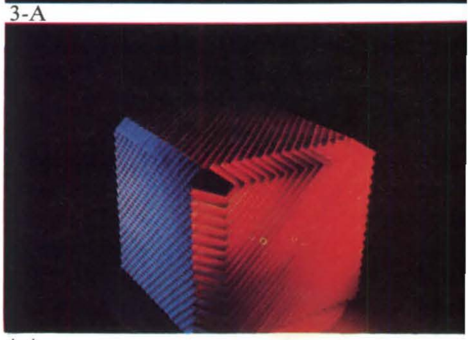


2-C

3. A building based on the gravity and light studies of the tetrahedron: (A) Looking at the southeast corner, with the south face upturned. Note the special character of the edge, where several ecological domains converge. (A structural system is used that allows changes in the thickness of material and strength, as well as changes in the planar dimension of the system.) (B) Looking southeast from the inside of the building. Each apparent floor is a 12-foot-deep truss that can support indiscriminant loading of three intervening floors by suspension. (C) Looking south from the inside of the building. The bearing wall system allows maximum control of sunlight and maximum lateral support and a deep spatial transition from the inside to the outside of the building. (D) The south elevation lighted from the inside.

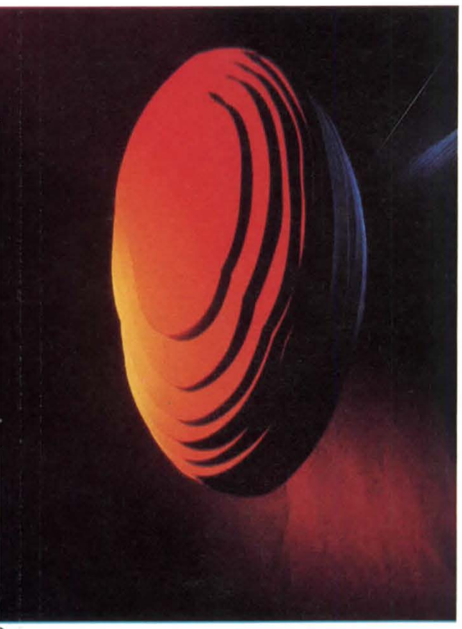


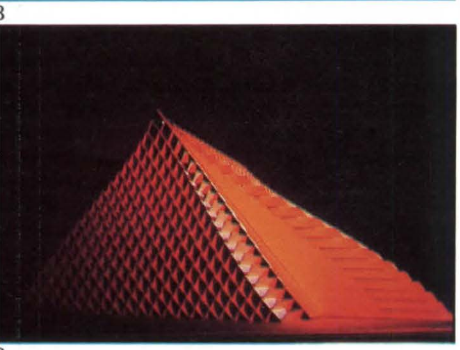
3-A

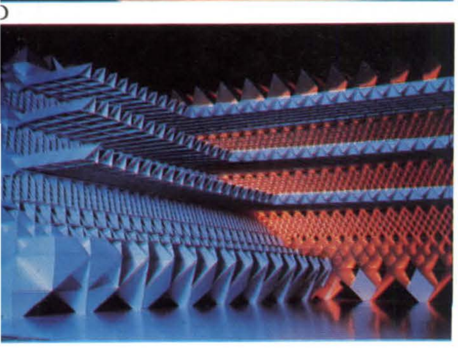


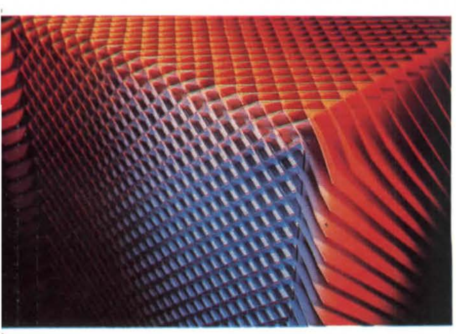
4-A

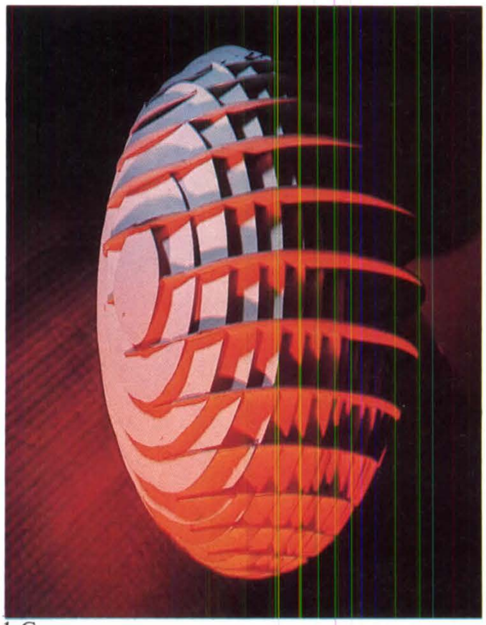
Photographs by Ralph Knowl





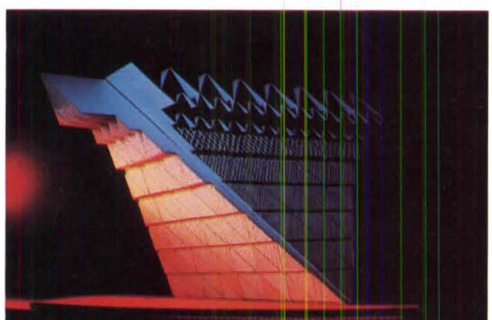




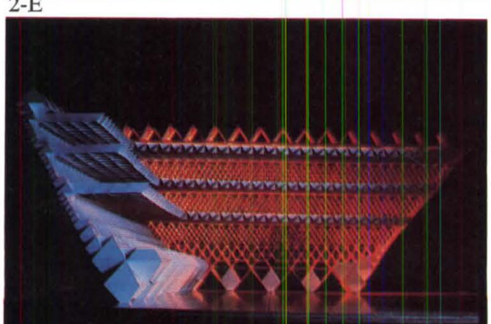


1-C

2. Tetrahedron: (A) Southeast view of light graph. Planes vary in spacing because they radiate from the vertices of the form. Because spacing varies, so must depth. (B) Gravity graph with the frequency of planes held constant and force increasing toward the bottom. The form is turned on its side, producing an asymmetrical shape so that gravity loads produce differentiation side to side as well as top to bottom. (C) Combined gravity-light graph viewed from the top with north to the upper right. The top edge divides the shallow northerly sun response from the deep southerly response, with gravity showing itself as a different vertical position on each side. The number of graphing elements is held constant. (D) The same gravity-light graph viewed from the northwest. (E) A gravity-light model produced by a different graphing technique in which the number of planes varies and dimensions change. Force effects increase toward the bottom. With the force held constant, the number of planes increases toward the bottom.

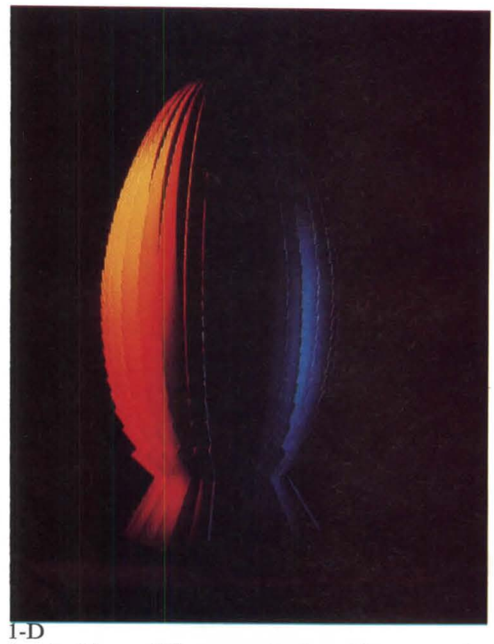


2-E



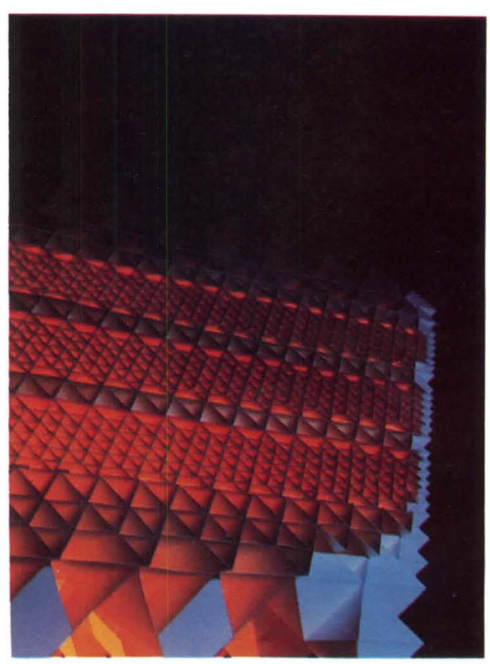
3-C

4. Cube: (A) A light graph, viewed from the southeast. The basic spacing of the planes is regular and undifferentiated, while their shapes and dimensions vary. (B) A detail of the northwest corner of the light graph, illustrating the corner as an ecological edge where several domains converge.



1-D

The researchers: Ralph Knowles is professor of architecture at the University of Southern California and winner of an AIA medal for research. He team taught the Auburn studio with William Turner. The illustrated models were made by students, here listed by geometric form: Ellipse: J. Bowden, J. Carrera, H. Hill, B. Knodel, L. Leeger and W. Richmond. Tetrahedron: R. Biggers, J. Coykendall, D. Eggar, B. Hagler, J. Regan and W. Savage. Cube: C. Boutwell, W. Brown, R. Freeman, G. Oldham, J. Smith and C. Snook.



3-D

Strategies of Daylight Design

By Marguerite Villecco with Steve Selkowitz and J. W. Griffith

Good daylight design does not simply mean large windows. It must be approached both quantitatively and qualitatively on broader and more sensitive design terms.

Daylighting seeks optimum amounts and areas of natural illumination for biological and task needs, which means good quantity and distribution of natural light. The impact of heating and cooling must be addressed and tradeoffs made appropriate to location and time.

Glare needs to be controlled to ensure that light will be comfortable and pleasant, as well as adequate in quantity. Appropriate surfaces need to be illuminated to dispel the perception of gloom.

Daylight is a dynamic phenomenon. The relationship to natural rhythms of the surroundings requires a dynamic design response, specific to time and place. Designers must learn to approach the design process with this dynamic in mind and understand that the building will be visually and functionally different according to day and season. Daylight is not something one adds to building design; it is implicit to every design decision.

Factors affecting daylight design include variations in the amount and source of daylight, caused by the position and intensity of sunlight. The luminance and luminance distribution of clear, partly cloudy and overcast skies must also be considered. The effects of local terrain, landscaping and nearby buildings and the glare and luminance patterns within view are important, as is the color of daylight as combined with other sources of light.

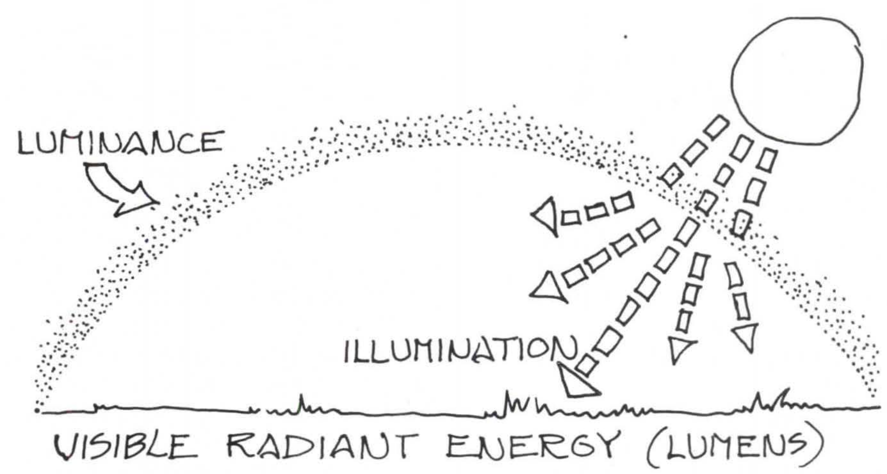
The design strategies used for admitting natural light into the building must be responsive to all of these factors. Natural light is a diffuse form of sunlight; daylight design must deal not only with direct solar radiation but with sky light and reflected light.

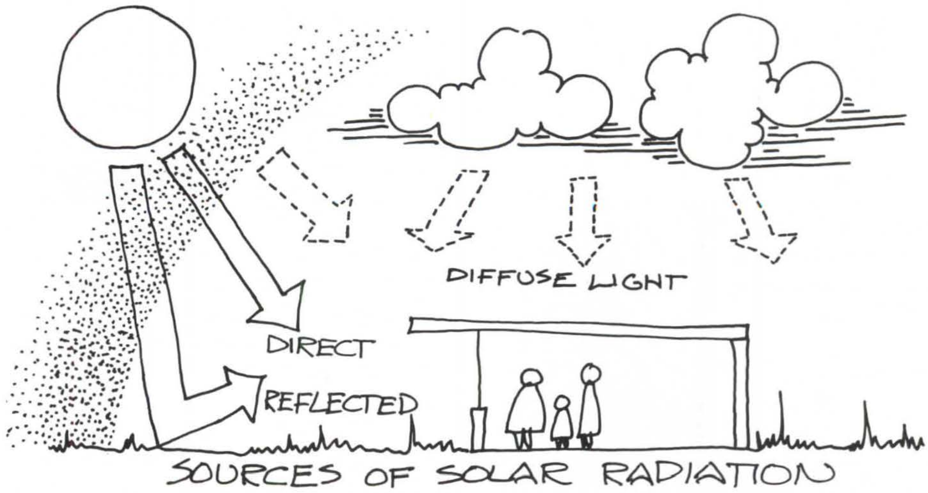
Compared to the sun, the sky has a large visual area and a relatively low luminance. The amount of daylight received from the sky depends on the position of the sun and on atmospheric conditions. For design evaluation, one or more of three conditions of incident light on the exterior vertical surface of the building are usually considered. The first is light from an overcast sky only; the second is light from a clear sky only, and the third is light from a clear sky plus direct sunlight.

According to the new Illuminating Engineering Society handbook on daylight design, the amount of light received from an overcast sky and the direction from which this light reaches the windows of a building depend on the luminance pattern of the sky. The luminance distribution of an overcast sky varies with the location, time, density and uniformity of the overcast. A uniformly overcast sky is normally 2.5 to 3 times as bright overhead as near the horizon. As a simplifying measure, a single luminance value representing the equivalent uniform sky luminance may be employed for design purposes.

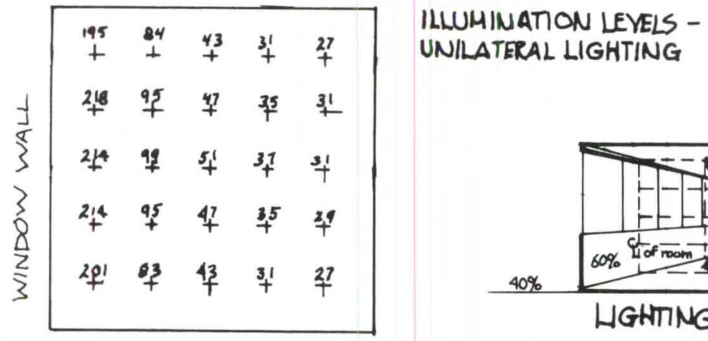
The sky luminance on clear days varies with the position of the sun and the amount of atmospheric dust or haze. Except in the immediate vicinity of the sun, the clear sky is normally brighter near the horizon than overhead. The concept of equivalent sky luminance mentioned above may also be used for clear skies. In daylight calculations for clear days, sky light only is included on non-sun exposures, while light from both sun and sky is included in calculations for sun exposures.

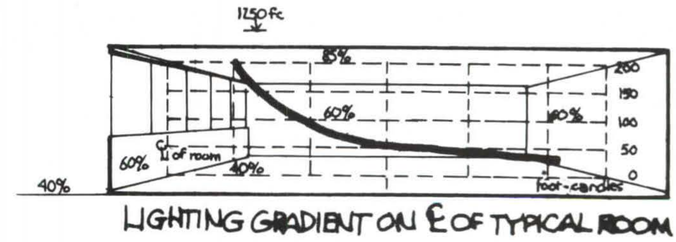
The illumination received on a horizontal surface from the clear sky alone is correlated with solar altitude. In the case of vertical or tilted surfaces, this illumination also varies with the orientation of the particular surface.

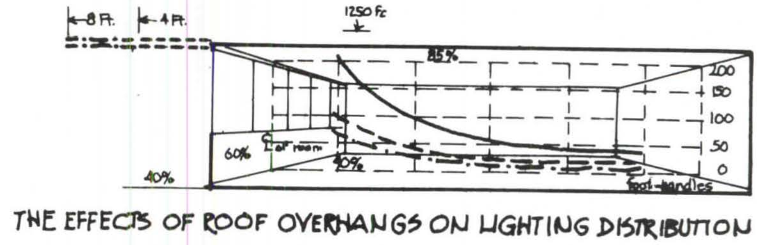


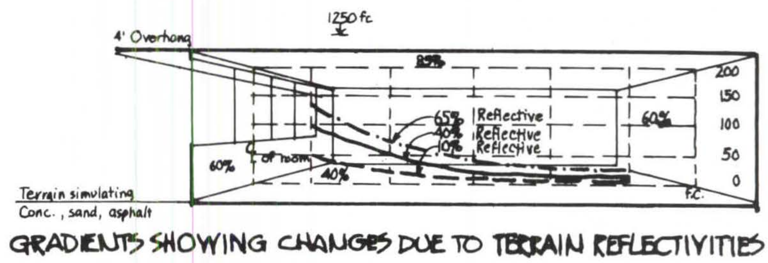


Mr. Selkowitz is with Lawrence Berkeley Laboratories and **Mr. Griffith** is former president and chairman of the daylight committee for the Illuminating Engineering Society. Material for this article also came from Harvey Bryan of LBL, lighting consultant William Lam and the new IES handbook, *Recommended Practice of Daylighting.*









Tests under artificial sky by Rice University

Sunlight reflected from the ground commonly represents 10 to 15 percent of the total daylight reaching a window area. Snow, light sandy soils or light vegetation may exceed these levels. On non-sun exposures, the light reflected from the ground may account for more than half of the total light reaching the windows.

Daylight is constantly variable, which may cause difficulties for the designer, but is a psychological amenity to people relying on it. The variations are somewhat predictable, in accord with changing weather conditions and the daily and seasonal rhythms of the sun. There is, however, a lack of information about daylight availability in the U.S. It is difficult to obtain information on whether the sky for a particular area is predominantly clear or overcast, or data about the fraction of the working hours in a year that one can expect minimum sky conditions to be exceeded. Data of this type exist for many European cities, but for only a few cities here.

Measurements that were made some time ago in Washington, D.C., and other urban areas are now suspect due to atmospheric changes resulting from air pollution and other climatic variables. Rather than wait several years before such data can be collected, it may be feasible to generate daylighting availability data from the solar radiation data now being collected throughout the U.S. Efforts to test the validity of such techniques are now in progress.

Daylight design requires sensitivity beyond that provided by simple rules of thumb. The thermal illumination tradeoffs and the qualitative, as well as quantitative, issues cannot be grossly simplified. A starting point, nonetheless, is to note that for pure daylighting purposes, the bigger the window opening, the better. The higher in the wall and the higher the ceiling, the better the design. If glass must be limited for thermal or comfort reasons, take it off the bottom for visual task performance and off the top for ambient purposes, where ground reflections can be useful. Openings are better horizontal than vertical because vertical openings set up strong patterns of light and dark contrasts. A predominant north/south orientation is useful because it lends itself to seasonal, or fixed, controls. Separation of view glass from daylight sources may help in making thermal and illumination design tradeoffs.

The most familiar approach to daylight design is sidelighting. Typically, this uses diffuse radiation only. Direct solar gain, although occasionally pleasant, typically leads to visual and thermal discomfort, although it may be integrated into a passive solar heating design approach.

Daylighting levels from windows in one wall of a room fall off rapidly as we move deeper into the room, from the window wall. A typical practical limit for daylight penetration into an office is 15 to 20 feet from the window wall. Design approaches based on sidelighting approaches were well developed in the 1940s and 1950s and the basic strategies for unilateral, bilateral and trilateral daylighting designs have remained unchanged.

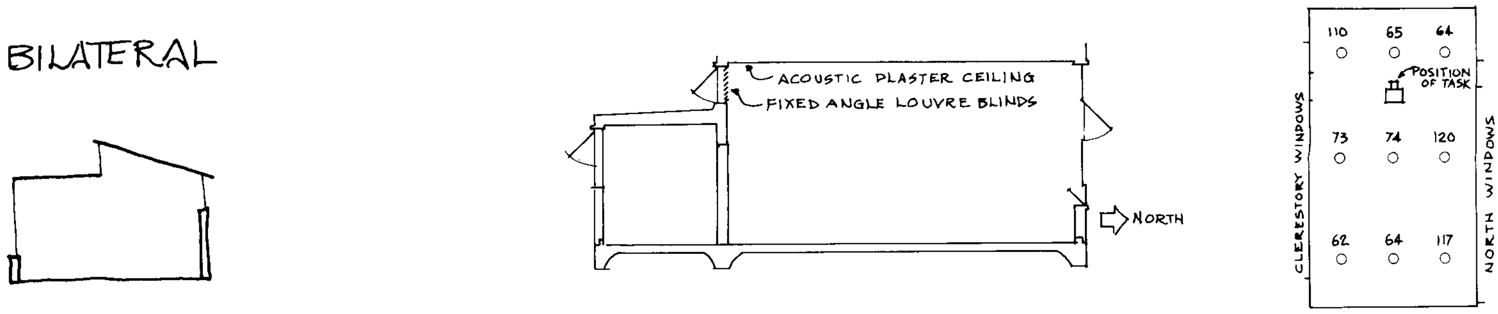
The above sections illustrate classic unilateral daylighting schemes. They represent sections that were tested under the artificial sky at Rice University during the mid-1960s. The rooms were typical unilateral designs, 30x30 feet and with 8-foot-high ceilings. Windows went from a sill height of 3 feet up to the ceiling; reflectances were 85 percent for the ceiling; 60 percent for the walls; 40 percent for the floor; 40 percent for the terrain. Test stations were located 30 inches above the floor, or at about desk height.

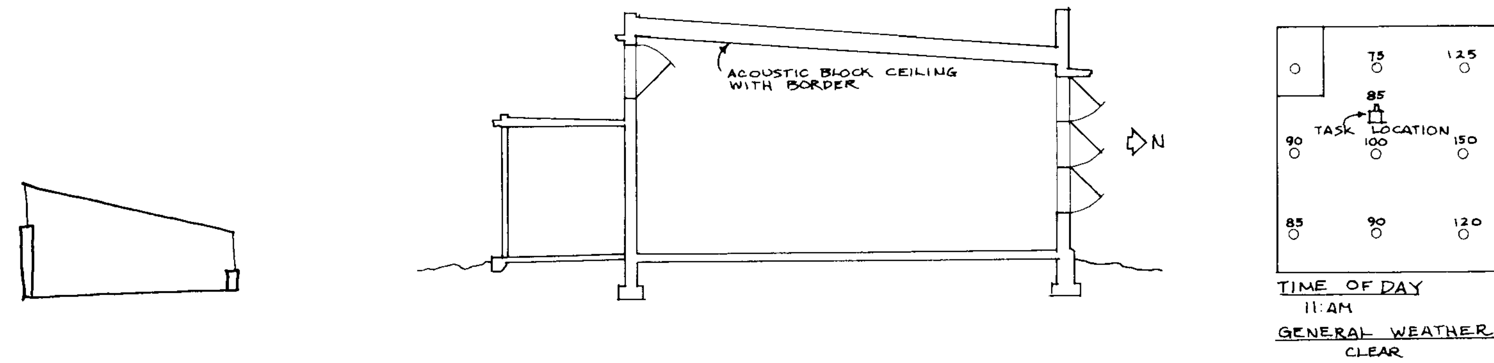
Lighting intensities decrease from a high at the center of the window space to approximately one-fourth intensity at the center of the room and one-sixth intensity at the center of the back wall. The researchers concluded that unilateral lighting must be balanced or reinforced by additional daylight or artificial light to achieve reasonable uniformity for tasks located away from the windows.

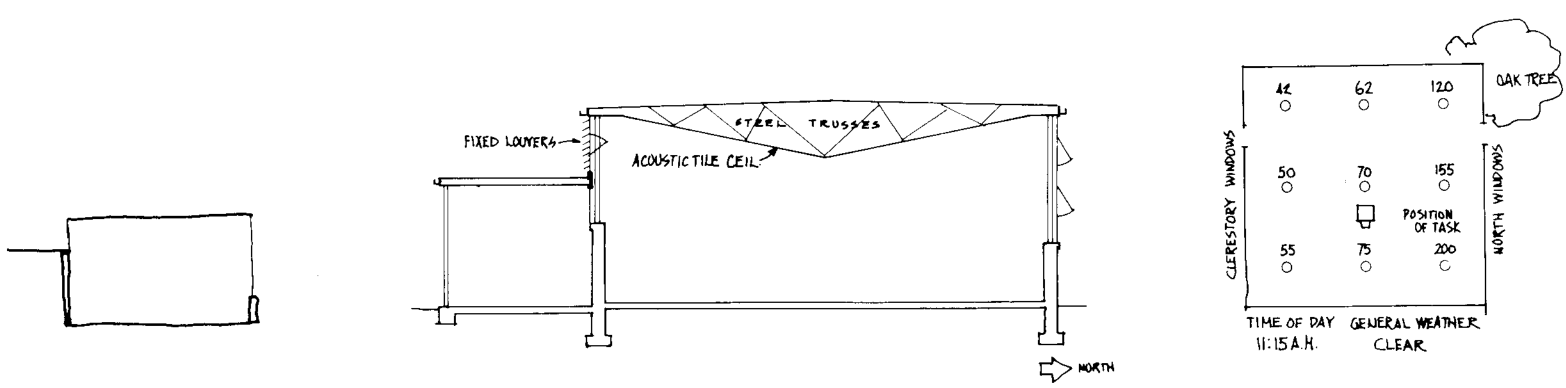
The Rice researchers also tested a unilateral section with a succession of overhangs, from 4 feet to 8 feet. From a lighting standpoint, the rooms begin at the edge of the overhang and the location of the window wall merely defines the usable portion of the space below the roof. The lighting at the windows decreased substantially as the overhangs increased; lighting at the center and rear of the space was less affected. The uniformity of distribution was improved.

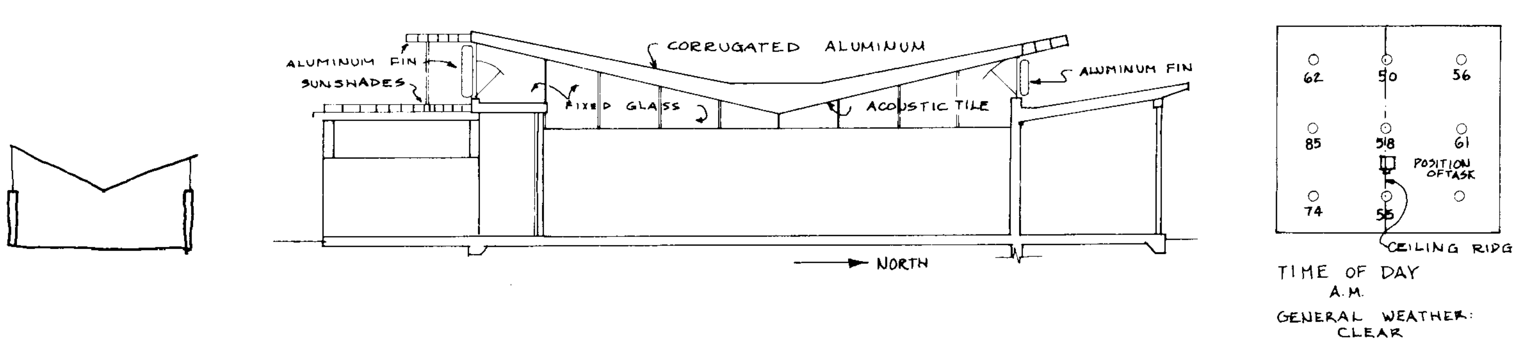
The California schools designed in the 1940s and 1950s to use daylight are a good reference for classic bilateral daylight design. Effective sidelighting produces less veiling reflection, improved contrast, and thus greater visibility than equivalent foot-candles from most overhead systems. The schools are particularly useful because a survey of their performance was made in 1948, which allows us to relate the design concept to information about their actual daylight performance. The following pages show generic diagrams of classic multilateral daylight building sections, examples of those sections as used in the schools and readings of light levels on their interiors.

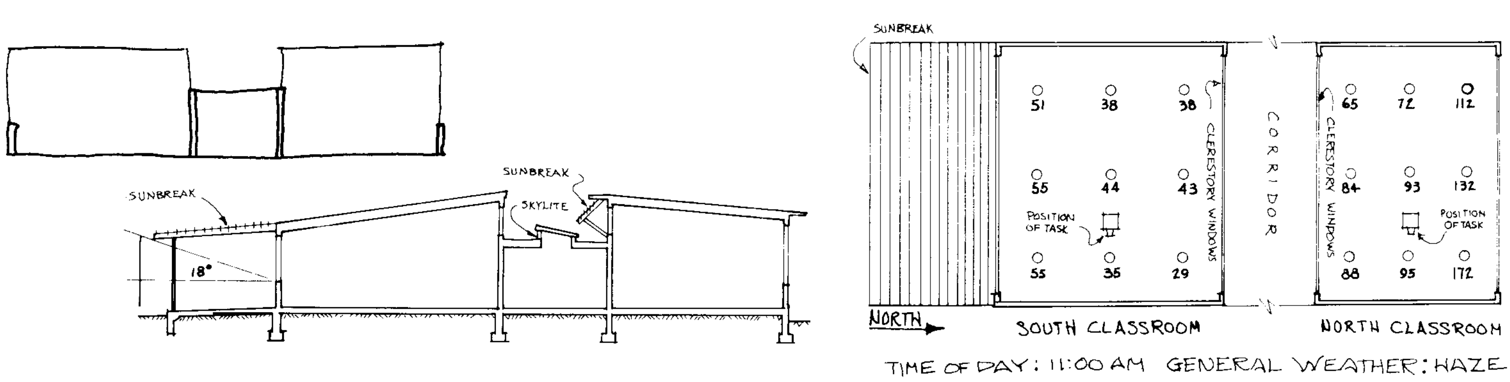
BILATERAL

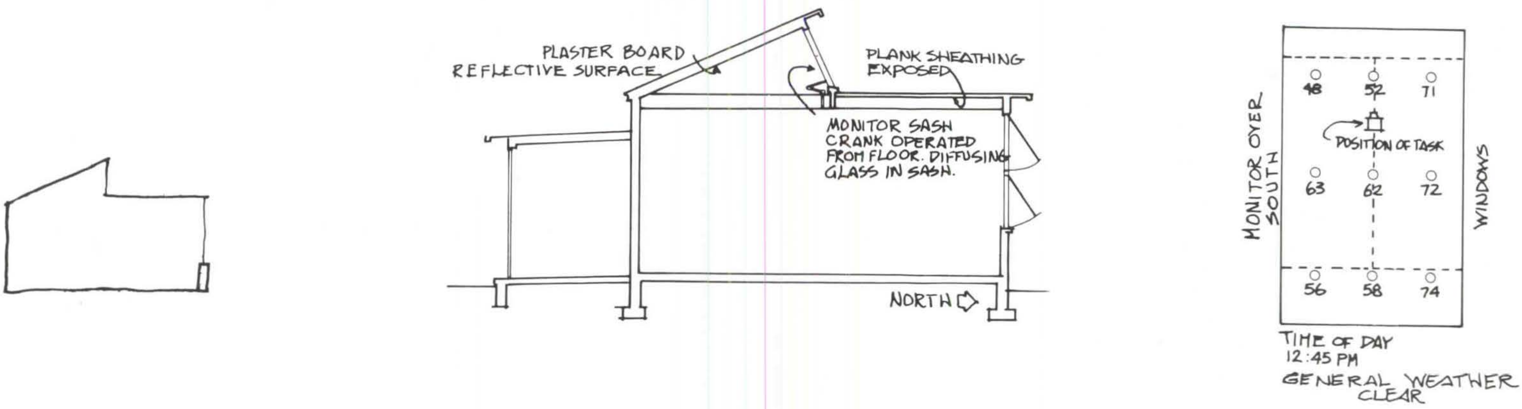

ACOUSTIC PLASTER CEILING
FIXED ANGLE LOUVRE BLINDS
NORTH
110 65 64
POSITION OF TASK
CLERESTORY WINDOWS
73 74 120
NORTH WINDOWS
62 64 117

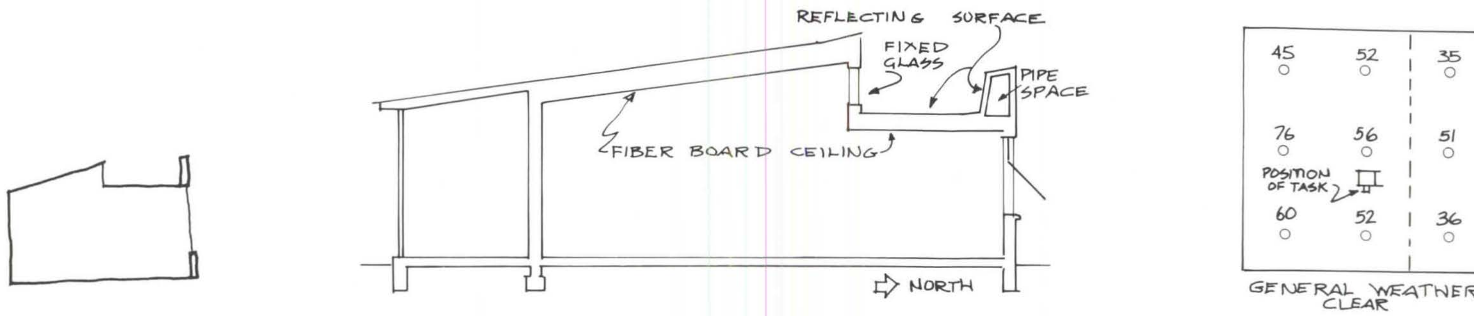

ACOUSTIC BLOCK CEILING WITH BORDER
N
75 125
85
TASK LOCATION
90 100 150
NORTH WINDOWS
85 90 120
TIME OF DAY
11:AM
GENERAL WEATHER
CLEAR


FIXED LOUVERS
STEEL TRUSSES
ACOUSTIC TILE CEIL.
NORTH
OAK TREE
42 62 120
CLERESTORY WINDOWS
50 70 155
POSITION OF TASK
NORTH WINDOWS
55 75 200
TIME OF DAY
11:15 A.M.
GENERAL WEATHER
CLEAR

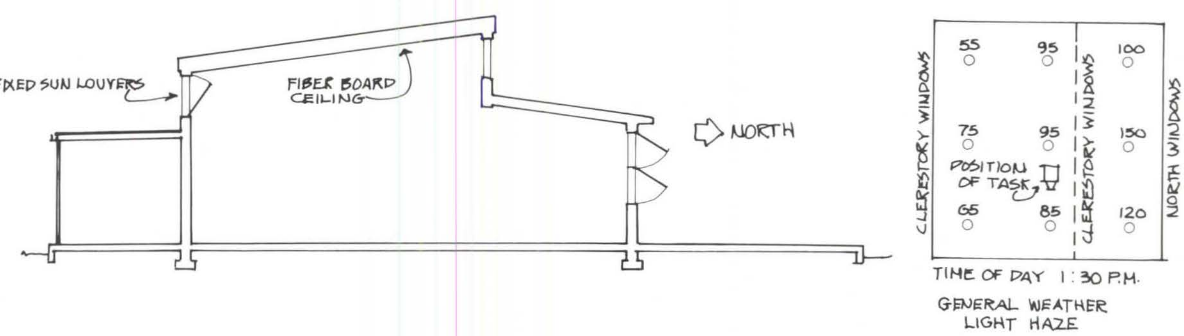

ALUMINUM FIN
SUNSHADES
CORRUGATED ALUMINUM
FIXED GLASS
ACOUSTIC TILE
ALUMINUM FIN
NORTH
62 50 56
85 58 61
POSITION OF TASK
74 55
CEILING RIDGE
TIME OF DAY
A.M.
GENERAL WEATHER:
CLEAR

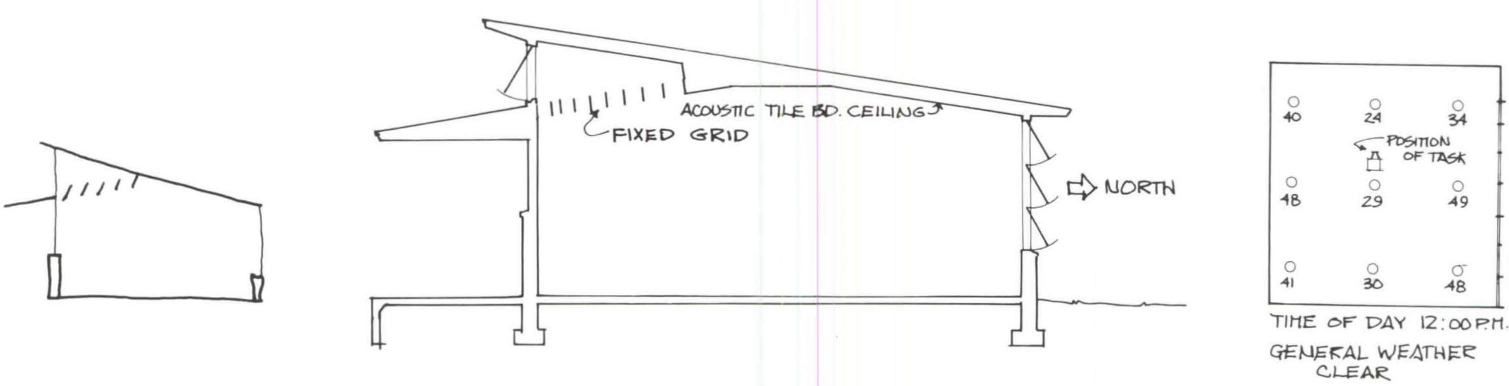

SUNBREAK
SUNBREAK
SKYLITE
18°
SUNBREAK
51 38 38
CLERESTORY WINDOWS
55 44 43
POSITION OF TASK
55 35 29
CORRIDOR
65 72 112
CLERESTORY WINDOWS
84 93 132
POSITION OF TASK
88 95 172
NORTH
SOUTH CLASSROOM
NORTH CLASSROOM
TIME OF DAY: 11:00 AM GENERAL WEATHER: HAZE

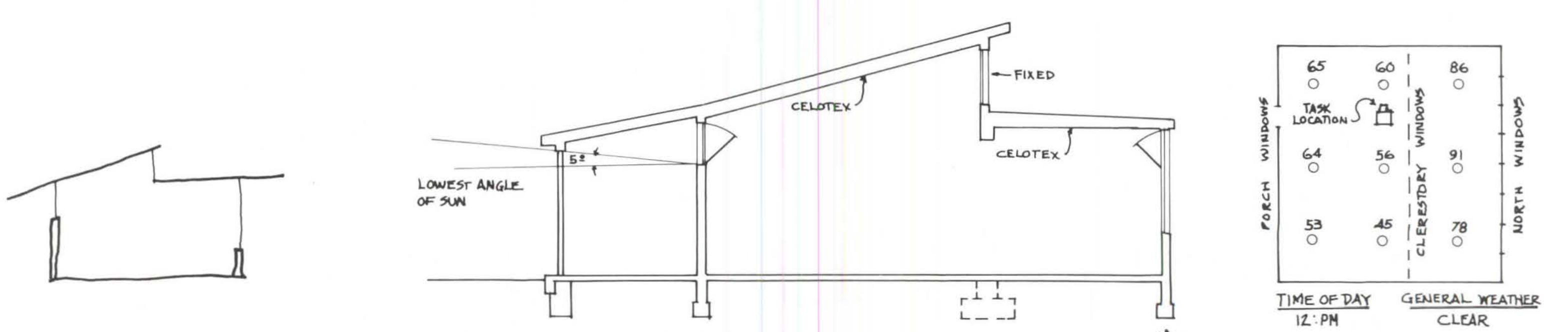

PLASTER BOARD
REFLECTIVE SURFACE
PLANK SHEATHING
EXPOSED
MONITOR SASH
CRANK OPERATED
FROM FLOOR. DIFFUSING
GLASS IN SASH.
NORTH
MONITOR OVER
SOUTH
WINDOWS
48
52
71
POSITION OF TASK
63
62
72
56
58
74
TIME OF DAY
12:45 PM
GENERAL WEATHER
CLEAR


REFLECTING SURFACE
FIXED
GLASS
PIPE
SPACE
FIBER BOARD CEILING
NORTH
45
52
35
76
56
51
POSITION
OF TASK
60
52
36
GENERAL WEATHER
CLEAR

TRILATERAL


FIXED SUN LOUVERS
FIBER BOARD
CEILING
NORTH
CLERESTORY WINDOWS
CLERESTORY WINDOWS
NORTH WINDOWS
55
95
100
75
95
150
POSITION
OF TASK
65
85
120
TIME OF DAY 1:30 P.M.
GENERAL WEATHER
LIGHT HAZE


ACOUSTIC TILE BD. CEILING
FIXED GRID
NORTH
40
24
34
POSITION
OF TASK
48
29
49
41
30
48
NORTH WINDOWS
TIME OF DAY 12:00 P.M.
GENERAL WEATHER
CLEAR


FIXED
CELOTEX
CELOTEX
5°
LOWEST ANGLE
OF SUN
PORCH WINDOWS
CLERESTORY WINDOWS
NORTH WINDOWS
65
60
86
TASK
LOCATION
64
56
91
53
45
78
TIME OF DAY
12:PM
GENERAL WEATHER
CLEAR

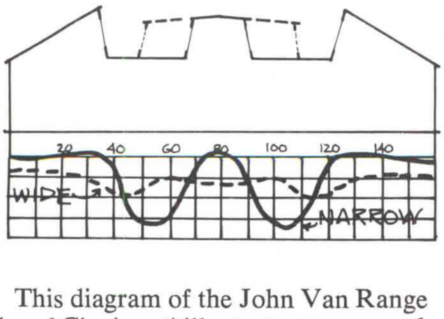
Some techniques for increasing daylight penetration, which either allow a wider building section or a greater percentage of daylight reliance, are being closely examined today. The most discussed strategy is beam daylighting, of which the Tennessee Valley Authority building (see page 86) is an example, using mirror reflectors and solar courts in its design.

One version of beam daylighting involves reflecting the direct rays of the sun from silvered reflective Venetian blinds mounted in the upper 2 feet of a window. The reflected rays are aimed toward the ceiling of the room to a maximum depth of 30 to 40 feet. The ceiling then acts as a diffuse reflector providing normal diffuse illumination deep inside the room. Although the light quality achieved by such a scheme is satisfactory, the control of reflected light as sun angles change is not a trivial problem.

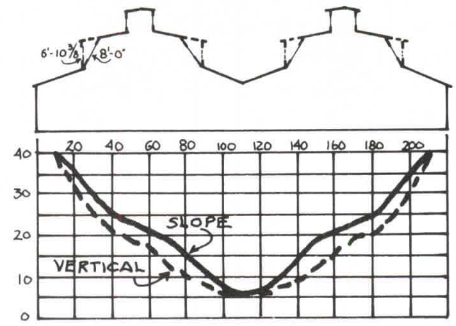
A variety of controllable reflecting or refractor-type devices has been examined, but the real issue is achieving simplicity and low cost in these devices without sacrificing performance. In addition, more sophisticated lighting controls are required for partly cloudy sky conditions where the illumination levels will vary greatly and quickly. Beam sunlighting appears to have limited application to existing buildings because of window and ceiling design characteristics, but the concept offers promise for new buildings designed specifically for it.

Toplighting is another important daylight design strategy, promising more uniform light for general illumination, although less appropriate light for tasks. Historically, skylights have been designed to exclude the direct sun (sawtooth and skylights with overhangs are examples).

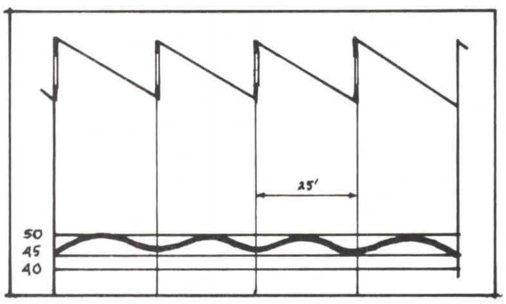
Large spaces, such as factories and warehouses, lend themselves to variants of conventional sidelighting and toplighting designs, such as the roof monitors and sawtooth clerestory illustrated here. More recently, translucent roofs provide substantial access to daylight, although control becomes difficult. An analysis of some industrial applications was published by Detroit Steel Products Co. in 1929.



This diagram of the John Van Range Co. of Cincinnati illustrates a narrow sky monitor that produced nonuniform daylighting levels that could be improved by widening the monitor.



This diagram of the Bethlehem Steel Co. compared the daylight performance of vertical versus sloped clerestories. An increase in monitor height increased performance, although the researchers concluded that 8-feet-high sloping windows admitted no more light than vertical windows 6 feet, 10 inches high, as dirt accumulated over a six-month period.



The most successful example of natural lighting in this study was a General Electric plant, 340 feet long with a sawtooth span of 25 feet. This design gained high illumination and uniformity.

Most modern skylights lie flat in the roof plane and thus accept both direct and diffuse radiation. Domed or peaked skylights provide a larger window to the sky and thus more daylight. All skylights raise the issue of heat along with light, and various controls by orientation or insulation may be needed.

Conventional skylights are limited to providing daylight in one-story or multiatrium spaces, but several concepts recently have been explored that use direct sunlight through a roof aperture and then distribute that light through the building by using mirrors, lenses and other optical controls. Such schemes are feasible, but their optical performance requirements and complexity limit their practicality for most building applications.

Orientation is a significant factor in skylight design. Several recent strategies have sought dynamic adaptation to heating and cooling conditions by developing movable insulation systems within a skylight. A north-facing skylight accepts light, but does not produce solar heat gain; a south-facing skylight admits both heat and light. Movable insulation can allow the designer to take advantage of both at appropriate times.

Controls

A guide to various devices for limiting, distributing and diffusing light in buildings.

Control is a key element in daylight design, in terms of both direct solar radiation and sky brightness and to ensure a desired quality, as well as quantity, of light. The quantity of daylight illumination in a space is a function of the amount of daylight available, the site, the fenestration and the room. The critical elements in daylight availability are the time of day, season, cloud cover, microclimate and air pollution. The site must be considered in terms of orientation, latitude, landscape and obstructions. Fenestration concerns include sun control, the framing and wall system, the sash, transmission characteristics, maintenance, wall location and size. The geometry of the space, plus its surface reflectance, maintenance, furniture and task location, are also critical.

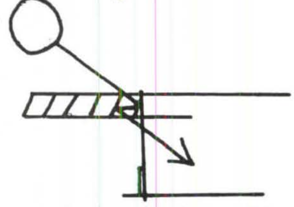
More light does not necessarily mean better light. The qualitative aspects of daylight and the tradeoffs between illumination and thermal design objectives must be considered.

There are three basic reasons to include daylight controls in any design strategy: to eliminate excessive illumination on interior surfaces, to eliminate high sky brightness or direct radiation and to redistribute sunlight by diffusing it.

Orientation is critical. Even on the north facade, a clear glass window may see 5,000 footlamberts on a cloudy day; glare control is necessary. Controls on the south, east and west are, of course, more critical because these elevations are exposed to direct radiation, which poses not only issues of illumination control but of thermal control. Ways must be found to respond to the rhythms of the sun, rejecting heat when unwanted and admitting it when desired. In general, control is the essence of design. A discussion of typical control strategies follows:

Fixed exterior controls are used to limit excess sun or skylight. Overhangs eliminate the impact of direct sunlight and heat on glass during specified times of the year. Designs may be flat or sloping; sloping versions may be of shorter length, but obstruct more of the sky view. They may be translucent or opaque. Translucent overhangs have the advantage of providing weather control and the transmission advantages of louvers.

Exterior louvered overhangs allow the reflected sunlight to illuminate the visible surface of the control to the room. If the louvers are not opaque, they allow better utilization of the sunlight and skylight in the room and also allow the dissipation of heat. Disadvantages are that louvers allow rain through them and cannot be used along narrow exterior corridors.



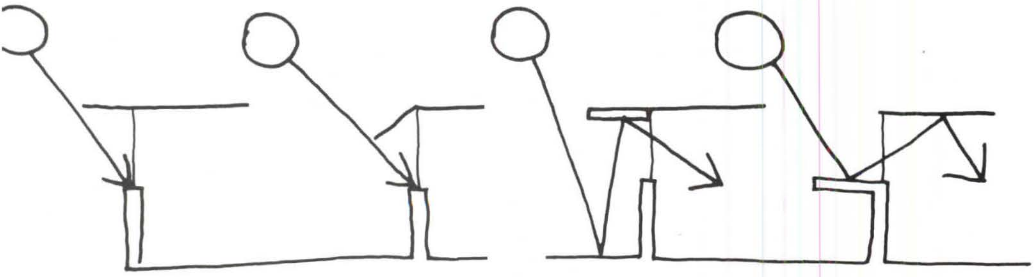
Exterior vertical or horizontal louvers are a variation that may be useful; the vertical louvers lend themselves to controlling sun on the east and west facades of a building; the horizontal louvers are most effective on the south side. Vertical louvers may also be used to control sky brightness on the north.

A diminutive louver can be applied to a window and not greatly obstruct the view; if the slats are fine enough, the eye will maintain clear vision by putting the image together as it does in pointillist paintings or with pictures screened for publication. Even a very small louver will shield the sun at critical times but allow a clear view if put across a vision strip. In Europe, rolling diminutive louvers are available.

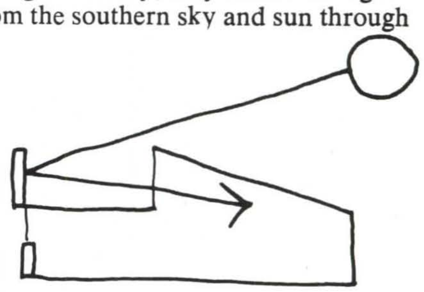
Other exterior fixed controls include screens, trellises and shrubbery. Trellises, in particular, have been used architecturally to control light, although the design must be carefully considered.

Fixed exterior amplifying controls enhance the impact of sun and skylight rather than diminish it. These include surfaces that either diffuse or reflect the light. For instance, white stones and concrete diffuse light; aluminum and mirror surfaces redirect it.

Overhangs with reflective surfaces underneath transmit maximum ground reflections. The surface may be painted white or may be of concrete. Light shelves are overhangs located below the window to reflect light up toward the ceiling inside.



Parapet walls are another variation. These are effective in combination with a north-facing clerestory; they reflect the light from the southern sky and sun through



the clerestory and onto the ceiling. Louvered overhangs can be designed as a control to both limit solar radiation from direct penetration into a space and to amplify its effects by reflecting it into the interior of the building.

Variable exterior controls offer the greatest control potential by responding to changes in day and season. Such controls include window awnings or awnings attached to the edge of a fixed overhang. Louvers adjustable for tilt may also be used. On the east and west facades they may be drawn to the side; on the south side, they may be raised and lowered according to the time of day and season. Tracking mirrors, such as those on the new building for the Tennessee Valley Authority (see page 86), are the most sophisticated systems. They required dynamic control to either track or adjust incrementally to the apparent movement of the sun and to changing sky conditions. The cost of such systems must be considered in the context of the overall building performance and according to life cycle cost/benefit analysis.

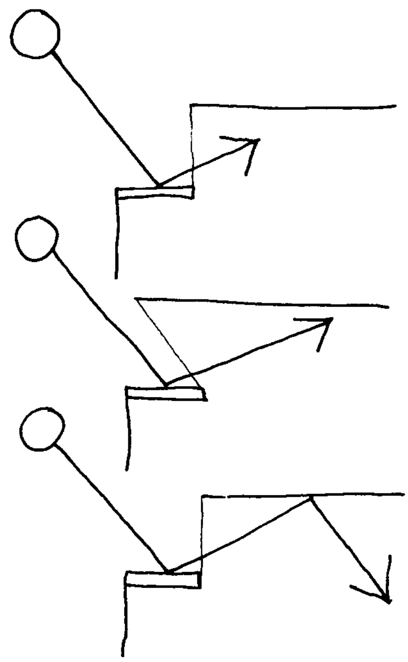
Interior fixed controls include diffusers, such as translucent materials, to soften and diffuse sunlight. The material may be part of a shade device or may hang loosely between the natural light source and the space. Louvers, installed inside a window or between panes of glass, may be adjustable or fixed. They are generally less effective than exterior controls because they let more heat into the building. The louver concept may also be applied to an egg crate louver installed beneath a skylight.

Prisms are another daylight control strategy. Prismatic glass block was used in the 1940s and 1950s. The prisms on the inside of the glass block were designed to accept sunlight and to redirect it upward onto the ceiling of an interior space as diffuse light. The glass block has not been used recently because the interior surface gets very hot. A prismatic version of insulating glass has been experimentally developed but not commercially produced because it is too costly. Research may yield breakthroughs in this field.

Reflective glass and tinted glass control daylight, but currently cannot respond dynamically. Diffusing glass, or milky patterned glass, has the same problem. These materials keep the sunlight out when the heat and glare are excessive, but they do the same when the heat or light may be desirable and result in generally lower daylight levels.

Variable interior controls include some of the simplest daylight devices, although they rarely are the most effective. Shades and draperies that diffuse the light or opaque versions that can be opened or closed to admit or reject heat and light are the most familiar. Variable horizontal or vertical louvers (Venetian blinds) can be adjusted for tilt and/or removed in response to natural light conditions. They may be installed inside a window or between its panes of glass. Reflective-coated shades or blinds can be used to reject unwanted heat and light. A variation has a black side to absorb heat in cold weather and a reflective side to redirect it in summer. Properly adjusted louvers can be used to amplify the effects of daylight by reflecting and redirecting it. Research in this area promises new developments soon. Multiple shades and draperies may also be installed and manipulated to diffuse light under one condition and to reject it under others. A familiar example is the sheer curtain as light diffuser with a heavy fabric drapery to draw over it to keep heat and light in or out of the space.

Fixed interior amplifiers, or light shelves, may be installed to take advantage of reflected light from below the horizontal or to reflect sunlight or sky bright-



ness. The shelves operate similarly to exterior overhangs and may have either diffuse or specular reflective surfaces, although the specular surface can result in bright spots. Light colored floors, ceilings, draperies, blinds and furniture also amplify interior light.

The issue of manual versus automatic solar and glare controls is part of the design tradeoff. It seems likely that office occupants will close shades and blinds to reduce excessive heat gain or glare for thermal or visual comfort. It is not clear, however, that they will operate these devices to save energy. The blind that is closed in the afternoon to prevent glare may not be reopened to admit daylight the next morning, unless people are made aware of the daylight as a design strategy.

A side effect of the energy problems in this country is that people are becoming more aware of and concerned with the natural cycles of day and season. Recent work at the National Bureau of Standards with employees indicates that people will manage Venetian blinds in a way that distinguishes orientations and season. There is also evidence that an individual will exercise control of a private space, but that a large space with many people diffuses a sense of individual responsibility and may not be as well managed. These are issues that need further attention as efforts to involve people in their own environment become more desirable.

If interior and exterior shading devices are used to control excessive sun and glare, the question of glazing properties becomes important. Workers in a typical office have a view of the horizon or the sky in the immediate vicinity of the horizon. With standard overcast skies, the horizon is three times darker than the sky overhead. In clear sky conditions, however, the luminance distribution is inverted and the horizon is brighter than the overhead sky. In urban areas, haze and air pollution can produce additional scattering of the light and additional glare. Because sky luminance at the horizon may be 500 to 3,000 footlamberts versus 25 to 75 footlamberts for a typical office, severe discomfort glare problems may result.

Some degree of light control in glazing is probably desirable, but it is unlikely that transmissions of less than 50 percent would be desirable for daylighting. Heat absorbing and reflecting glass may also be desirable for such situations as sunlight reflected by water or from adjacent landscaping or buildings.

The development of sophisticated glazing materials, with heat absorbing and reflecting properties, is a relatively recent innovation.

We can reasonably expect additional improvements in the thermal and solar optical properties of glass to satisfy new performance criteria. One research program supported by the Department of Energy (DOE) is an effort to develop selective transmittance solar control coatings for windows. Approximately 50 percent of the incident solar energy at a window is visible light; the rest is invisible solar infrared radiation.

A selective transmitting window will allow the visible light to pass through it into the room but reflect the solar infrared portion back to the outside environment. Coatings of this type might have light transmission values of 60 to 80 percent, with shading coefficients as low as .3 or .4.

Although the concept is not new, such products are not available to designers today; DOE is seeking to speed their delivery. Some of these materials are selective by absorption, such as blue/green glass, but the shading coefficients are not as low as reflective coatings and some heat gets into the buildings. Selective reflective coatings are available in Europe, but are still having cost and technical delays here.

A more speculative approach to solar glazing control involves coatings that cause glass to act as an optical shutter, admitting light when desired and rejecting it when not desired. The concept here is to take window management down to an atomic or molecular level. Similar types of coatings exist today in the form of liquid crystal watch displays, which switch from transparent to reflective. It also may be seen in the phototropic sunglasses that change optical density in response to changing ambient light levels. There are still severe problems in making such glass economical and durable, but the dynamic nature makes the concept very attractive.

Integration

Some of the implications of daylight for artificial lighting and energy conservation.

Daylight can provide good visibility and amenity for indoor environments, but it will not reduce energy consumption unless people turn off the installed artificial lights. Daylight design may result in lower levels of installed lighting, but its greatest energy contribution is that it allows people to turn off the lights. This may sound obvious, but many of the buildings cited for good daylight design are operated as though daylight did not exist. This is partially the result of inappropriate control systems and lack of user awareness.

Efficient lighting controls can save energy even without daylight. Lighting systems can be controlled over both space and time to achieve these savings. DOE's "energy efficient lighting program" currently includes two demonstrations of the effectiveness of more sophisticated lighting control systems in typical office buildings. These systems are designed to provide more flexible user control and to prevent energy waste from overdesign required by lighting maintenance schedules and lamp lumen depreciation. One system also employs photosensors and will be capable of achieving energy savings in daylit offices.

Lighting control options include on/off switching, which has a low to moderate cost, but may not realize the full daylight potential and implies uncertain user response. Dimmable and multilevel cut-off systems have a moderate cost, although this is dropping. They add complexity in return for greater savings. Sensing and control devices are available as manual systems, which are fallible but flexible, and as automatic systems, which are reliable but limited.

On/off switching is available on an off-the-shelf basis and has predictable results on fluorescent lamp life. There are potential problems with user acceptance resulting from sharp changes in lighting levels as one or more fixtures are turned on or off. Experimental results on this issue are mixed. On/off switching can be handled on a circuit-by-circuit basis, fixture-by-fixture, on individual ballasts with a single fixture, or with multilevel ballasts. The latter options, although they involve more expensive switching and control systems, provide effective multilevel responses that may be more acceptable to users.

Dimmable systems are typically more complex and more costly. Although dimmable fluorescent systems are available for specialty applications, there are no widely specified, cost-effective, dimmable fluorescent systems used in the U.S.

Dimming need not be continuous. Multilevel step dimming can bridge the gap between on/off switching and conventional dimming systems. A new generation of fluorescent ballasts promises to provide dimming at little incremental cost. These solid state electronic ballasts are now under development by a number of U.S. firms and are receiving support from DOE. They should appear on the market within the next three years. The high-frequency electronic ballasts lend themselves easily to dimming. As sales increase, and the ballasts incorporate integrated circuits, prices should fall to levels comparable to premium ballasts today.

The DOE ballast demonstration includes several floors in a typical office building that has been retrofitted with dimmable ballasts in both perimeter and interior offices. Various experiments are planned to determine the best use of these controls. For example, should photocell sensors be placed on the ceiling looking down or on a window looking out? On the work plane facing up and in single or multiple locations? Photosensors may require time delays to prevent them from being fooled by a transient reflective object in a room, yet must be sensitive enough to respond to changing cloud conditions that can result in rapidly varying daylight illumination within a room. All of these issues are solvable, but we lack the experience to confidently answer them at this time. Controls in skylit rooms are simpler than in rooms that are sidelit because the light is more uniform.

Given either dimmable or on/off switching, controls can be actuated manually or automatically. Manual controls are flexible, combining sensitivity and judgment at their best. The main danger is that they will be forgotten or unused. Experiments suggest that people in a daylit room will sometimes select higher artificial lighting levels than they will in a windowless room in an apparent attempt to match indoor and outdoor brightness. People will turn lights on more readily than they will turn them off. But this is a matter of education. Most people prefer the idea of a daylit to an artificially lit space; that preference needs to be supplemented by active participation in the daylit scheme.

Automatic controls are more reliable but work without judgment. They must be kept simple to avoid complexity and high cost. Microprocessor controls provide virtually unlimited control, but represent overkill in a simple office environment.

Selection of control systems depends on occupancy and function. Perhaps the simplest example is a warehouse with skylights distributed across the roof. Here we can provide simple daylighting over the entire space with a simple control system because the daylight is uniformly distributed. With sidelighting from a window, the daylight gradient into the room becomes significant.

In small offices, work stations should be oriented so that the occupant faces parallel to the window to reduce glare, provide good contrast and high visibility. With one or two occupants in a small office, there should be little argument over lighting levels, and controls can be simple. Both ambient and task lighting levels can probably be achieved with daylight.

In larger offices, we find deep bays and open landscape furniture systems. It may be inconvenient to orient all tasks appropriately, and interior spaces may receive insufficient daylight for office tasks. However, daylight may provide adequate ambient light and some design strategies may increase interior daylight performance beyond conventional dimensional limits, which range from 24 to 40 feet. In the larger office, task light may be provided as a supplement to ambient daylight. A relatively simple system can then be used to control an artificial back-up system for ambient light, while each occupant individually controls task lighting. Given hardware costs for various types of lighting control systems, analysis can reveal whether a specific control system is cost effective. Life cycle cost/benefit analysis, which has been developed by J. W. Griffith, provides a useful approach.

Analysis

Methods of computing, graphing and modeling probable performance of daylight design.

A major obstacle to daylighting design is a continuing lack of simple and accurate design analysis methods. These methods can be computational or graphic solutions; they can be in the form of graphic tables and computer programs; they include protractors and physical models. All of these exist, but none provides the combination of reliability, accuracy and dynamic response that daylight design requires. The designer must therefore choose among them according to specific program and design objectives and use the results with caution.

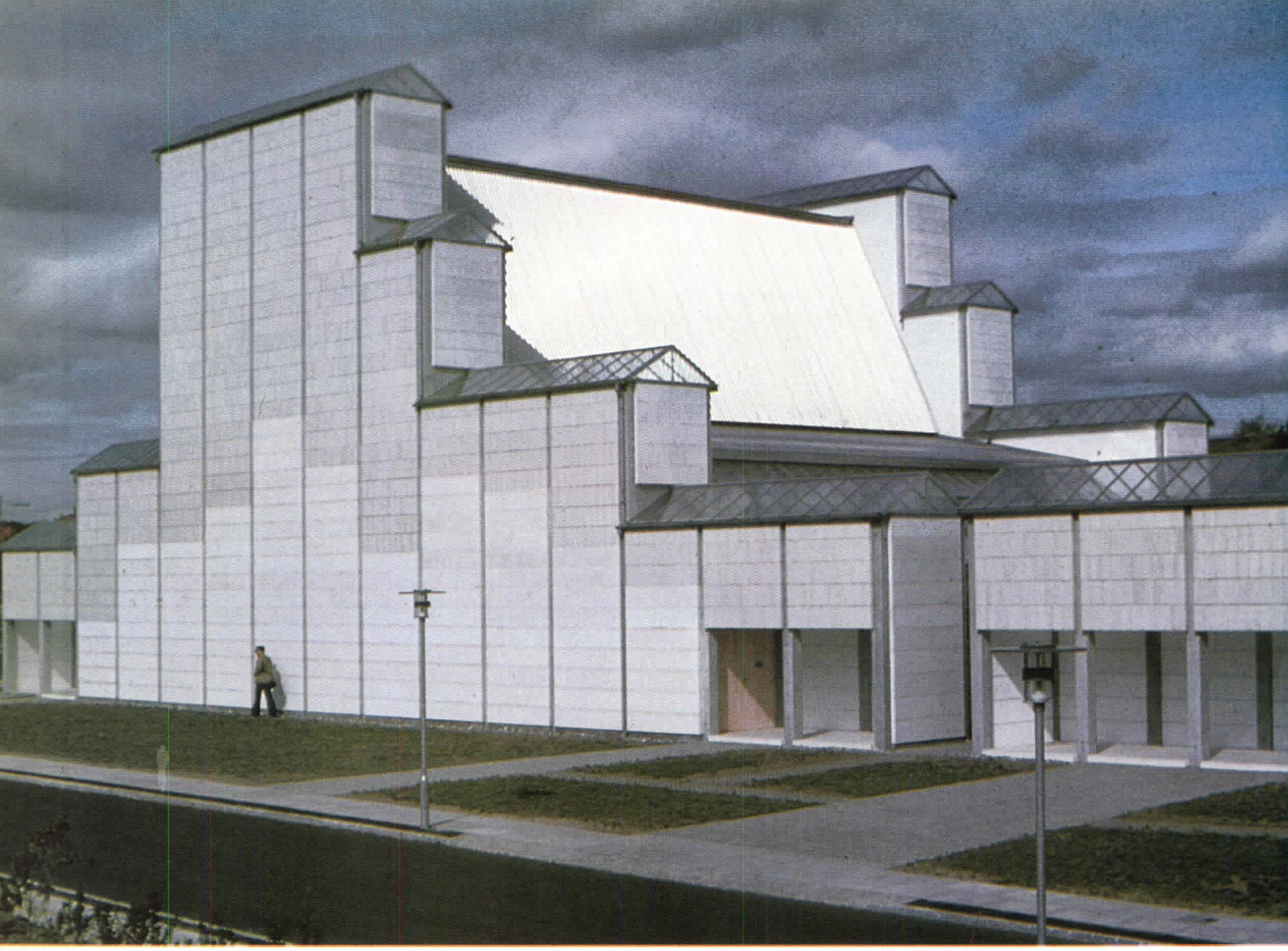
Calculations are at best a representation, or simplification, of reality. All computer programs are a model of reality; what they do and do not measure is frequently more important than how well they measure a given element. The daylight designer must therefore approach all such programs and calculations as useful, but not conclusive, information. Daylight is a visual phenomenon; one should believe one's eyes and use them to challenge calculations. Because daylight is an instantaneous event and cannot be stored, averages can be very misleading.

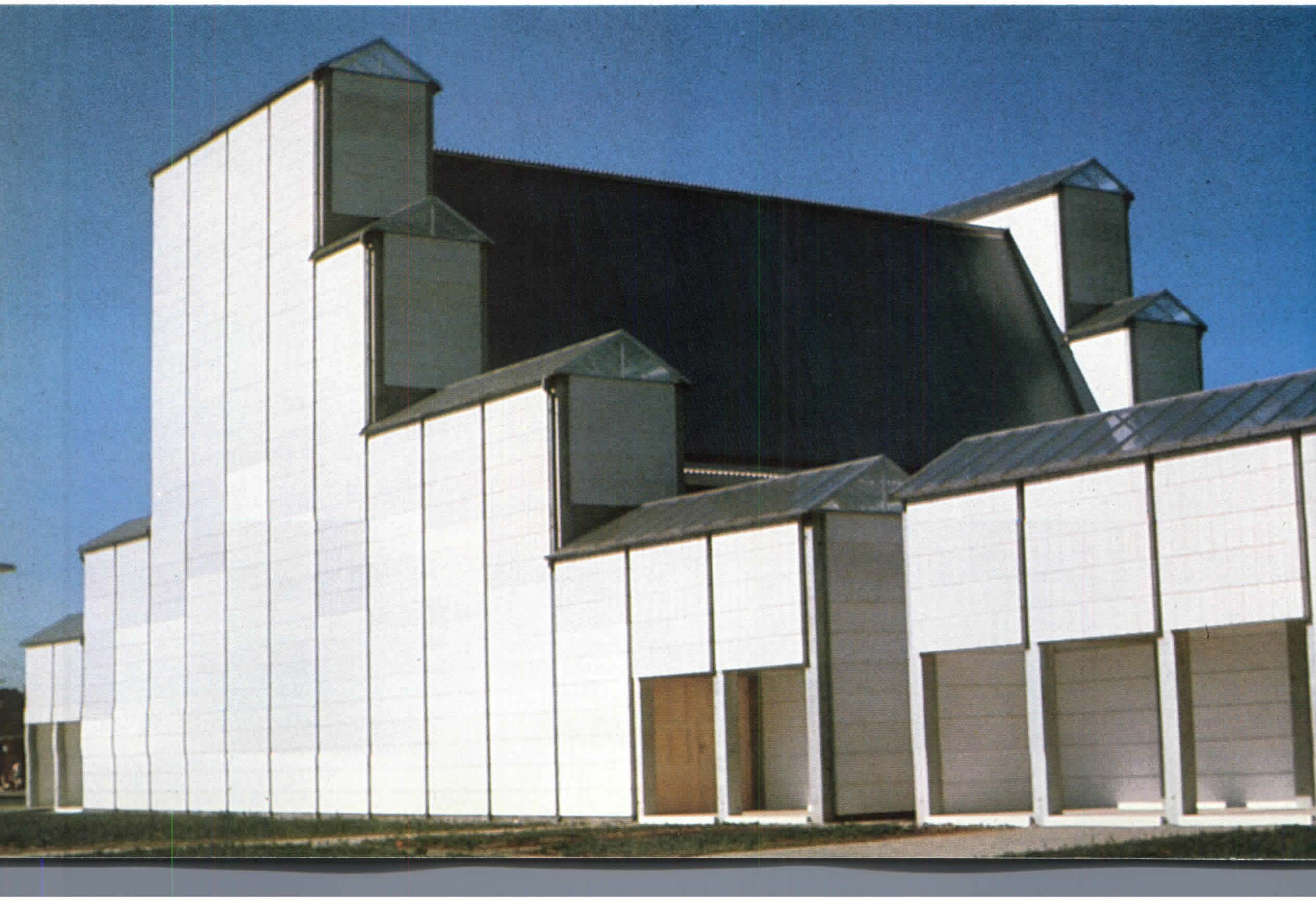
Physical modeling of a daylight design is therefore critical. Such a model is valuable for predicting both the quality and quantity of daylight and can reveal lighting gradients, specific glare problems and the effects of building form and finishes. Whereas a mathematical model may work for a standard design condition, a physical model will provide information on complex, unusual and specific design performance.

The built model should be tested outdoors, under naturally varying conditions. An artificial sky allows testing under more controlled conditions, but implies stable conditions and exact numbers that belie actual daylight conditions. Preferably, the model should be tested at the proposed building site so that it can model such local conditions as reflections from landscaping or adjacent buildings. Outdoor testing suggests the limitations of real time, but the passages of season can be simulated by tilting the model to obtain the proper relationship to the sun.

A daylight model can be simple, quick and dirty compared to a conventional architectural model. In the early stages of design, the model may simply deal with

This text continues on page 104 and is followed by a section on codes and standards affecting daylight design.





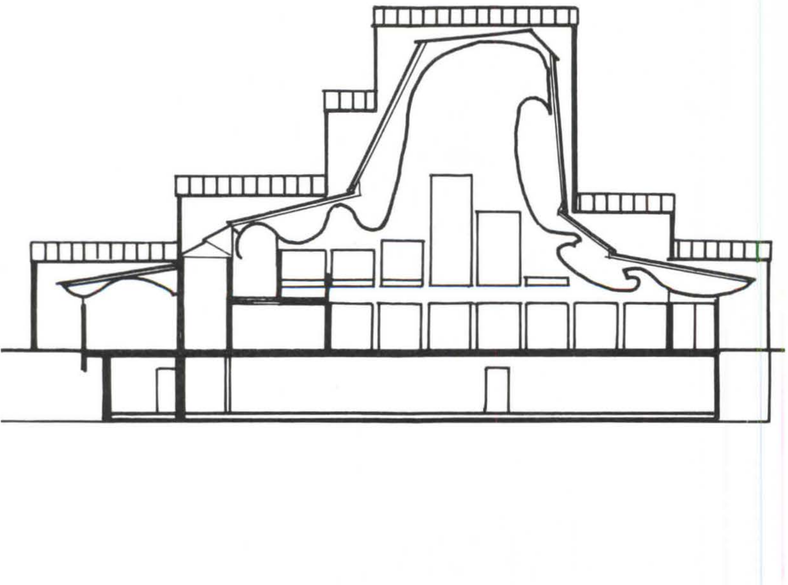
Kaleidoscope

A brief review of some recent buildings employing elements of daylight design.

A church that changes with the quality of light

Photographs by Richard Peters

Jorn Utzon's church in Bagsvaerd, Denmark, a suburb of Copenhagen, has overtones of both castle and grain elevator in its form. Walls are of gray concrete panels, some polished and some not, and the roof of galvanized metal. Both reflect—and change with—the quality of light (left). Inside, Utzon returns to his accustomed plasticity: a ceiling structure which undulates within the church's rising and falling volume (see section), and light from a single clerestory reflected into the sanctuary. Richard Peters of the University of California (see page 52), who visited the church, says that "there is a sensuous feeling of the ceiling unfolding that draws you and the light to the altar." Beneath the low ceiling, with the clerestory out of sight, "you aren't sure where the light is coming from." Clear glass looking out on courts between the church and ancillary buildings delineates the side aisles. Artificial light contrasts with the soft natural light but is integrated with it in the form of a brass cylinder in the ceiling with exposed bulbs on four-inch centers. Thus, the artificial light is linear, horizontal and sparkling; the natural light soft, vaulted and vertical, in Peters' terms.



A factory in which light and air were formgivers

Factories frequently are built exclusively around the mechanical processes they house. They are dull, hermetically sealed environments. In contrast, the Rosenthal Glass Factory in Amberg, Bavaria, was designed in 1968 with the workers in mind. Conceived before the energy crisis, it relies almost exclusively on passive daylighting and cooling by considering light and air as spatial formgivers.

The facility is the design of The Architects Collaborative, Walter Gropius and Alex Cvijanovic, AIA, principals in charge, and houses the automated glass blowing equipment of the Rosenthal firm, famous for its porcelain and crystal. It consists of a main glass hall, which is a cathedral-like space 88 feet wide, 354 feet long and 54 feet high, oriented with its long axis north-south, flanked by courtyards and low, one-story service areas on either side. The courtyards can be seen and enjoyed from the interior and visited during rest periods.

The most serious problem in glass manufacturing is excessive heat from the kilns. Air temperatures reach as high as 140 degrees in the areas where the glass blowers work, and they must drink several bottles of beer on the job to replace body liquids. Given the hostile nature of the manufacturing process, the client charged the architect with designing as humane and pleasant a facility as possible.

According to Henry Ortega, AIA, job captain, TAC's team arrived very early at the key concepts that were to give the factory its final form. For cooling, they considered taking advantage of natural convection to create a chimney effect in which cool outside air is pulled low in the space, passes by the workers, is heated by the kiln and rises to the top to be drawn out. From this initial concept evolved the triangular space with its continuous ventilating ridge monitor at the top and glass doors along the bottom. Reinhold Lerch, director of Rosenthal facilities, says the building, in operation since 1970, has been working as conceived with no major problems. The resulting ventilation is sufficient to remove the heat, even in summer, and provides a welcome breeze. Since the glass doors can be adjusted to choke or throttle incoming air, there are no chilly drafts in winter.

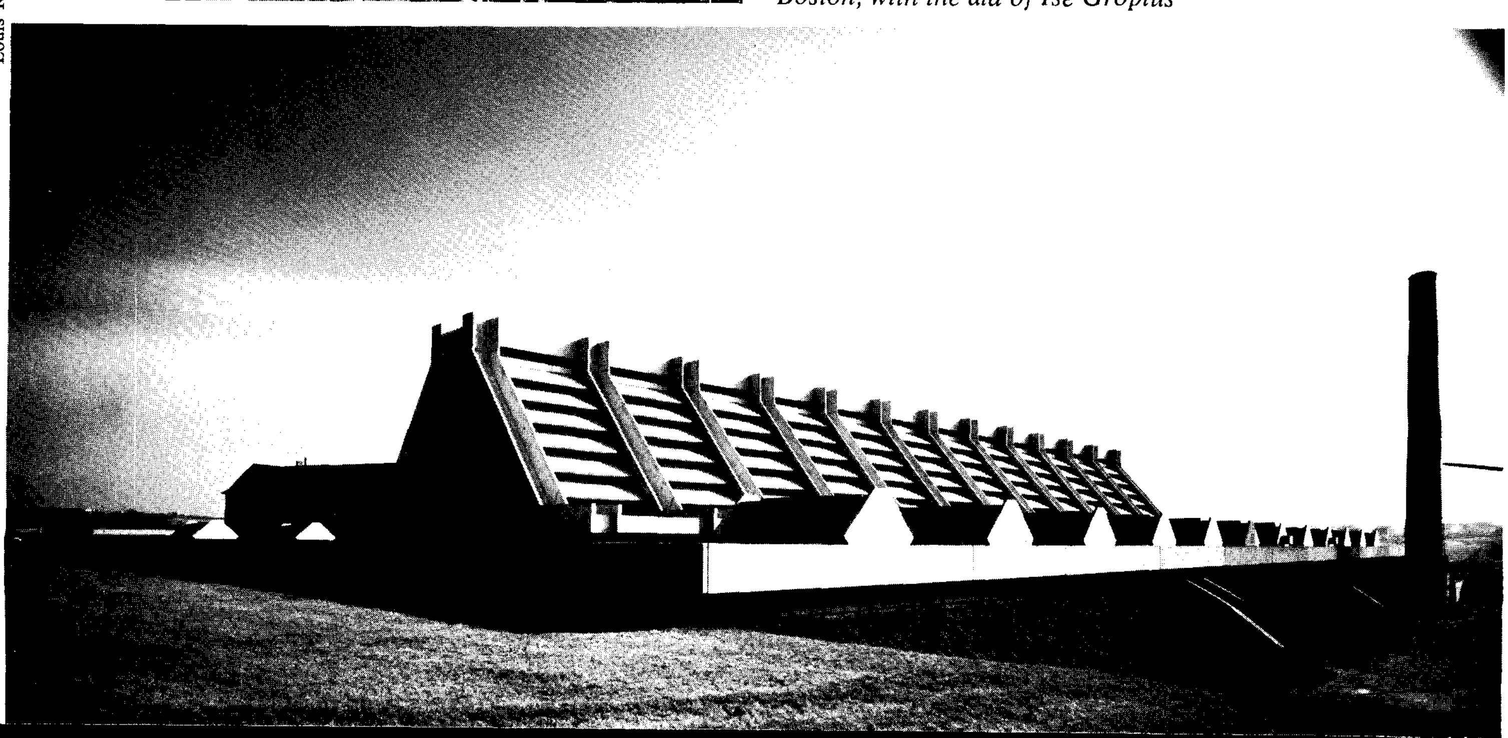
Louis Reens

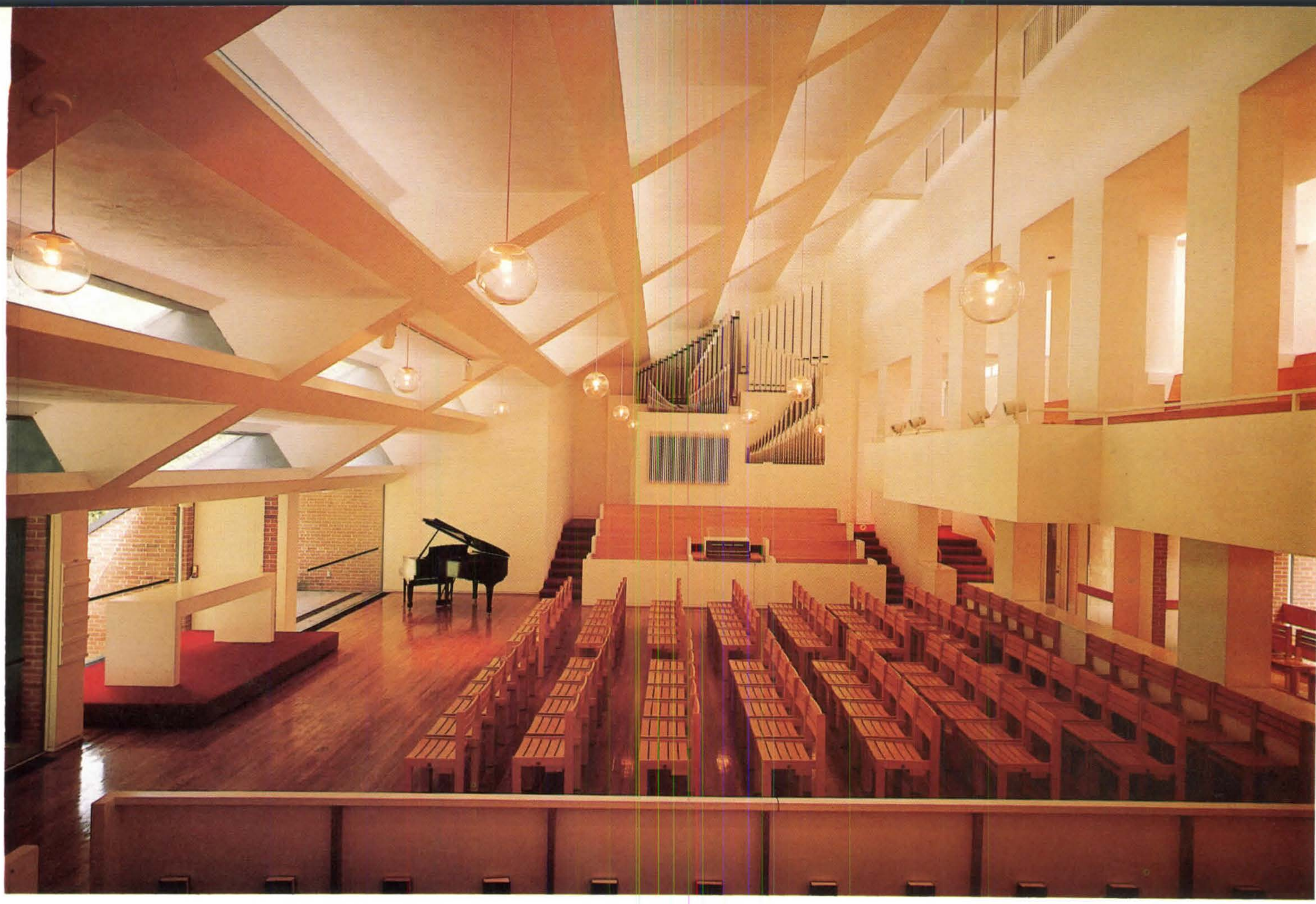
Glass blowers need an evenly distributed source of diffuse light to spot bubbles and other imperfections in the molten glass, and since the kilns are operated in the round, the light must come evenly from all directions, high and low. To accomplish this, the architects developed the building skin as a natural daylight diffuser. On the triangular roof of the main glass hall, they placed a series of sloping baffles. Speaking of the lighting design, Royston Daley, TAC associate in charge, says, "Since you obviously do not want to introduce more solar gain into an already hot space, we introduced a series of sloped concrete fins that are glazed in-between and overhung so no direct sun can enter except, of course, at very low angles. In this way you get reflected indirect light off the underside of the fins, which helps balance the brightness coming from the glazed north and south ends and the glass doors along the sides."

Reinhold Lerch says that the craftsmen are very satisfied with the light quality, its evenness and absence of glare, and that the space is like being under a giant parasol. Electric lighting is needed only for very dark days which occur at northern latitudes (50 degrees) in the dead of winter. The ribbon skylights in the roof are fixed air-tight so as not to short-circuit air entry at worker level.

Prismatic skylights are also provided over the low, flanking service areas, particularly to introduce light in the glass finishing section where grinding and polishing are done. In addition, the low, flat roof is separated from the bermed earth by a continuous 30-inch ribbon of clerestory windows which provide side light, balancing the brightness from overhead, a lighting concept used in the main glass hall as well. While glazing provides the asset of natural daylighting, it also carries the liability of unwanted heat loss and gain. For this reason, skylighting in the service areas is reduced to that needed for beneficial psychological effect and supplemented with electric lighting. This is in contrast to the lighting scheme of the main glass hall where the overabundant supply of kiln heat completely eliminates the penalty of heat loss through glazing.

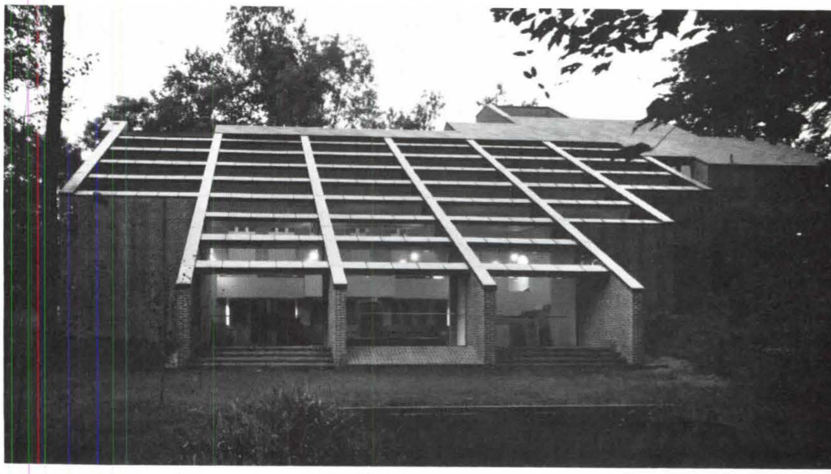
The Rosenthal Glass Factory was the last major work of Walter Gropius before his death in 1969. It is interesting to compare it with his first, the Fagus Shoe-Last Factory of 1911. Both projects were for clients who were concerned for the welfare of their employees and willing to share the risk with an architect who thought the ordinary solution could be improved. And in both, the use of fenestration to better the life of the workers was of major significance. *Nevin Summers, a design consultant from Boston, with the aid of Ise Gropius*





Robert Lautman

A chapel that acts as a daylight fixture



The chapel at Mount Vernon College in Washington, D.C., designed by Hartman-Cox, appears closed and small. "The object was to get the building out of sight," says Warren Cox, FAIA, "because the college didn't want any modern buildings on the colonial campus. We originally sited the chapel on top of the hill and then shoved it down into the valley."

Inside, however, the multiuse building—it also serves as theater, music hall and conference room—is an expansive, surprisingly large space (seating 300), which virtually acts as a fixture to capture, diffuse and direct natural light. "We were trying to use light to reinforce the form, which, if we got it right, reinforces the program," says George Hartman, FAIA. And, as he puts it, "The basic program requirement of a useless building such as this—one that doesn't have a product—is the ambience. What we tried for was a sense of serenity."

The architects' principal design strategies were threefold: They used indirect, shadowless, reflected light, often from hidden sources, for a soft, airy quality. They layered light as well as space, increasing the intensity of daylight as it reaches the chancel. And they opened the building to surrounding woods and sky to give it an appearance of expanding outward and upward.

The main entry is on the uphill corner. A few steps below is a landing overlooking the chapel floor. This is the "introduction," as Hartman calls it, to the building's salient features.

A balcony-level gallery with high, recessed windows serves as circulation path and is screened from the main space by two bearing walls with large cutouts. These layered openings lead the eye through increasingly bright spaces to the building's focal point, the west wall, which is blanketed with slanting clerestory windows canted at a 45 degree angle. Daylight passes through them at right angles, after being filtered through green foliage and bounced from a painted metal roof. It is then reflected up onto ceilings and finally falls downward and onto the back wall, feathering surfaces with indirect, soft light.

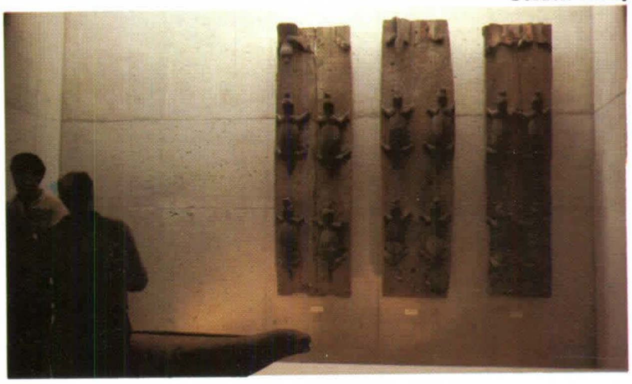
At ground level, three large bays of recessed glass on both east and west sides create a deliberately vague sense of boundary between the building's edge and the outdoors. "At the chapel level," says Cox, "we wanted people to feel a part of the little valley, to be able to look straight out in both directions."

The building appears to expand upward as well as outward, because at the chancel level light is admitted through three clerestory bays which increase to a width of four higher up, then to five and finally to six at the peak. "So you're getting a good deal more light and the space is getting smaller as you go upward. That's deliberate," says Hartman.

Although overall light levels are intentionally low to create the feeling of a cool, shaded building, there is ample illumination without supplemental artificial light. In fact, switching on lights hardly makes a difference.

Hartman and Cox took their cues primarily from Aalto. They evolved a roof system which, combined with the backlighting, provides almost totally indirect light. Their use of interior colors and materials—white walls, shiny, light wood floor and oak furniture in the main space, dark red carpet in ancillary areas—reinforce the effect obtained from controlled daylight.

Gordon Ashby



Gordon Ashby

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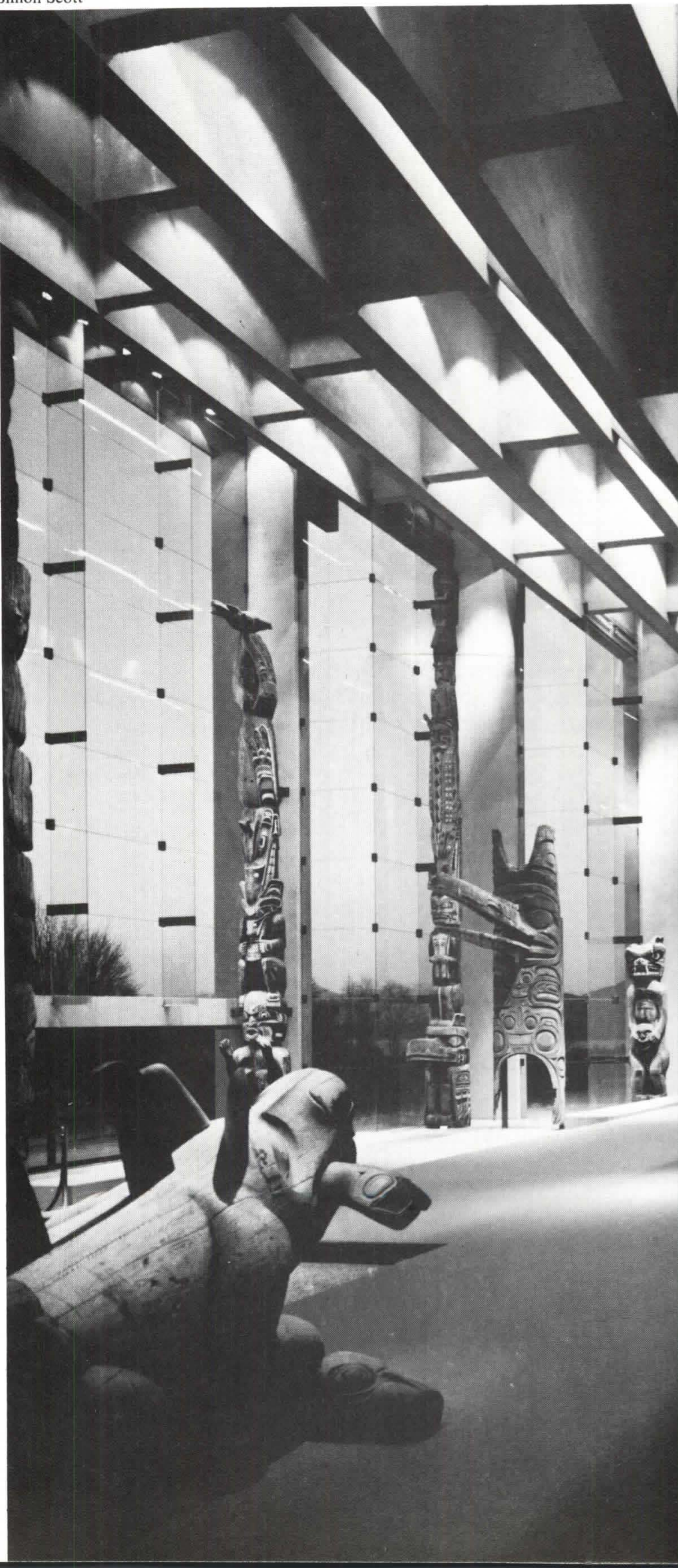


Daylit museum for display of Indian artifacts

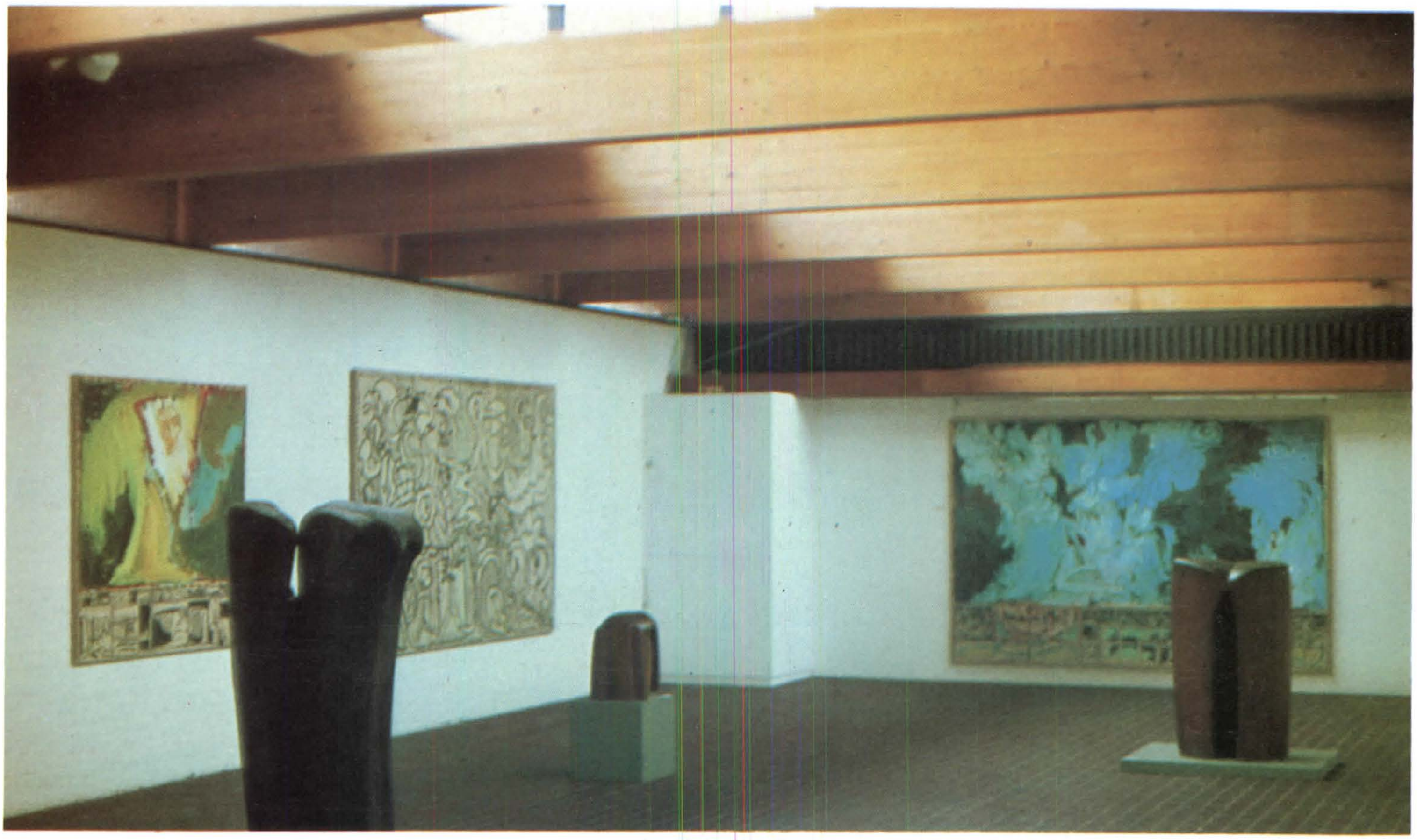
The Museum of Anthropology for the University of British Columbia in Vancouver was designed by Arthur Erickson to display artifacts of the northwest Pacific Indian cultures. The siting of the building and its overall design were intended as a metaphor of the villages from which the art objects were collected. These were built on beaches between sea and forest, with huge totems standing guard between longhouses and the beach. The museum hovers on the edge of a cliff overlooking a sea on one side, wooded mountains on the other, and has large areas of glass wall and skylights that open it up to the mist-filled light of the region. The building's basic structural theme is a cadence of concrete channels and posts, which recall the primitive frames of the northwest Indian longhouse.

Erickson has written: "I have been anxious to find, wherever I build, the right response to light. The northwest coast is a particularly difficult area with its watery lights, which are capable of soft and subtle moods. The coast demands transparency in buildings, or skylights bathing walls with a gentle light. . . ."

The museum has three principal display areas. A ramped gallery houses massive carvings placed in concrete alcoves and has only natural toplighting from a concealed source. According to Erickson, "This gives the rather mysterious effect of forested seclusion to enhance the figures." The "great hall" (right) contains artifacts eight to 45 feet high that stand against a 45-foot high glass wall. The objects, says Erickson, are lit from all sides and above "to simulate as much as possible their typical forest edge setting. The heavy concrete piers with slots of light between simulate the light through massive tree trunks." Smaller objects are displayed in a skylit gallery of intimate scale (top right).

Gordon Ashby, a designer of museum exhibits, visited the museum shortly after it opened as part of his work on a Guggenheim fellowship examining the use and control of natural light in museums from Alaska to South America. In his judgment, the Museum of Anthropology is outstanding in its balanced concern for art and architecture and its use of natural light. Ashby notes that natural light is usually the enemy of museum designers because it is unpredictable, uneven and may cause damage to art. But here, he feels, it is used to excellent advantage.

The artifacts gathered here lend themselves to being seen in natural light, he says, since most are of wood or ceramic and originally stood outdoors. Bringing them inside could well have diminished their impact by imposing an artificial surround. Instead, he says, this museum allows the objects to be seen against the sky and trees, while protecting them from the elements and ultraviolet light.



Richard Peters

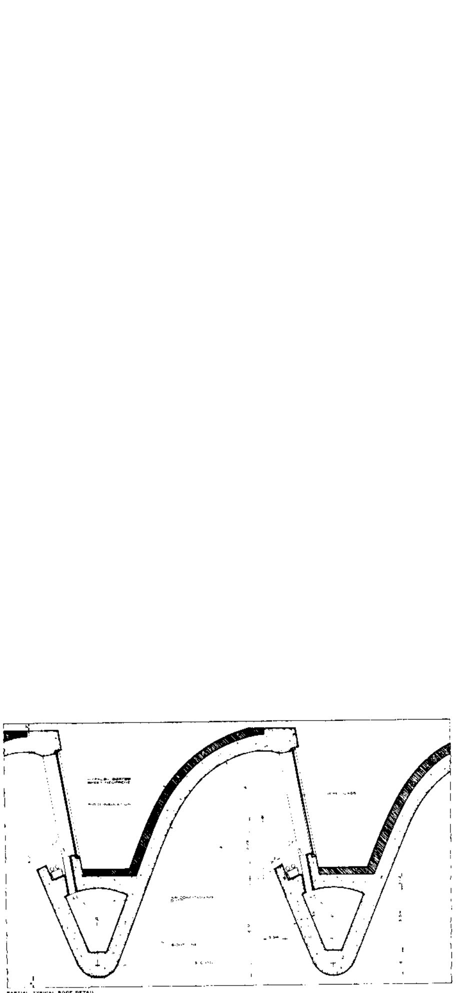
Danish museum that uses light in varied ways

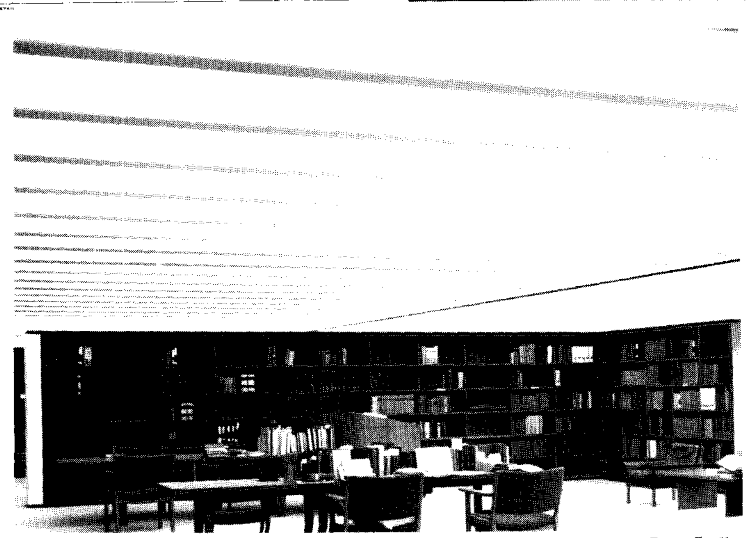
Richard Peters

The Louisiana Museum of Modern Art (named after the founder's three consecutive wives, each of whom was a Louisa) is an understated, brick, wood and glass building some 20 miles north of Copenhagen. It consists of a 19th century house, situated in a park, plus a new addition comprised of cloister-like corridors, which have glass on one side and a display wall on the other, and lead through galleries to a restaurant overlooking a bay.

When designing the building, architects Vilhelm Wohlert and Jorgen Bo wanted to subordinate their building to nature while underscoring the pastoral setting. Richard Peters, after visiting the museum, observed that they succeeded in doing so largely by emphasizing transparencies and by emulating the ever-changing light of the outdoors.

Some galleries are lit from wall-to-ceiling glass, others by clerestories, still other by diffuse toplighting. As Peters put it, "Wohlert and Bo are masters of changing light levels. Yet the control of direct light into rooms is carefully calculated." The orientation of the building is southeast and northwest to suit the region's northern latitude; deciduous trees filter and tint the light in summer, and overhangs are used to control glare.





Ezra Stoller

Princeton library with a glowing, sculptured ceiling

As architects' critical sensibilities and values change, buildings which received limited attention in their time are cast in a new light, both for the quality of their original intentions and for the ideas they suggest as solutions to a new set of design priorities. The library at the Institute for Advanced Studies in Princeton, N.J., is such a building.

Designed by Harrison & Abramovitz and completed in 1964, it is the work of Wallace Harrison, FAIA, based on the program of Robert J. Oppenheimer, director of the institute at the time. From the beginning, Oppenheimer wanted a "light and airy" feeling and a high quality visual environment down to the smallest details. Harrison conceived the north-facing skylight system which incorporates a long span structural shape, HVAC supply ducts, indirect, recessed lighting and natural daylighting into an elegant and integrated ceiling. The even quality and levels of light delivered create a serene atmosphere on the main floor of the library, appropriate to the pastoral setting of the institute grounds.

Esthetics aside, however, of interest to energy-conscious designers is whether such a system could also be employed to conserve energy for lighting, which constitutes 40 to 60 percent of the total energy budget for buildings of this type. Energy conservation, however, was not the important technical concern for the designers. At issue was whether the indirect fluorescent lights, recessed in the skylight next to the glass for esthetic reasons, would provide sufficient light in the stack areas at night. (It was assumed that there would be enough light during the day.) Harrison & Abramovitz constructed a full size model of two bays of the skylight. Although large amounts of light were lost through the glass at night, sufficient levels were measured at the floor and higher for use in the obstructed stack areas. Indeed, the light lost through the skylight at night became notorious in Princeton. The university's observatory asked the institute to close at night during one of its experiments because the glow interfered with observations.

The librarian and superintendent tell of other technical problems with the skylight system. Condensation on the inside of the single glazing has dripped into the recessed lighting tracks and shorted out some of the circuits. Also, ice dams have formed in the drains of the roof areas between skylights, causing the whole area to fill with water above the level of glazing. The subsequent leaks have also caused short circuits in the electrical system. The superintendent does not assign these problems to the concept of the skylight, but to the lack of double glazing and poor design of the drainage system.

The librarian's description of difficulties with the switching and control system identifies conflicts between function, esthetics and energy conservation. All the ceiling lights are controlled at a central switchboard. Each switch controls the lights in three bays —either all on or all off. The librarian says the original intention was for all the lights to be turned on an hour before dusk so that as it got dark, the artificial light would slowly take over the job of the daylighting, maintaining the luminous ceiling quality. Apparently, this works beautifully and is one of the charming aspects of the library. But the central controls create problems in these days of high energy costs. On overcast days when there is insufficient light in the stack areas to select books, three bays are usually turned on where needed. But frequently, the lights are then left on because of the nuisance of having to go back to the main desk to notify the librarian that one is finished in that area. And, on some cloudy days, the librarian would prefer to turn on every other fluorescent fixture rather than all 1,252 40-watt fluorescent tubes.

Despite these technical and functional limitations, the system has been energy efficient, even by today's standards. The librarian reports that in summer the lights are turned on an average of one day a week; in winter, two days a week. This figures out to 70 percent of the lighting requirements provided by daylighting. In addition, most of the technical difficulties and inefficiencies reported appear to be easily corrected by design improvements. For instance, lighting loss through the glass could be reduced by improving the shape of, and adding reflectors to, the light trough in the skylight so that more of the light is directed downward. Staged switches (stepped controls) would allow a closer fit between auxiliary lighting and the ambient conditions provided by daylighting. And the condensation problem could be solved with double glazing; the leaks caused by ice dam flooding could be avoided by a "failsafe" spillover gutter system at the perimeter.

Overall, the importance of the library lies in its promise that daylighting can work as a design directive, allowing energy conservation and esthetics to work in concert. *Harrison Fraker, AIA, who has a practice in Princeton and is a designer with the Princeton Energy Group*

Joshua Freiwa

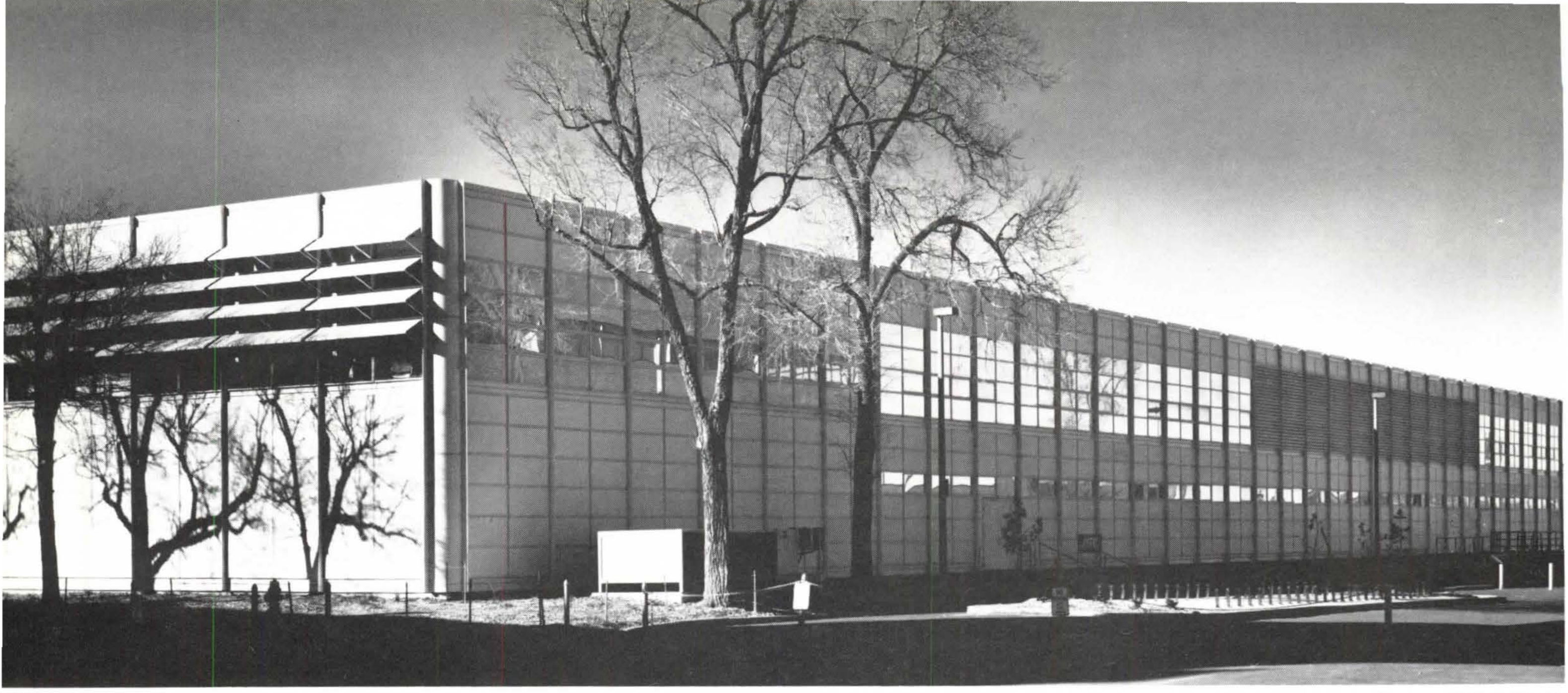
California store with a translucent roof

This is a first in sophisticated retail store design—a translucent roof admitting shadowless, diffuse natural light. It was developed by Environmental Planning & Research Inc. (EPR) and engineers Geiger Berger Associates for a Bullock department store at Oakridge shopping center in San Jose, Calif. The intent was to reduce energy costs by discarding what EPR Vice President Vergil Carter, AIA, calls a backwards approach to store design, "building huge, fully enclosed black boxes, then pumping them full of artificial lighting, which requires vast amounts of energy for cooling." He also maintains that his experiment at San Jose consigns to folklore the retailers' cherished notion that daylight is of no value whatever for displaying merchandise.

The roofing membrane, a combination of single and double glass fiber yarn, is strong and lightweight, and it rejects 75 to 80 percent of the sun's heat. It admits approximately 5 percent of the light that strikes it, producing 450 to 550 foot-candles of light to "make artificial lighting unnecessary even on cloudy days," according to Carter. He says that the fabric has the additional advantage over glass of giving a much gentler, more comfortable light. "There are no harsh points or weak areas; it has a strangely reassuring character, like returning to the womb." His enthusiasm is shared by Paul Heidrick, chairman of the board of Bullock's northern division.

During daytime, artificial lighting is largely confined to showcases; accent lighting normally found in department stores for mannequins and displays is minimal or nonexistent. To highlight and differentiate displays and departments, EPR has created a series of subspaces and used bright colors and highly reflective surfaces to direct the eye.

EPR developed the fiber roof as a prototype and has been retained by the client, Bullock's parent company, to reproduce the daylighting system on a much larger scale for another store and to evaluate its potential applicability to other parts of the country where the corporation has divisions.



Barbara Elliott Martin

College library clad in metal sunshades

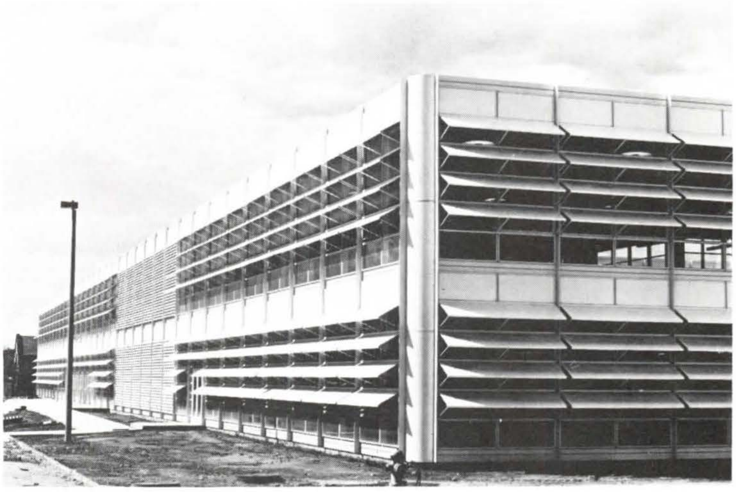
The shiny Auraria Higher Education Center is the main focus of a new college campus in Denver. As such, the 184,000-square-foot building clad in glass and white-painted aluminum was designed by Helmut Jahn, FAIA, of C. F. Murphy Associates to be invitingly transparent, light, airy and energy efficient. Its two floors, which house a library plus facilities for film and tape production and education, are organized as flexible loft spaces and divided by two asymmetrically placed interior courtyards and three open stairways.

Jahn wanted to provide floor to ceiling glass in reading areas, yet prevent the sun's summer rays from entering the building—Denver has on average 300 sunny days a year. His solution was to combine on the south and west elevations clear float glass with exterior metal sunshades that are two inches deep and set at a 40 degree angle. Hypothetically, diffused natural light from the sunshades gives adequate reading light to 40 percent of the building.

Leo Dwyer, who is doing research on natural light as a form of passive solar energy at the Solar Energy Research Institute in Golden, Colo., went through the building on a bright day and reported: "It has nice lighting effects inside. The south elevation, for example, has trees very close to it, which cuts down a lot on the brightness and gives a very nice quality. There was plenty of light, but I had trouble deciding whether it was coming from windows or fixtures, because all the halide lights were on. People in the administration said they get complaints about all the lights being on all the time. There aren't any provisions for switching them selectively." Architect Jahn's explanation is that the budget for the building, $28 per square foot, prohibited use of automatic controls, so he used area controls.

Dwyer also noted that reading areas next to the interior courts—only the glass on the south is shaded—were too bright and glaring. "Even looking out through the glass facing north into the court, the brightness from the sky plus the whiteness of the building make things pretty bright." Jahn explains that south-facing sunscreens on the original scheme were cut out of the budget. Also eliminated, apparently, were provisions to shield the building from hot morning sun in summer on the east facade. "We got so much opposition on this building and could fight for just so much," Jahn says.

Although the structure was intended as a prototype for future buildings on the new campus, the college board of governors soon decreed that subsequent buildings be clad in red brick, and the Auraria Center now stands surrounded by fairly mundane, traditional buildings.



Light and texture in a student center

Except for inconspicuous doors, the only materials visible on the exterior of the Christian Science Student Center, Urbana, Ill., are Paul Rudolph's well-known ribbed and hammered concrete of a warm, yellow-brown texture and untinted glazing. Flat, unbroken sheets of glass, set almost flush with the concrete, are contrasted with two large, two-story window walls deeply recessed behind projecting vertical fins and horizontal overhangs. The 12,650-square-foot structure reads as a collection of rectilinear masses.

The building has 10 rooms, eight of which are public spaces. Of these, three are "towers"—the stair tower, main meeting room and a central light shaft—which rise 40 to 50 feet, undivided vertically. The other five public spaces—foyer, small meeting room, reading room, mezzanine and the balcony of the meeting room—are all basically one-story spaces, ranging in height from 8 to 16 feet.

Each of the two categories of interior space has its own type of natural light, but each area is also illuminated by light borrowed and flowing into it from the other spaces. Light enters each one-story room through glass on one of four walls, flush in one room, deeply recessed in the remainder. The towers have only flush glazing, which in the stair tower occurs at several levels and, in the other two, high in the space on all four walls. The light in the tower spaces is reflected only off the concrete surfaces, unaffected by other color, while in the one-story spaces it is colored and subdued by being reflected off burnt orange carpeting and ceilings.

The nature and intensity of both natural and artificial light were predetermined by the architect. There is no way to control either, which was not reported as a problem by occupants, probably because of the variety of light entering the building.

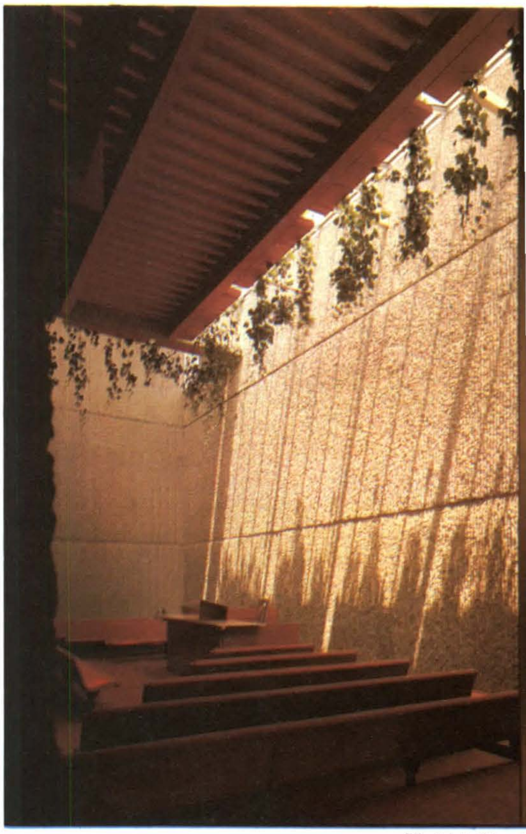
Even on the grayest day, the natural light within the three high spaces is more than adequate. But the same cannot be said for the one-story rooms. The meeting room balcony, often used for working space, would seem to be the building's one real blunder. It is a basically dark room in which one large, unshielded, south-facing clerestory produces disturbing sky glare and uncomfortable contrasts, and even artificial light here is insufficient. It is also ironic that the reading room, of all spaces, has the least natural light, and must rely wholly on artificial illumination.

Most notable in this building is the changing character of natural light and the way it links and differentiates architectural spaces. On a gray day, the quality and intensity of light dramatically reinforces the spatial flow of rooms and picks out the texture of ribbed concrete contrasting with smooth floors and paneling. One looks through several spaces and sees, always, a set of receding planes lit with subdued but marked differences in intensity. On a bright day, the dark spaces are only a little lighter than on a dark day, but the brightest spaces are much lighter. The impression now is less of a continuous flow than of contrasting volumes played off against one another.

As the sun moves from east to west, different surfaces are lit, producing different moods, and as clouds move over the sun, patterns and shadows cross walls and move through space, since light enters from high openings. People who spend much time in the building say they especially appreciate these changes.

The overriding effect of this interweaving of light and space, and of the changing quality of light, is not primarily intellectual or symbolic, as in Gothic or baroque churches. It serves instead to bring out more immediate sensations: the experience of linked but differentiated spaces and the delight of changing light patterns. This would seem most appropriate since Christian Science emphasizes the role of Christianity in daily life and its continuity through space and time. *Robert B. Riley, professor and head of the landscape architecture department at the University of Illinois, Urbana/Champaign* □

Hedrich Blessing



Hedrich Blessi

Daylight as a Central Determinant of Design

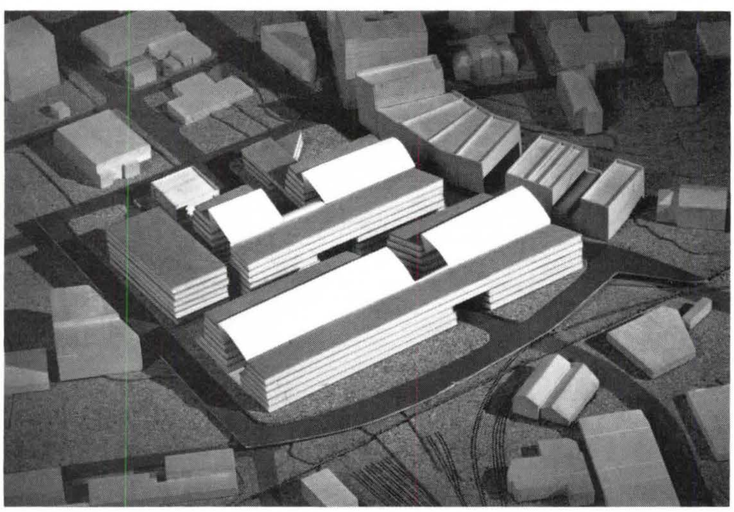
How it helped shape a new TVA office building. By Scott Matthews and Peter Calthorpe

The Tennessee Valley Authority has been identified with innovative and socially conscious architectural and engineering projects since the Roosevelt era, when the Depression brought to it some of the most talented designers of the time and a broad mandate for environmental improvement and resource conservation. A project now on the drawing boards promises to follow that mandate, this time with emphasis on alternative energy sources and energy-conscious design. The new project is an office complex for TVA's own use of over 1 million square feet for a downtown site in Chattanooga, Tenn.; construction is scheduled for 1982.

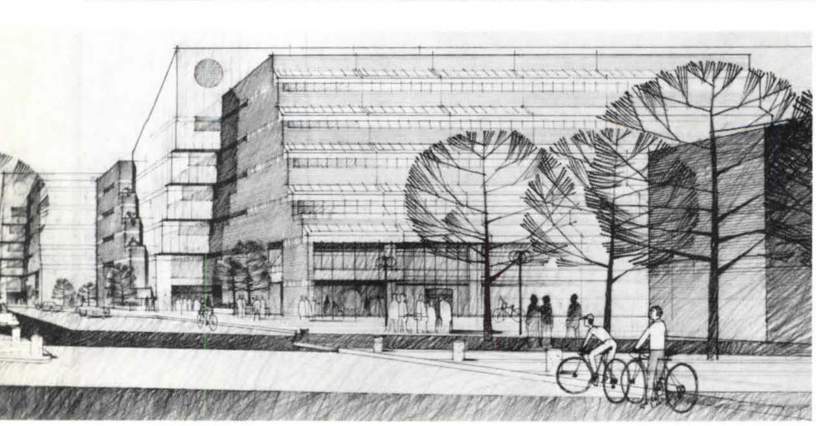
From the start, TVA intended this project to be special. It assembled, on a person-by-person basis, a design team of diverse skills and viewpoints and then directed the team to "advance the state of the art in energy-conscious design," while stressing the need for sensitivity to human needs, the urban context and environmental quality. The emphasis of the team soon became the integration and synthesis of energy strategies with the more qualitative functional and architectural goals. Daylighting emerged as a theme central to both the energy mandate and the architectural and urban character of the building.

Daylight became the expression of a design process that was to synthesize qualitative and quantitative goals; it was considered the most appropriate use of solar energy by both criteria. The design strategies for daylight, which included concepts of reducing the scale of the building by breaking it up into a series of narrow sections, were complementary to other goals. These included maximum year-round use of exterior spaces, respect for the scale and character of surrounding buildings, the provision of mixed-use spaces, a sensitivity to pedestrian scale and amenity, and respecting, by adhering to the concept of a solar envelope, its neighbors' rights to also use the sun.

Initial phases of the project include a computer center (upper left on model) and office space with broad exposures facing north and south. The perspective shows east facade along commercial street.



Steve Rosenthal



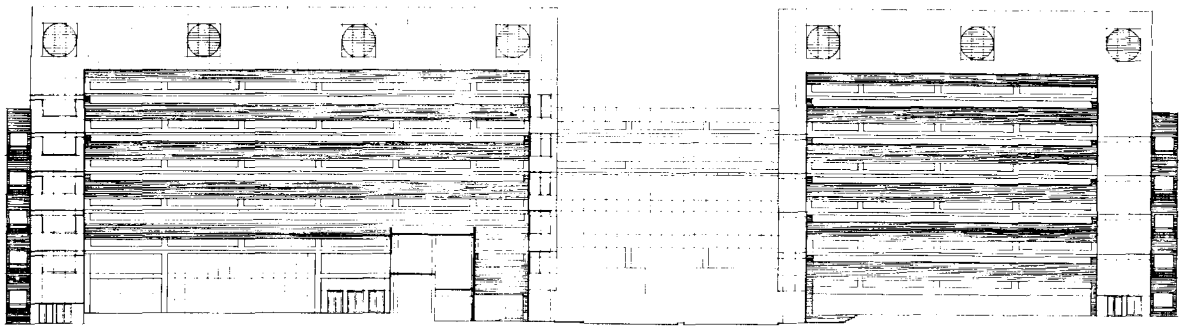
Preliminary studies reinforced the tendency toward a linear, horizontal form, differentiated and articulated in response to the sun. Studies of climate and building thermal loads identified lighting as a major energy consumer, both as an electrical load and as a cause of increased cooling requirements. This is frequently the case for office buildings; lighting may account for as much as 80 percent of the energy load and is thus a major target for conservation. The issues of orientation and massing in relation to function requirements were also studied. The social pressure for identifiable units of human scale within the huge project and urban design implications were also important in determining the building footprint.

Some early studies challenged preconceptions. The expectation that a compact building form would be most energy efficient was confronted directly by a computer thermal analysis that compared several simple building forms and orientations in the difficult Chattanooga climate: cold in winter, hot in summer, with humid and dirty air year-round. The sun shines less often than the national average. The design team came to feel Chattanooga's climate a challenge, and that an energy-conscious design solution there would probably work better almost anywhere else, as would strategies for daylight. The team came to rely on the parameter studies as a basic design tool, utilizing a modified and enhanced version of the NBSLD thermal loads simulation computer program and local weather tapes to evaluate tradeoffs.

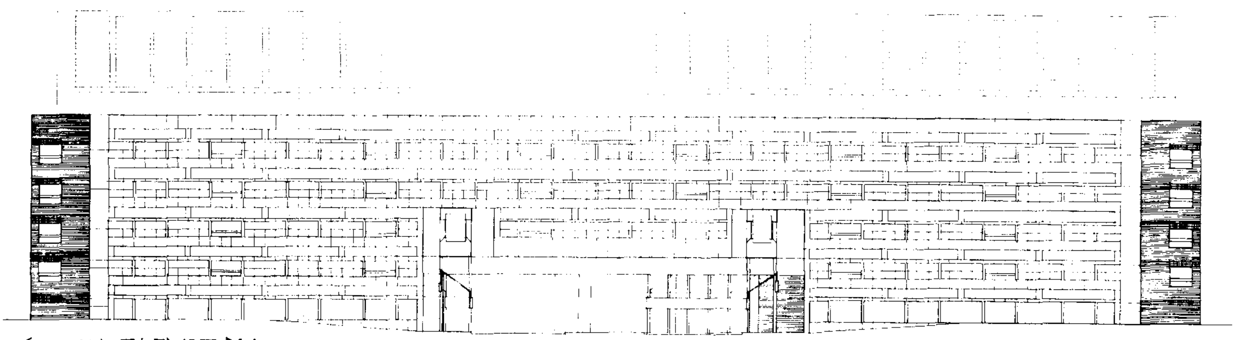
A series of "shoebox" building floor configurations were modeled. Although these studies were necessarily simplified, each building configuration was modeled on the computer with a combination of exterior, intermediate and interior zones. This method avoids errors caused by aggregating zones of substantially different thermal performance. Thus, these studies can be considered of first-order accuracy and can be used as the basis for preliminary design decisions.

The conclusions of the study, which assumed the east and west facades to be fully shadowed and double-glazed throughout, indicated that the linear building form with long north and south facades demanded less energy. Although the heating and cooling loads increased with linear forms and their increased

Mr. Matthews and **Mr. Calthorpe** are with Van der Ryn/Calthorpe & Partners. Members of the design team of the Chattanooga building are: Caudill Rowlett Scott, architects (Sizemore/CRS, Bickle/CM); The Architects Collaborative, Inc., architects; Van der Ryn/Calthorpe & Partners, architects; TVA Architectural Design Branch, architects; Syska & Hennessey, Inc., engineers; Bolt, Beranek & Newman, Inc., acoustics; LeMessurier/SCI structural; William Lam Associates, Inc., lighting; Travis Price, energy.

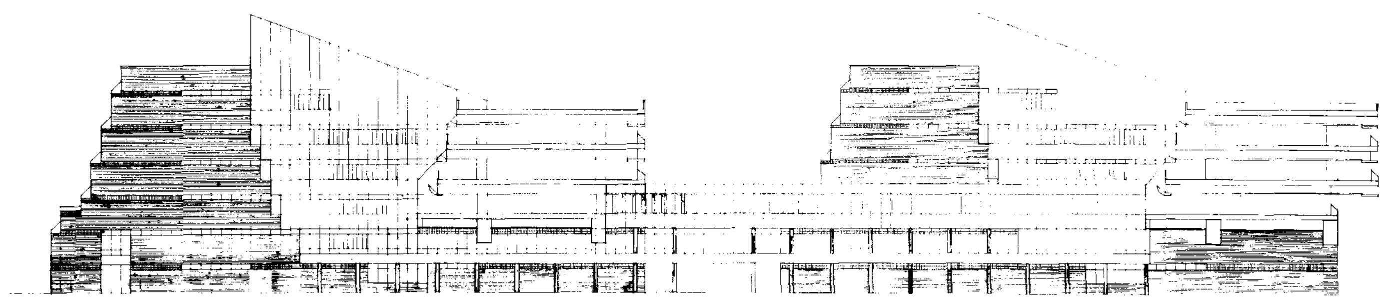


NORTH ELEVATION



SOUTH ELEVATION

EAST ELEVATION - MARKET STREET



WEST ELEVATION - BROAD STREET

surface area, the reduction in the range of 30 percent of lighting loads offset the skin loads. Interestingly, the study indicated that there is a balance point between surface area loads and interior lighting loads. The thin 45x222-foot form generated higher loads than 60x167-foot form, although less than a square.

At this point, the concept of courts or atriums emerged. The balance between compact and daylight building forms, along with the program needs for clear circulation, social gathering points and organizing elements, led to linear south-facing courts between major building sections. The courts are intended to increase the apparent thermal compactness of the building by reducing its surface area and maintaining excellent daylight access. This phenomenon occurs because the court replaces two exterior wall surfaces with one double-glazed roof, thus reducing the number of exposed building surfaces.

The courts, which have been called solar malls or atriums at various stages of the design process, primarily are buffer zones. They allow direct solar gain in the winter to offset the heating loads, while providing shade in the summer to reduce cooling loads. The variation between heating and cooling load times, especially in spring and fall, necessitated an operable, dynamic shading system over the courts. From a daylight point of view, the dynamic system allowed the building to be designed for both sunny and overcast conditions by providing a capability for redirecting the light to specific goals. When the direct sun is not desirable, it can be beamed out of the court or reflected to an intermediate surface or, when both heat and light are desirable, the sunlight can come directly into the court.

A second computer study on thermal parameters compared a covered solar court to an open court with fixed shading on the south building facade. The results indicated that an open court would increase energy consumption by 23 percent.

It has become apparent to most designers and researchers in this field that, once an office building's thermal loads have been reduced by appropriate architectural design, the use of daylight for office illumination is the most effective strategy for further reducing the building's energy demands. However, if daylighting is to be effective, it must be controlled in terms of its intensity

A court shaded by versatile horizontal louvers.

(heat gain, discomfort glare) and direction (disability glare). For the designer this means that the building must maximize the source area of illumination for biological, or ambient, lighting needs and provide a good quality and quantity of task light. The distribution of light is critical, both in terms of illumination quality and the variable impact of the sun on heating and cooling requirements. The appropriate surfaces need to be illuminated to dispel gloom, but direct sun needs to be controlled to minimize glare and maintain an effective brightness ratio.

Fortunately, there are multiple dividends for the added design ingenuity and, in some cases, the added expense, required for the proper control and admission of daylight:

- An estimated reduction of 20 to 60 percent in the energy consumption of a building when compared to a conventional energy-conserving design.
- An increased sense of color perception, or "seeability," due to a close match between the spectral characteristics of daylight and the sensitivity of the human eye.
- A reduction in the shadow, or veiling glare, on tasks lit by large area diffuse light sources (reflected daylight from ceilings, structures and walls).
- Overwhelming worker enthusiasm for daylight and the concept of natural light as the preferable source of office lighting.

For this building, the design goal of maximum feasible dependence on indirect daylight became a major factor in its form. The preliminary energy parameter studies and the influence of the urban site's constraints provided a starting point. The complement of the daylight and urban design objectives confirmed this direction.

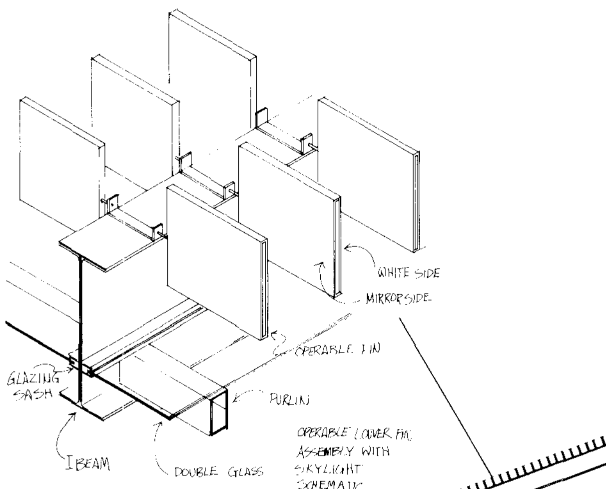
One conclusion of the preliminary energy parameter studies was that a double "extruded" building section connected by a solar court would be an energy efficient response to the site, and to the climatic and programmatic goals. The thermal caveat for this design response is that the court requires external shading on sunny days during most of the year, but can benefit from direct solar heat gains on many cool mornings and during the winter months.

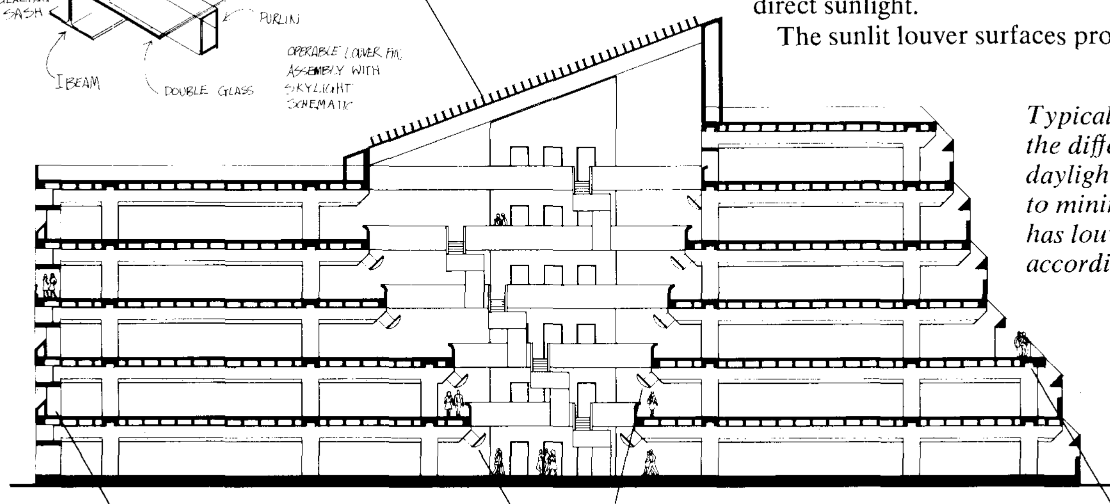
This dynamic requirement led to an external horizontal louver system that could continuously track the sun, redirecting sunlight into or out of the atrium as necessary to control heat, while allowing diffuse or reflected daylight to enter. On demand, the louvers can be repositioned at set intervals or continuously.

The need to shade the court from the sun's heat gain and yet to daylight the court's adjacent office space implies a significant operational conflict. However, the existence of an operable solar control system offers the opportunity for shading the court, as well as daylighting the office spaces, by using light "borrowed" from the court roof. This is accomplished by redirecting light reflected from the shading system to provide illumination for the court and surrounding office spaces.

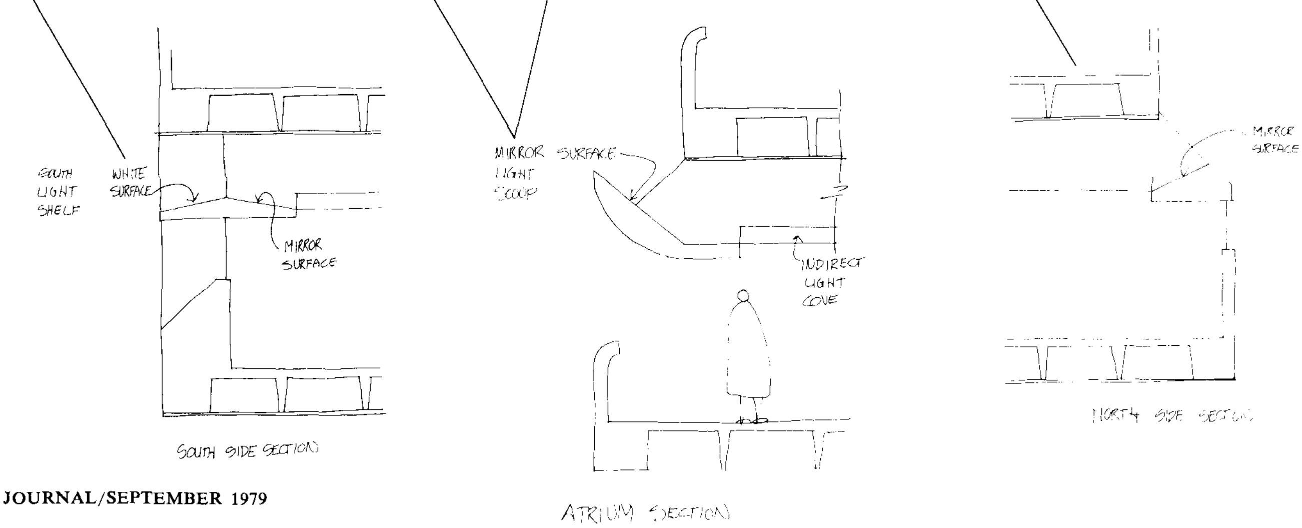
The louvers are designed to achieve maximum daylight control. The south-facing louver surfaces are mirrored; the north-facing surfaces are flat white. The roof shading system angles the array to project sunlight onto the white surfaces of adjacent louvers, thus achieving reflected daylight while controlling direct solar heat gain. This is a more effective daylight strategy than tilting the louver array to provide a simple shading mask for direct sunlight.

The sunlit louver surfaces provide a large area source of dif-





Typical building section illustrates the differential form responses to daylight. The north facade is sloped to minimize shadows. The atrium has louvers to control light and heat according to office requirements.



fuse white light equivalent to 800 to 1,000 foot-candles at the court floor, with only 25 to 30 percent of an unshaded roof's heat gain. A light shelf on each floor level houses a large mirror tilted to the proper angle for reflecting light from the court roof onto the ceilings of the adjacent office space. The ceilings, in turn, become a large area light source similar in function and perception to the office's totally indirect ambient lighting system. The daylight and the artificial light sources are visually compatible, which is important when using automatic controls to ensure that the installed lighting will respond dynamically to the changing daylight conditions.

A variation of a classic light shelf is used on the south facade with a mirrored inner shelf to increase the light reflected onto the office ceilings. A modified version of the court's mirrored light shelf forms the exterior north face of the building, reflecting the diffuse north sky light onto the ceiling of adjacent offices.

During periods when the building is in a heating mode, or operating with an economizer, the building and court can accept heat gain equivalent to or exceeding the heat of displaced artificial lighting. The shade fins of the court roof can be tilted to track the sun and to reflect direct sunlight vertically on the court floor and onto each floor's mirrored light shelf. The effect of the sunlight on the court floor and its ambient effect on the temperature of the court and adjacent offices is of passive solar heating. The light that is directed onto the mirrored light shelves is beamed onto the ceilings of the offices and used as a source of interior illumination. This use of twice reflected sunlight easily doubles the daylight level in the office areas farthest from the windows, and it reduces the building's heating load.

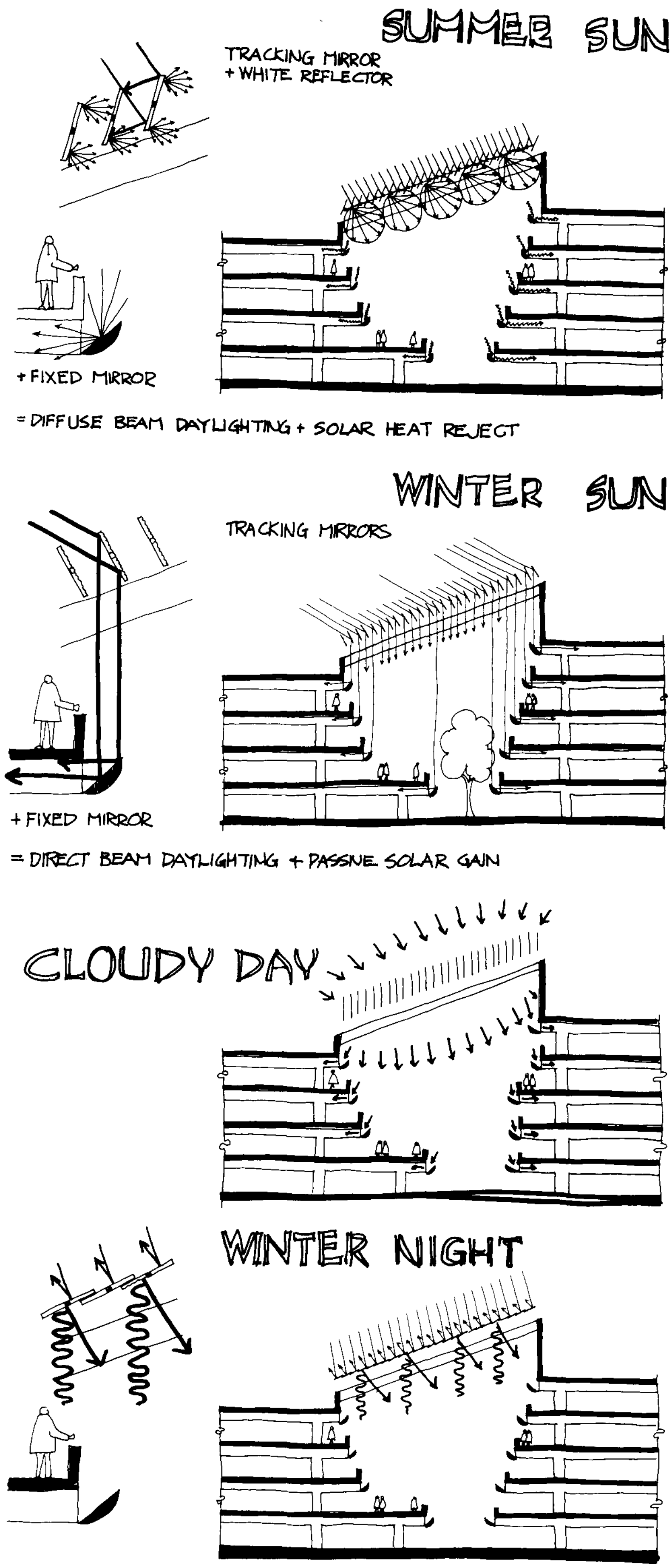
During overcast periods, the court shading system will tilt to the vertical position to provide the maximum aperture for the office floor's light shelves, or the system may continuously track the brightest part of the sky. At night, the court shading fins will either remain in a vertical position to permit nighttime heat radiation from the court roof or, on winter nights, close with mirrored faces down to rereflect long-wave radiation back onto the court's roof, thus reducing the court's heat loss.

Preliminary tests have shown that the combination of mirrored light shelves, high ceilinged (12 feet) offices and the operable court shading system will increase the usable daylight penetration from 200 to 300 percent over a classic sidelit office daylight design using clear glass and an eight-foot ceiling. A rule of thumb may be applicable here: Usable daylight penetration is equivalent to twice the height of the window. The increased performance of this design is bought at the risk of increased glare from stray light reflected onto a standing person's line of sight. This is controllable for direct sunlight by carefully setting the tilt of the mirror so that sunlight striking the mirror will always be directed toward the ceiling. The reflected image of the north sky will not be objectionable because light is reflected to surrounding surfaces and contrast thereby minimized.

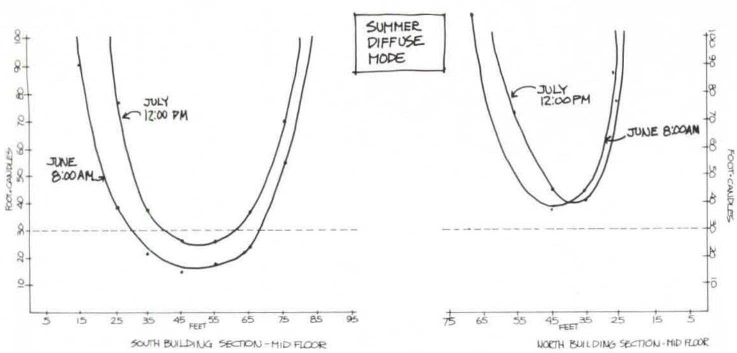
Existing graphic and numerical daylight analysis methods are not easily adapted to handle sunlight or reflected light from multiple sources. This, and the need to provide a visual confirmation of the quality of light expected within the office spaces, indicated the need for model studies to prove the concept and predict its performance. These studies have assumed three levels of complexity.

1. Two-dimensional model: Alzac mirrors were held perpendicularly against a diagrammatic flat surface or section of a room. Light from point sources was reflected from the mirror onto the white surface as a short-cut means of analyzing the path of reflected light for sizing and defining the proper tilt of light shelf mirrors.

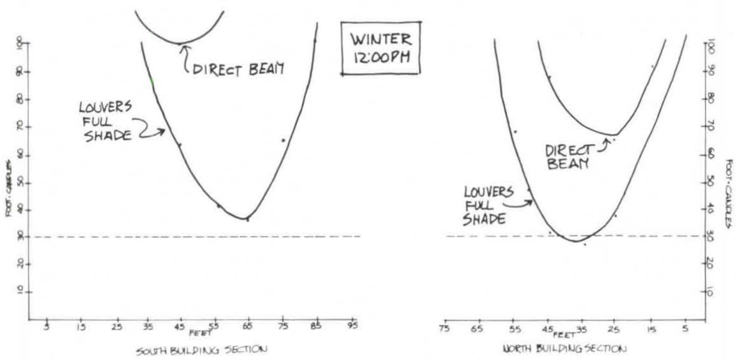
2. Conceptual "shoebox" models: Simple plywood and cardboard scale models (one-half inch to one inch = one foot) of a typical office floor and court roof shading options were used to prove the validity of the design concept and to roughly predict working light levels. These models measured the components



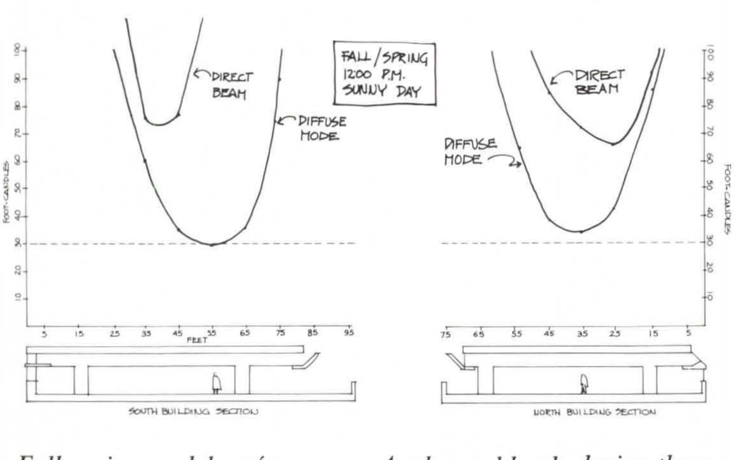
Summer: Direct sunlight is reflected onto the white side of the louver and diffused. Winter: Tracking mirrors reflect sunlight onto a vertical path; the fixed mirror reflects the beam onto the ceiling. Cloudy day: Louvers fully open. Winter night: Louvers closed with the reflective surface down to create an infrared barrier and reduce heat loss.



Summer diffuse mode: The court is fully shaded by the fins and light is diffused off the white side. In this mode the north building section will require no ambient lighting while the south morning condition will require lighting over 50 percent of its area. As both the south light shelf and court mirror are 'seeing' mostly low brightness blue sky, this reading is a 'worst case.'



Winter direct beam mode: Although the direct beam mode should be employed through the winter, a shading mode is shown for contrast. The south building's lowest light level for the shaded court condition is 65 feet from the exterior, indicating the effective performance of the south light shelf mirror in beaming in the low angle winter sunlight.



Fall-spring model performance: As thermal loads during these periods vary, both the direct beam and diffuse louver modes may be employed. The direct beam mode results in light levels over 70 foot candles throughout, requiring no task or ambient lights. The diffuse mode is in excess of 30 foot-candles, offsetting the need for ambient lighting.

Across page, model simulations of the south atrium facade under diffuse daylight conditions (upper left) and direct beam (upper right). The north facade in diffuse mode (lower left) and direct beam mode (lower right).

Using a model to test potential performance.

individually, one side at a time. One model included a 60-foot building section and atrium; another included a whole building section, including two office spaces with a court in between and a 120-foot section. While not architecturally representative, the shoebox models provide a reasonably reliable model of a space's light environment if the reflectance of surfaces is realistically modeled, as well as interior and exterior obstructions to the reflection of light onto the sensor. The good agreement between the shoebox model tests and the later results of the more complex court/office floor model indicates that shoebox models are sufficiently accurate for most simple design needs. Their accuracy need be exceeded only for complex designs, if an automatic dimming system is to be designed or if daylight levels are to be predicted for dynamic energy analysis purposes.

3. Refined daylight and architectural model: A model of a three-bay section of the entire solar court, adjacent office floor on north and south facades and the operable court shading system was constructed at a half-inch scale. This is a smaller scale than the minimum recommended for daylight models (one inch = one foot), but was required by the size of the space modeled. The space is so vast that potential modeling errors attributable to the small scale are minimal. The effects of architectural surfaces, space dividers, furniture and even the building's glazing has been accounted for in the model to increase its accuracy.

The tests on this model are still in progress, but early results are encouraging. As shown on the accompanying graphs, reasonable light levels required for ambient lighting (30 foot-candles) are exceeded in most areas of the building for the times tested so far. Enough illumination to make the need for supplementary task light negligible (70 foot-candles) is provided in about 50 percent of the building during most working hours. These statements may seem rash, based on a few tests made for sun angles approximating well-lit conditions, but preliminary analysis of the tests support their validity.

Accurate understanding and interpretation of the test results, however, require some qualifications:

- These tests are not conclusive in that the glass simulating the effect of the building's glazing has not been installed, and the long-term effects of dirt accumulating on the mirrors, glazing and reflecting surfaces (walls and ceilings) is not accounted for. Visible light transmission through glazing is well documented to be 80 percent for one-fourth inch double-glazed lights.

The system's realistic maintenance factor is still conjecture. Past research into the effects of dirt on light transmission, primarily in the United Kingdom for industrial skylights and in this country for solar collector reflectors, indicates that surface dirt will not seriously affect the transmission of diffuse light through the system. It may impair the specular reflection of direct beam and, to a lesser extent, diffuse daylight. The design team therefore used a working figure of 40 percent for a total light depreciation factor, or 60 percent for total light transmission for calculating the long-term effects implied by the model results. This assumes that TVA implements a relatively conscientious maintenance program.

- On the other hand, the light levels shown in the graphs are conservative in that they were made with the sensor placed within a box simulating a work station. It therefore only received light from the ceiling, simulated open space partitions and from the open "doorway," which is always oriented east/west.

Consequently, the light levels measured, while indicating the amount of light available on a task, may understate the ambient light level perceived by the building's user. Our perception of the brightness and quality of the ambient light environment of a space is influenced as much by light reflected from vertical surfaces as on horizontal, since the vertical surfaces generally occupy the majority of the field of vision for nonwriting task operations. Since vertical walls and partitions receive light reflected from other surfaces and the window wall, as well as light





Photographs by Scott Matthews

Concern for humaneness as well as efficiency.

from the ceiling, the space may well be perceived as brighter than measured horizontal values indicate. This theory will be tested and, if proven, may decide the control conditions for the building's automatic lighting control system.

• The light levels measured do not vary significantly with changes in the sun's altitude or orientation, according to the model. A 100-degree variation in relative sun window azimuth and a 50-degree variation in sun altitude have little effect on the north side and produce an acceptable drop in performance on the south. In fact, the "June A.M." plot for the "summer diffuse mode" is expected to be the building's worst daylighting condition during working hours, since both its court mirror and south-facing light shelf see primarily blue sky. Early morning blue sky at an average measured brightness of 220 to 250 footlamberts is a fraction as bright as an average winter overcast sky and is therefore a "worst case" light source. The north building, on the other hand, is adequately daylit at worst case time in that its court mirror receives light reflected from the north-facing white sides of the roof's shading louvers.

• As indicated above, overcast conditions are not expected to prove significantly different from the diffuse mode results shown because the system is designed primarily to exploit illumination from the sky or, in the court's case, a controlled sky. Consequently, daylight illumination levels under overcast conditions are expected to be lower than those shown for the north building section on clear summer mornings, but higher than those given for the south building under similar conditions. This conclusion is tentative and may be disproved when overcast day test results are made, due to the potential influence of sunlight reflected from surfaces adjacent to or within the light shelves' field of view.

The design's reliance on daylighting interjects another element into the widespread debate over the virtues and liabilities of greater or lesser areas of glass in office design. In common with most energy conserving office buildings in temperate climates, the project's heating load is very small in comparison with its annual cooling requirements. The benefits of passive solar heating are therefore minimal and not generally coincident with the project's peak heating loads. The debate, therefore, was one of increasing glass area for daylighting and view versus decreasing it to reduce thermal loads.

The issue was resolved by using dynamic computer thermal analysis to predict the implications of various glazing options. For the purposes of analysis, we assigned daylight schedules, described later, to account for their relative effect on the building's lighting demand and heating/cooling load due to lighting. Carefully handled, the results partially vindicate both points of view and, more importantly, point the way to greater freedom of expression in office design:

1. Preliminary "shoebox" lighting model studies indicated the clerestory glazing above north and south light shelves and the court light shelves provide most of the daylighting for the office spaces. The view glass is responsible for illuminating only the work stations next to the window.

2. The daylight credit associated with the view glass is small. Unlike the clerestory glazing, it does not offset the thermal energy penalty for the glass, even on the south side. However, the penalty is small: a 2 percent total energy increase of 560 Btu per square foot per year for each additional foot of view glass height over the original dimensions. These included two feet for perimeter daylight and view and three feet for clerestory daylighting. The energy penalties, however, must be weighed against the psychological benefits and the need to meet biological needs for ambient light. The design team is considering this tradeoff.

3. Each additional foot of glass height will increase the building's peak and annual cooling load by 3 percent.

Existing computer thermal analysis tools were sufficient for parameter studies calculating the relative effect of various glazing options given assumed daylight contributions, but are not capable of predicting the extent of that contribution. In the TVA project's case this prediction can significantly affect the design of the project's HVAC and energy management systems, as well as the building's estimated energy consumption.

Up to the present, the development of sophisticated energy analysis programs for building design has been concerned primarily with the dynamic modeling of thermal and operational loads in buildings and the various systems' responses to these loads. Lighting has been modeled as an hourly varying schedule of added thermal load (watts/square foot) and power consumption per kilowatt hour. Daylight, if considered, has also been scheduled, usually as an assumed reduced lighting level.

The obvious drawback to this approach is its static nature. Daylighting, like a building's thermal loads, is affected by external weather conditions. If a large building's daylighting performance is to be accurately modeled, it daylight conditions must respond to hour-by-hour weather changes, just as computer models of buildings' HVAC systems are currently capable of doing.

A dynamic model for daylight design analysis may prove one of the most significant contributions of this project. We are developing a computer code that will automatically vary the power input modeled for daylit zones of the computer model as a function of operating schedules *and* exterior weather conditions. Its rationale, still experimental, is based on developing a correlation between measured daylight levels and measured solar diffuse and direct radiation rates, modified by a factor accounting for sky conditions. It is unclear, at this point, whether such a correlation can be validated, given the usually inverse relationship of cloud cover and solar radiation to sky brightness when considering indirect daylight (greater cloud cover yields less radiation but more diffuse daylighting potential).

The concept's potential is encouraging. A schematic version, using data from "shoebox" tests and assumed diffuse radiation levels, did produce believable and conservative results (40 percent reduction in yearly lighting power demand). If the correlation can be proven, the second generation simulation is expected to yield a substantially higher daylight contribution.

The extension of daylighting beyond the limits imposed by sidelit, shaded windows requires a substantial commitment of design imagination, analysis time and, in some cases, construction dollars. As we move into the 1980s, this commitment is desirable and necessary.

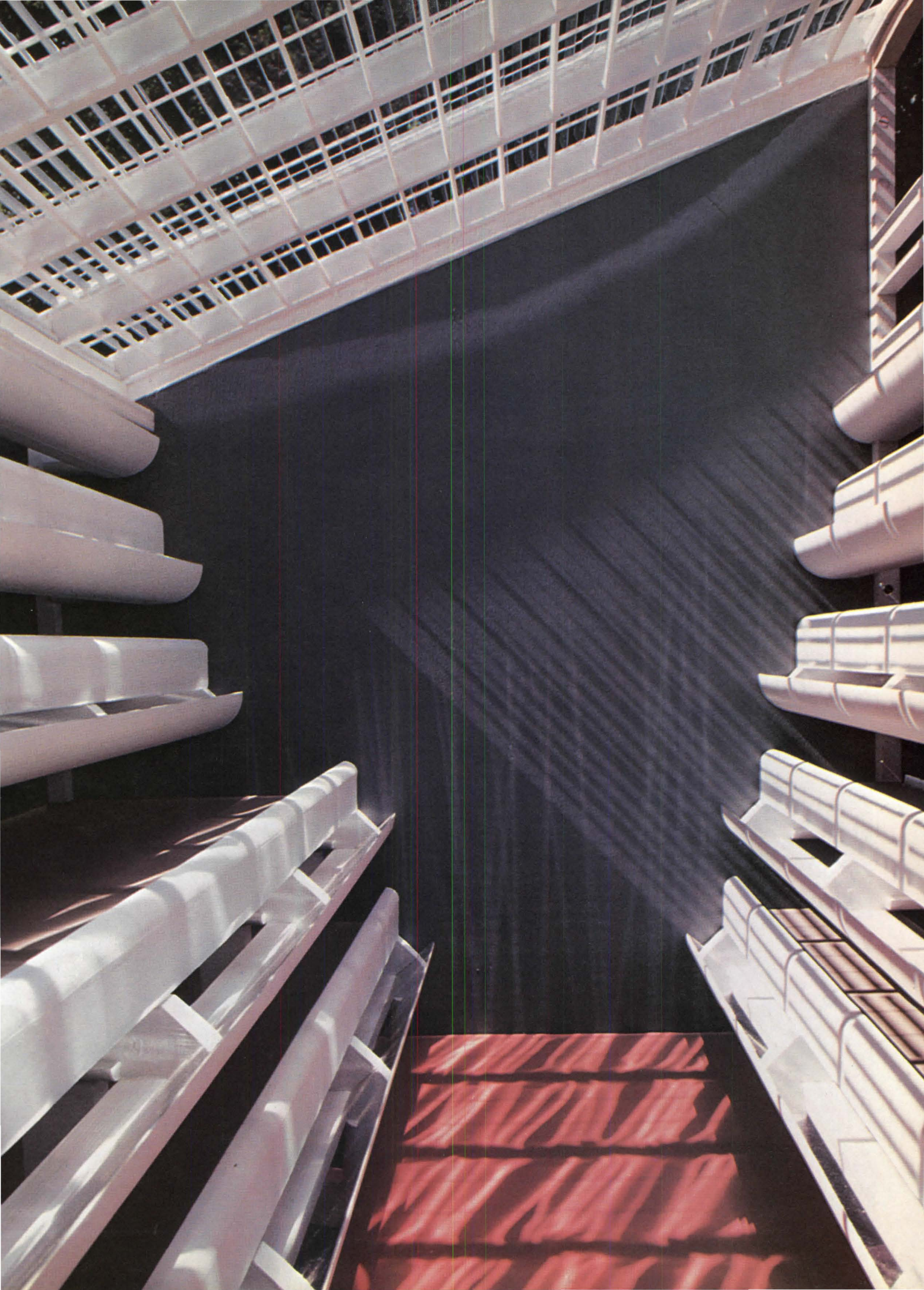
The added effort to daylight a project of this scale and complexity is not justifiable on the grounds of energy savings or by traditional cost/benefit analysis alone. The cost of electricity saved over the economic life of the project cannot alone pay for the system's construction costs if one looks at TVA's currently low electric rates and its high cost of money. But isolating the daylight from the overall design concept and the amenity the daylight provides leads to false conclusions. The political and technical context will change and the climate was especially challenging. But the strongest justification for the daylight effort comes when economy and energy conservation are understood in the context of humane, as well as efficient environments.

Short-sighted decisions that discredit benefits not valued in the financial marketplace have contributed to our national dilemma. How do we place numerical values on the conservation of future scarce resources, the richness of natural light's ambiance and its inherent bond to the day's cycle? How do we quantify the psychological involvement with the passage of the sun and season that daylight can provide the indoor user?

Daylight is more than an energy strategy. It should be an esthetic tool for every architect and a qualitative asset for every building user. This reinforces the notion that energy-conscious design will propagate a humanistic tradition of architectural design. □

Atrium with direct sunlight through open louvers.

Photograph by Don Finkell



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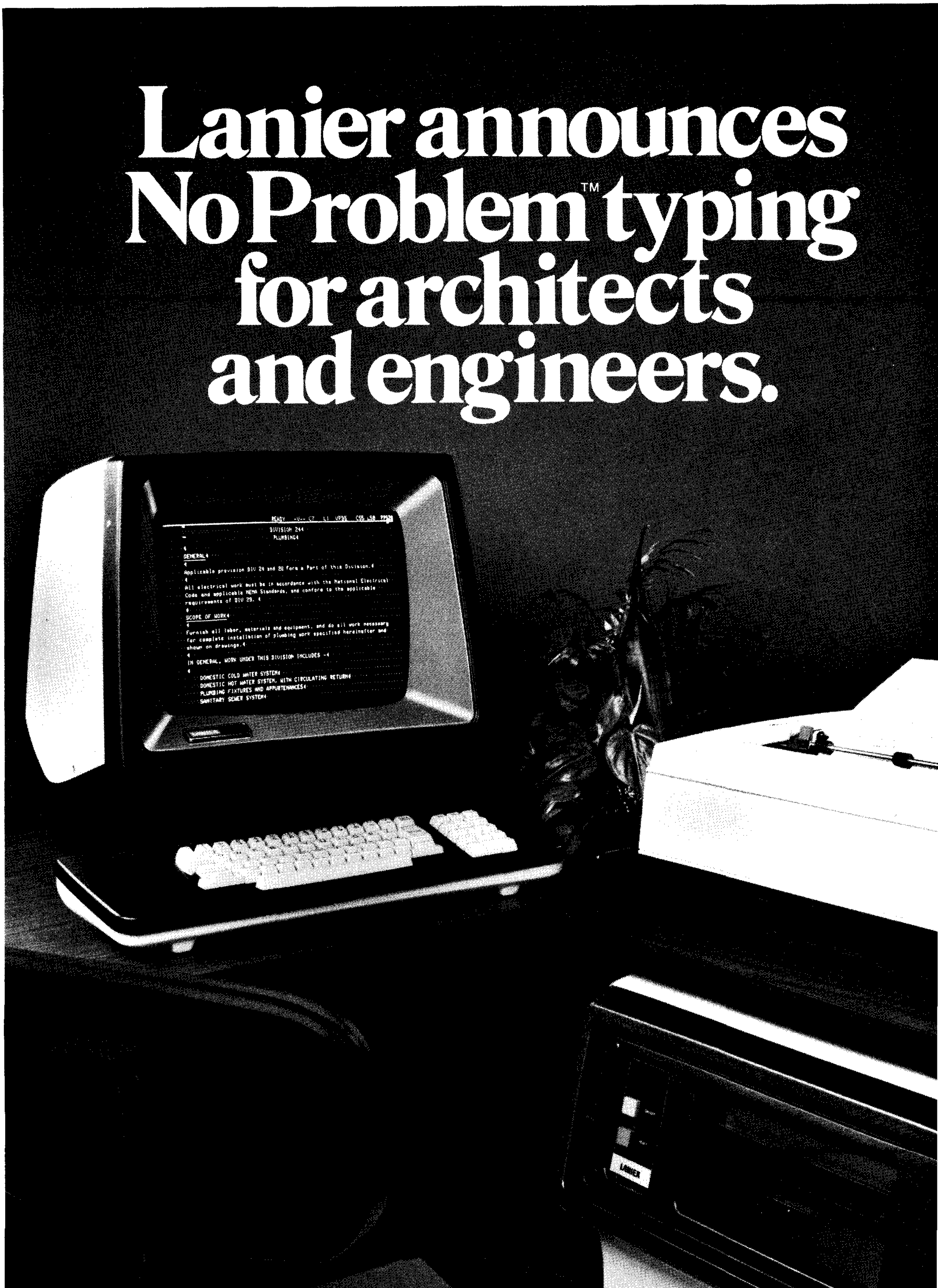
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BOOKS

A Lively Compilation On an Essential Element

Water and the Landscape. Grady Clay, Editor. New York: McGraw-Hill, 1979. 193 pp. $19.50. (A *"Landscape Architecture* Book.")

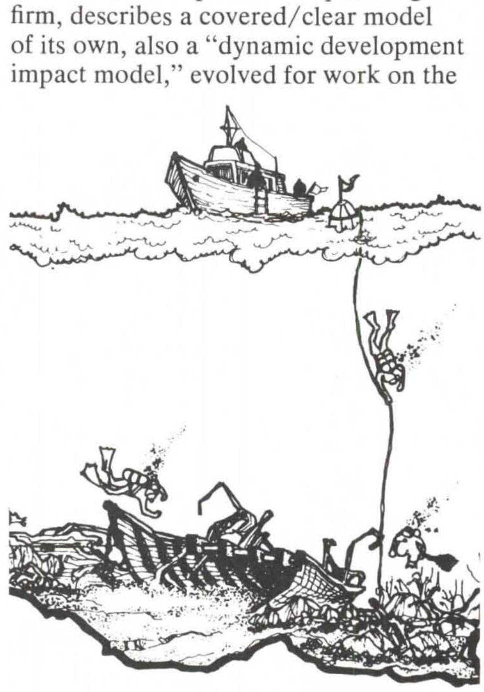
If the title of this handsome book evokes images of Versailles and Blenheim, it is misleading, for ornamental waters—whether formal or informal—are not the concern of a survival manual.

Although landscape architects of the 1970s do still seem to enjoy an occasional bit of urban waterplay, their real attention is elsewhere. Water, for them, is not a material for pictures or sculptures or music, but a vastly complex, ultimately fragile circulation system upon which all life is dependent. They see themselves responsible for maintaining or restoring the health of that natural system and for shaping the built environment to that end; for today's professional, water is less a medium than a master.

Ian McHarg has, of course, been most influential in effecting the transformation of landscape architecture into ecological planning, yet some of the credit must go to Grady Clay, editor of *Landscape Architecture* and himself a veteran Stream Saver. Here Clay has assembled between hard covers 40 or so essays which he commissioned for his magazine between 1970 and 1978. He has grouped them in six headings: Watershed Planning and Design, Communities and Rivers, Low-Lying Land Development, Hazards, Resource Analysis and Management, and Recreational Water Use. The lively, large-view introduction which Clay has written for each section is always welcome, for most of the essays are case histories prepared by the planners of the projects under discussion.

Other than for a few recreational waterscapes, mostly in foreign parts (notably an *underwater* park for Ontario scuba divers, drawing above, and a Dutch mixture of daytrippers' watersports with polder agriculture), the projects studied are from the U.S., and pleasure of any kind is incidental to the achievement of sound water management through appropriate land use and design, based on rigorous problem analysis.

Wallace, McHarg, Roberts & Todd presents a new analytic technique for deriving site-specific limits to impermeable ground cover from the requirements of a natural drainage system—a method developed for The Woodlands, Tex. (the first ecologically planned city, they claim), but applicable to the Coastal Plain from Long Island to Florida. The firm also contributes a description of the planning process which it applied to the new resort community at Amelia Island, Fla. Rahenkamp, Sachs, Wells & Associates, another Philadelphia-based planning firm, describes a covered/clear model of its own, also a "dynamic development impact model," evolved for work on the



Wissahickon watershed, which checks the demands of conservation against the demands of development.

The book contains one rousing story: an account of Wesley Marx, a curious tourist, of how the downtown of Hilo, on the big island of Hawaii, made a "graceful retreat" from the shorefront following the disastrous seismic wave of 1960. How were the people of Hilo dissuaded from rebuilding on the same site? How was relocation financed when federal relief funds are now generally restricted to repair? What does the new waterfront look like? Read all about it.

One might expect that a measure of beauty would result from an attitude toward landscape design which respects natural topography and processes and seeks to avoid the technological fix, but these planner-writers are too busy to do much philosophizing. Aside from a proposal by Roy Winter, writing of stream preservation at Redditch New Town, that landscape design is the best tool for endowing a new town with an "atmosphere of permanence and 'place,' " the only thoughtful statement on esthetics which I came across was in a report by members of the Seattle firm of Jones & Jones on the planning method they developed (evidently an adaptation or elaboration of earlier work by Luna Leopold) in order to identify those portions of Washington state's Nooksack River best suited to preservation, to passive recreation or to active recreation: "Rather than attempting to identify scenic values or preferences, which often leads to ambiguity and confusion, we need only to discover the highest quality of river experience. The potential level of experience will depend on how strongly the river expresses itself—a function of the level or magnitude of intrinsic river characteristics operative at a given location. *Areas possessing high esthetic quality may be assumed to be those which most strongly and distinctly express natural processes and form. . . .*" I have italicized the last sentence because it seems to apply to the landscape architect as creator as well as to his role as preservationist. And isn't it a pity that the esthetics of architecture cannot be stated that simply? *Elizabeh Kassler, author of "Modern Gardens and the Landscape" (New York:Museum of Modern Art, 1964)*

The Architecture of the Renaissance. Leonardo Benevolo; translated by Judith Landry. Boulder, Colo.: Westview Press, 1978. 2 vols. $60.

In this treatment of Renaissance architecture, fully developed as to content and presentation, Leonardo Benevolo carries further his investigations into urban design commenced (for the English reader, at least) in *The Origins of Modern Town Planning* and his *History of Modern Architecture.* Architectural historian and critic, Benevolo is attuned to the concerns and issues of the present day. His scholarship is thus invigorated and his works have received a correspondingly wider audience.

Commencing with Brunelleschi's dome of the Florence cathedral, Benevolo surveys "the inventors of the new architecture." He finds many sources—in painting, sculpture, figurative art, the perspective of Alberti and elsewhere. The new architecture is characterized by autonomy, scientific character, social

continued on page 100

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DRINKING FOUNTAINS

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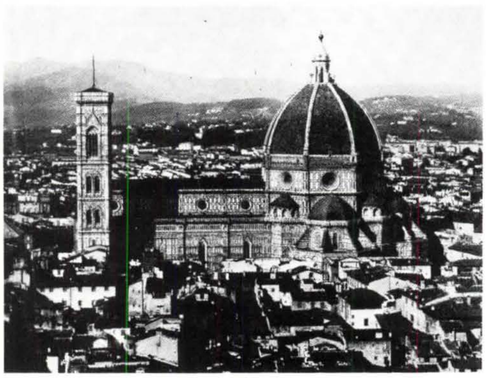
function. A new artistic culture has been created.

These elements are brilliantly synthesized in the chapter describing the ideal city. In an era of urban growth, the new artistic culture is applied to town planning. Engineering is developed as its tool. What Benevolo calls the "third style" (derived from Vasari) emerges in the hands of Leonardo, Bramante, Georgione, Raphael and Michelangelo.

Urban growth in the 16th century provides the framework in which to trace the diffusion of the new urban design as new imperial capitals, port cities of the new trade routes and an enlarged typology of cities appeared. The creative center shifts from Italy to the France of Francois I, to other European nations and to the colonial cities of the world, many of which antedate their parallel examples in Europe. Benevolo's even-handed treat-



ment of urban development in the Americas breaks new ground, sections dealing with Mexico being especially important.

"The crisis of sensibility" is traced in religious architecture commencing with Vignola's Gesù, and in the emerging art of the theater. Here the clarity of the Renaissance concept falters. Benevolo's view is that it is a movement, not a historical period. But it has a beginning and an end, dated 1418 to 1750, by which time "it is a concluded whole."

Now we enter the *grand siècle* and its urban spectacles set pieces—whether redevelopment, extensions or new towns—of Paris, Versailles, Fontainbleau; of Vaux-le-Vicomte and the Palais Royale; of Nancy and Richelieu. In the New World, our attention is directed to the plans of Montreal and Quebec.

Finally, the 18th century produces "court classicism and bourgeois classicism," spread across the entire Western world from Uppsala and Edinburgh to Palermo and Naples, from Batavia to Washington, D.C. It is in Amsterdam that Benevolo finds the most appealing and convincing illustrations of this new urban element where, in Huizinga's words, the spirit of the age "was not here, as elsewhere, embodied in absolutism." English garden design as well as the creation of the squares and crescents of Georgian London, Bath and Edinburgh are thus socially interpreted. Finally, one is given another long and original discussion of the New World's colonial cities and their architecture, with particular emphasis on Mexico.

By now it is apparent that Benevolo has greatly enlarged the idea of the Renaissance; that is, he is concerned with the influence and application of the artistic ideas that originated in Italy in the 14th and 15th centuries, and with what they mean today. The conclusion of this original and remarkable analysis takes up three projects at the urban scale undertaken about 1750: the Place Louis XV (today the Place de la Concorde); the three squares in Nancy, and the reconstruction of Lisbon after the 1755 earthquake. Brilliant as were these three schemes, they disclose the exhausted tradition of the Renaissance. Something new succeeds. The new spirit of rationalism, neoclassicism, the Gothic revival. The universal models of the Renaissance are fractured and the unity of traditional artistic culture has disappeared.

Rousseau, Ledoux and Voltaire are summoned as witnesses to the change. While Rousseau's antiarchitectural view is compelling, the quotation of Voltaire has greater pith: "They talk of a square, and of a status of the king. It is always a square. Even if this square were built, Paris would still be very irregular and very inconvenient. What is needed is public markets, fountains which really do give water, regular crossroads, halls for entertainment. And the roads need broadening."

It is a thought that finds its echo today. And that must be what Benevolo intended. *Frederick Gutheim, Hon. AIA, Washington, D.C.*

Frank Lloyd Wright: His Life and His Architecture. Robert C. Twombly. New York: Wiley, 1979. 444 pp. $19.95.

In the preface to this book, Robert Twombly says: "Authors rarely have the chance to redo books, to correct errors (hopefully without making too many new ones), to restate opinions with the benefit of accumulated experience and to rethink everything conceptually." The book, then, is a revision of Twombly's *Frank Lloyd Wright: An Interpretative Biography* (Harper & Row, 1973). Despite the addition of several new chapters, more illustrations and revisions to the original text, the question becomes the level of fulfillment of the above stated intentions. This question is raised because, in total, the new work seems to "restate opinions" rather than to "rethink everything conceptually."

Of major importance in Twombly's earlier volume was the unraveling of Wright's childhood (especially regarding Wright's father), coupled with exhaustive and comprehensive research into the particulars of Wright's personal, social and public life. Some new material has been added to the new book which extends the earlier contributions. Where Twombly faltered in the initial volume was in his architectural analyses. His assessments were of uneven quality, often failing to come to grips with the architectural influences affecting Wright's life. Therefore, it would seem appropriate for Twombly to have seriously considered the criticism made of the first volume regarding the architectural analyses. This implies that some reconsideration of his original conceptual framework was necessary. By changing the subtitle, implying weight to both "Life" and "Architecture," one assumes major adjustments are made.

While some inroads have occurred in the area of architectural assessment the second time around, what continues to be omitted or glossed over is disturbing. Disconcerting still is Twombly's relegation of Wright's association with Sullivan to a few paragraphs. That, as Twombly states, "Wright's relationship with Sullivan was personally and professionally complex" does not give license to ignore it. Similarly, excluding from discussion the Steinway Hall group does not balance out, in terms of architectural assessment, the well presented development of Wright's social and public life during the same time period. Twombly does, as part of a new chapter, deal more fully with the members of the Oak Park Studio, an obvious response to criticism of the earlier book. But for the most part, personal analysis takes precedence over architectural analysis, qualitatively speaking, in the overall level of development. This can be said as well of the discussion of the Taliesin fellowship, which still suffers from both superficial and seemingly prejudicial analysis, rather than a sincere attempt to clarify the relationship between its more important members and their "master." (This is now made extremely difficult due to the position taken by the Frank Lloyd Wright Foundation in closing its files to all but "approved" scholars.)

This shortcoming evidenced throughout the book suggests Twombly's unfamiliarity with the way architectural ideas and concepts emerge and are evolved. It is no mystery that the great architects of this century, as with their predecessors, freely took and used ideas of their peers and associates. Demanding much from those around them, they did not work in a vacuum, and Wright was not an exception. Thus we find an unfortunate irony in Twombly's book. While he dispels the myth of Wright as always viewing himself as the "persecuted genius" (as Twombly notes, this attitude really began in 1909 and was set forth for the first time by Wright in 1914 with the publication of

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"In the Cause of Architecture: Second Paper"), Twombly approaches the analysis of Wright's ideas and works as if formulated solely by a lone individual unaided by those around him. To more fully understand the role of Wright's many associates does not diminish his own "genius," but puts the entirety of Wright's achievements into a more informative perspective.

But on Twombly's behalf, the discussion of the influence of Japanese prints on Wright, the chapter on the Usonian house (with acknowledged indebtedness to John Sergeant) and the analysis of Broadacre City are among the better accounts in the book. More importantly, Twombly can be quite frank in his criticism of some of Wright's activities, especially those where Wright gets his own way. "During the last three decades of his life, Frank Lloyd Wright spoke and wrote so frequently for lay and professional audiences that he damaged his credibility," Twombly writes. "His style obscured his substance; outrageous remarks, esoteric jargon and abysmal prose fostered misunderstanding and dismissal." If Twombly had brought this level of insight to Wright's architecture, as he does with his life, the book in its entirety would be more satisfying.

Twombly only partially fulfills his intentions in revising his earlier work. While the entire book is well written, extra consideration should have concentrated on the issues I have mentioned. Also, there is need for a work that deals more completely with the later part of Wright's career. In Twombly's case, this could have been achieved by omitting the last chapter on the Taliesin Associated Architects. Added to the works of Grant Manson, Henry-Russell Hitchcock, Vincent Scully, Norris Kelly Smith, John Sergeant, Wright's own *An Autobiography* and Wright's buildings, Twombly's book provides additional material toward our understanding of the totality of Frank Lloyd Wright. But we are still awaiting the comprehensive biography of Wright to be written, if that is possible. *William C. Miller, AIA, Associate Professor, College of Architecture and Design, Kansas State University*

Legal Pitfalls in Architecture, Engineering and Building Construction. 2nd edition. Nathan Walker, Edward N. Walker and Theodor K. Rohdenburg, AIA. New York: McGraw-Hill, 1979. 321 pp. $17.50.

Since the first edition of this book was published in 1968, there have been many changes in construction industry practices. There are changing relationships between designer and builder, and construction management has become a factor in the construction community. Users of the first edition know that the work is comprehensive in coverage. The second edition contains a great deal of new information on such subjects as the architect as developer, construction management, arbitration, professional corporations and copyrights. The authors warn that the book is to provide guidelines for avoiding the inevitable "pitfalls"; they do not intend to "render legal, accounting or other professional services." Legal principles are explained in nonlegal terms through case studies and examples. An invaluable book for any architect's office library.

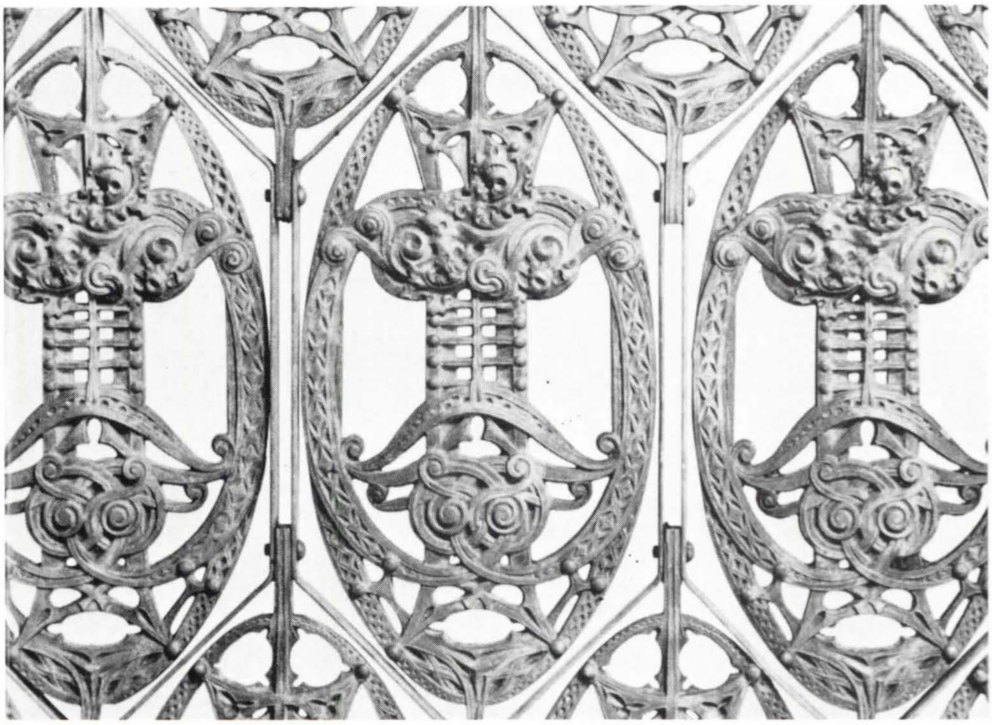
Hotel and Restaurant Design. Douglas Smith. New York: Van Nostrand Reinhold, 1978. 137 pp. $15.95.

The author of this book, a fellow of the Royal Institute of British Architects, has written a comprehensive treatise on the design of restaurants and hotels. His aim is to bridge the gap between client and architect in the improvement of buildings, furnishings and services. With informative text and an array of illustrative materials, Smith discusses planning, site and landscape, building exteriors, interior design, services and equipment and legislation and regulations. He also provides sources for further information—all in Great Britain (the book was first published in London by Design Council). While the section on legislation is also directed to the British reader, the major part of the book covers principles which are applicable anywhere.

Robert Maillart's Bridges: The Art of Engineering. David P. Billington. Princeton, N.J.: Princeton University Press, 1979. 146 pp. $17.50.

Robert Maillart, a Swiss engineer (1872-1940), arrived at a new esthetic for reinforced concrete in his beautiful bridges. This book, as the author explains, centers on a small number of Maillart's most significant works and on his major ideas. The primary goal, he says, "is to explore structural form as it arises out of esthetic feelings and scientific ideas." He succeeds admirably, and even the non-engineer will find the book most interesting. Especially appealing is the discussion of structure as art.

Bridge art, says Billington, as practiced by Maillart, was "vision disciplined by technique; and more specifically, a vision of the public landscape formed by economic constraints on public structures. It is a difficult art, with the artist continually struggling to control his elements in the face of public opinion, codes, budgets and politics." Maillart's ability to accomplish such art puts him in the class of a genius who could not only bridge spaces, but also the distance between science and art. □



The Prairie School Tradition: The Prairie Archives of the Milwaukee Art Center. Edited by Brian A. Spencer, AIA. New York: Whitney Library of Design, 1979. 304 pp. $30. (Available through AIA Department of Publications Marketing.) Through more than 300 illustrations of plans, drawings, buildings and objects, this exceedingly handsome book surveys Prairie school architecture, covering the work of such notables as Frank Lloyd Wright, Adler & Sullivan, the Greene brothers, Walter Burley Griffin and many others. Spencer provides an introduction, biographies of the architects and captions. The book is based on an exhibition organized by the Prairie Archives of the Milwaukee Art Center. Above is a detail of an elevator grille (bronze-coated cast iron) from the Guaranty Building, Buffalo, by Adler & Sullivan (1894-95).

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Strategies *from page 75*
basic dimensions, openings and surfaces; later in the design process, specific architectural features and furnishings must be modeled.

The model must be large enough to use with a meter and camera, or other instruments, but small enough to carry to the site (½-inch to 1 inch equals 1 foot). In an assignment to his students at MIT, lighting designer William Lam notes that a model need not be painstakingly detailed; it needs to be accurate only in terms of room proportions, opening sizes and reflectance and transmission values of plus or minus 10 percent. He warns that some model materials will transmit light and must be covered with chipboard, aluminum foil or paint to make them completely opaque. If adjacent surfaces, such as roofs and pavement, reflect enough light into the model to affect measurements, they should be included in the model and have an accurate reflectance. The plan orientation of the space in relation to north should be noted and the model should have hatches in the floor and walls for taking measurements and photographs. If there is no glazing in the model itself, measurements must be factored to reflect actual glazing conditions.

Numerical calculations complement the physical model design evaluation. They allow the comparison and tradeoffs and an overall assessment of design performance. All but a miniscule fraction of buildings are daylit buildings. But not all of them are good daylit buildings, that use daylight to provide useful illumination, an environment of good quality and energy efficiency. Ask most architects to design a room to provide 50 foot-candles on a desk for 80 percent of working hours by using daylight and you are likely to get a puzzled look and a fast shuffle through papers and textbooks. The problem is not a lack of methods but a lack of accessible, simple and appropriate methods.

There are, in fact, about 60 recognized daylight design methods. But most were developed in Europe, where overcast skies prevail, and few are well suited to this country, where clear skies prevail. All of these techniques, however, can be divided into two main categories: the lumen method and the daylight factor method.

The lumen method was developed by J. W. Griffith at Southern Methodist University for Libbey-Owens-Ford Co. on the basis of extensive model studies under an artificial sky. The method was adopted by the Illuminating Engineering Society and has been the most widely used method in the U.S.

The lumen method allows a comparison of various window wall schemes and their economic tradeoffs with HVAC and electrical lighting values. The effects of various glass transmittances, ground reflectances, wall reflectances, diffusing shades, Venetian blinds, overhangs, clear and overcast skies and direct solar radiation are included in the calculation, which can evaluate them for energy or return on investment.

The method is limited to schemes of maximum utilization of daylight and it predicts illumination levels on a center line from the windows, according to intervals of five feet from the window, the middle of the room and five feet from the back of the room. The technique was designed to evaluate schemes of variable window management, as well as fixed controls, to obtain the total benefits of daylight utilization, rather than meeting a minimum requirement. The method is applicable to a limited range of window configurations and accurate only for points situated along the center line from the window; it is also limited to vertical glazing.

Britain has a well developed set of design aids to deal with issues of daylighting.

The daylight factor method was developed in Great Britain to meet a minimum code requirement. It predicts the daylight anywhere in the room for a standard sky condition without sun incident on the window. The method, which is recommended by the Commission Internationale de l'Eclairage, is used in Europe. Britain has a well developed set of design aids such as diagrams, graphs, tables and protractors to deal with daylighting at various stages of the design process. The daylight factor method is an essentially analytical process.

The daylight factor is described as a percent of diffuse light received at a point of reference. The percent expresses the ratio of interior illumination at a given point to the available illumination from an unobstructed sky outdoors. The point of reference is a horizontal plane.

The method allows nonuniform sky luminance distribution and is sensitive to the position of a window in a wall. There is no limit to room size or shape and it accommodates nonvertical glazing. Its capacity to respond to shading devices is limited, as is its capability to deal with clear sky conditions. Direct sun is essentially excluded. The daylight factor, however, does provide a relative measure of all daylight, not only light directly from the sky (including losses from glass, dirt, window bars, etc.), but also the contributions from light reflected directly to a reference point from visible exterior surfaces and from light interreflected between the room's interior surfaces.

Both the lumen and daylight factor methods can be used in the early stages of design to evaluate alternative schemes without a computer. If the window schemes are on the east, west or south, the lumen method allows tradeoff evaluations with variable sun controls.

Computer models have also been developed for daylight calculations: to compute illumination levels and equivalent sphere illumination levels in daylit rooms. (ESI is a useful, or nonglare foot-candle. Specifically, it is the foot-candle illumination in a sphere that gives equal visual performance to the illumination, of whatever foot-candles, in a specific lighting system. Daylight from side windows provides two or three times more ESI than typical overhead light sources. ESI cannot be effectively measured in a physical daylight model because the measurement instruments are too large.) Available computer models, however, cannot easily model specific architectural details or such information as the placement and nature of room furnishings. The computer models also must still rely on essentially static analysis of a dynamic design problem.

Lumen II Daylight is a computer program for predicting daylight illumination and ESI for a simple task anywhere in the room. It is relatively expensive and therefore of limited usefulness in the early stages of design. The value of the ESI component is also being studied; Blackwell, the originator of ESI, has questioned the method he used to obtain calculation factors.

The physical and mathematical daylight analysis methods discussed deal only with the illumination aspects of daylight design. Daylight implies thermal tradeoffs that also need evaluation. The sizing and placement of windows to maximize daylighting benefits need to be considered in the context of thermal performance and overall energy performance.

A number of computer programs have been developed for energy analysis, but they are based on certain mechanical assumptions about the thermal design of a building. And none deals with daylight. Most concentrate on thermal design and deal with illumination by using standardized operating profiles for installed lighting.

Some of these programs are relatively complex and can model a building's performance hour by hour throughout the year. Daylight performance has been incorporated experimentally into several of these, but the results have yet to be validated by comparison with actual conditions. None is at a state where an architect could use it with confidence to obtain accurate information.

The pressures for an integrated thermal/illumination model incorporating daylight continue to build. New energy perfor-

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mance standards will generate more pressure to incorporate daylight into existing energy analysis programs. But the problems of validation and the implications of the simplified data used in a computer program have yet to be resolved. Such programs also need to be user oriented, accessible and inexpensive.

The issues surrounding the illumination aspects of daylight and how to provide the designer with accurate information continue also to be the subject of intensive research. Daylight availability is so variable that trying to predict absolute values is not cost effective; therefore the precision of any measurement may be less important than in other cases. The lumen or daylight factor methods will give the architect a relative evaluation of alternative schemes useful for early design decisions. The physical model remains the most cost-effective way to approach absolute values for specific design solutions, allowing both qualitative and quantitative evaluation, and perceptual as well as analytical insights.

Codes

Their relationship to daylight design has become more critical in the era of energy regulation.

The issue of solar access has become a critical concern as architects and planners start to address the uses of solar energy at community scale. Ralph Knowles has done the pioneer research into the use of a solar envelope as a basis for solar access zoning. This envelope defines the maximum volume of development possible for a given site and set of time constraints without shadowing the neighboring surround. The issue of daylight access in a legal context raises some parallel issues when applied at urban design scale.

J. W. Griffith addressed the issue of daylight in building codes in 1962 when he prepared a model residential ordinance for Chicago. The code was not implemented, but the concept has gained new relevance today. The purpose of the daylight code was to establish minimum standards of daylight for habitable rooms where the Chicago building code already required a window. The scope of the task also included the development of workable techniques for applying and testing compliance with the code, and it included an examination of the impact of daylight controls in a variety of locations and situations.

The Griffith report noted that the Chicago building code already required effective clear glass areas of "not less than 10 percent of a room area." But a window specification is not a daylight specification. So the code further stated that the minimum amount of glass should be increased to 25 percent if the window was obstructed. The code also included dimensional requirements for courts and side yards for daylight purposes.

Griffith's proposed regulation called for 10 foot-candles of daylight in habitable rooms. Since this was a worst-case condition, it was assumed that most rooms would have higher daylight illumination levels. A version of the British daylight factor measurement technique was recommended to determine compliance. Based on an average room depth of 14 feet, Griffith chose a penetration of 7 feet at a height of 30 inches (desk height) as a measurement point of reference.

The implications of the daylight code are of interest today. Sites in desirable locations for daylight could increase density to the limits of existing floor-area ratios and economic parameters. The regulation, however, would encourage orientations, at either the building or apartment unit scale, that would maximize the potential for daylight and minimize obstructions.

Open space requirements would vary with building height and bulk. In very congested areas, the residential use of lower floor areas could be restricted if obstructions prohibited minimal daylight penetration. The relationships between buildings, including new and old construction, would become critical.

Where conformance to the daylight code was based on sky conditions, the maximum density and bulk of a building could be determined by conventional floor-area ratios. Where a reflective component is necessary, the daylight control would fix the height of a building (taller buildings may block the light from an obstruction and therefore decrease reflected light).

The daylight code would affect the orientation of buildings and the dwelling units within them in relation to the surround, but would not require unusual or undesirable building shapes. Griffith noted that the lower residential floors present the most restricted daylight condition and that codes for vertically stepped buildings therefore offer little daylight advantage.

The issue of daylight in relation to building codes is especially critical in this era of energy regulation. Component performance standards, such as ASHRAE 90-75, which has been adopted by many states, are based on assumptions about the thermal performance of windows that have resulted in strict limitations on window area. These assumptions relate to the concept that windows are a source of uncontrolled heat loss and heat gain and therefore a burden to mechanical heating and cooling systems. Such assumptions,

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however, not only ignore the potential for passive solar design to achieve thermal comfort, but they also limit the potential for daylight. Less glass area means less exposure to skylight, sunlight and other daylight sources.

Energy performance standards that relate to the performance of a whole building and do not specify the performance of individual building components are far more sympathetic to daylight design strategies. These standards do not specify the design of a building, but only its performance, and skillful use of daylight promises significant improvement in the performance of a building, not only in energy terms, but in human terms.

There are situations where design strategies for daylight would seem to conflict with design strategies for efficient thermal performance. These conflicts, however, are greatest when the designer assumes mechanical solutions to thermal comfort. While daylighting may result in tradeoffs with the version of energy conservation that dictates compact buildings, small surface-to-volume ratios and minimal windows, it is thoroughly compatible with many aspects of passive solar design.

Daylighting implies large window areas that can be oriented and controlled to admit solar heat and light in heating seasons, or only light in cooling seasons. It implies high ceilings, which complement natural ventilation. It implies controls that respond to the sun dynamically. It implies asymmetrical building forms and differentiation by orientation, as does passive solar design.

Daylight also implies an urban design concern for a public right to light that is slightly different but nonetheless consistent with the concept of solar access. And daylight implies a relationship between the user and the natural variations and tempos of day and season, something that has been lacking in most modern urban environments. For many people concerned with the quality of urban life, the bond that daylight can forge between people and natural cycles is its most critical contribution.

Certainly energy is one of the justifications for renewed interest in daylighting. But the energy argument frequently put forward in its defense may not be the correct one. The most frequent argument is that daylight can offset large electrical demands for artificial lighting systems. This is subject to a number of important qualifications, however. One is that natural lighting cannot reduce energy consumption if the electrical lighting system is not responsive to daylight conditions. Many highly publicized daylit buildings have artificial lighting systems that are designed and operated with no regard for daylight contributions to illumination. Another qualification is that daylight must be considered an integral part of the building design, an important consideration in the location and form of the building. Separating the daylight elements from the overall building and assessing them by a conventional cost/benefit analysis may lead to false conclusions about their cost and energy efficiency.

Steve Selkowitz of Lawrence Berkeley Laboratories (LBL) has been particularly concerned with current justifications for daylighting. He cautions that daylighting must be justified on human and environmental grounds as well as improved visual performance. He has also developed some strong energy arguments, but they are not the conventional arguments.

At LBL, Selkowitz has been involved with some of the research into more efficient artificial lighting systems and components. He is concerned that if people justify daylighting solely on the basis of reduced electrical demand, predicted improvements in artificial systems will make comparative daylight "energy savings" ap-

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pear insignificant. Task/ambient lighting systems are now available that operate in the range of 1 to 1.5 watts per square foot of installed power. If one projects the introduction of electronic ballasts and improved fluorescent lamps with improved phosphors and higher efficacy, and smaller HID systems indoors with improved color rendition, one can expect to see indoor lighting systems with efficiencies of 100 lumens per watt. This is roughly a 50 percent improvement over the typical 65 lumens per watt for conventional fluorescent systems. Improved lighting practices, will further reduce electrical demand.

With these changes, lighting electrical power demands could be reduced from 7.5 to a range of 1 to 3 kilowatt-hour per square foot per year. The 1 to 2 kilowatt-hour per square foot per year now achieved with daylighting seems less impressive in this context. By that criteria alone, daylight contributions to energy conservation might make daylight design seem superfluous. But Selkowitz does offer strong energy justifications for daylighting that are not compromised by advanced artificial systems. One argument relates to peak power demands; the other relates to power system failures.

Peak power demands remain a critical issue for utilities, and lighting demands frequently coincide with peak heating and cooling loads. Charges for peak power may represent a significant fraction of a firm's total electric bill. Many utilities are now implementing selective rates to penalize peak power consumption. One utility in the state of Washington is now campaigning for the use of daylight as a way to reduce peak power demand.

The significance of peak power demand can be seen in the following example. Consider a typical all-electric office building in which half of the energy load results from lighting. Assume that one-third of the usable floor space is close enough to a window to benefit from natural light. The maximum potential daylighting savings is this one-third of the electrical demand for lighting, or about 15 percent of total energy demand. If 50 percent of that is achieved by a dimming system, the daylight contribution is only about 8 percent. The peak power situation is quite different, however.

Under summer peak conditions, typical cooling loads amount to 5 to 10 watts per square foot, of which 3 watts represents lighting. With a net coefficient of performance of 2, the cooling power requirement is that 2.5 to 5 watts per square foot. If we turn the lights off in one-third of the building area, we reduce the power consumption by 1 watt per square foot and also produce a reduction in cooling requirements equivalent to one-half a watt per square foot. Under these circumstances, daylight saves 1.5 watts per square foot, or roughly 10 to 20 percent of the building's peak power demand.

The cost of new power plant construction is frequently $1 to $2 per peak watt of installed power. In a new building, a 150-square-foot office with 3 watts per square foot of lighting requires a utility investment of $450 to $900 in new generating capacity. Although this analysis is greatly simplified, it would seem that dimmable controls or other strategies to increase daylight contributions would be a sound investment. In the case of the Washington utility mentioned earlier, the argument is even stronger. It currently relies on hydropower to produce relatively inexpensive electricity; should additional generating capacity become necessary, it would have to turn to nuclear power and electrical rates in the area would soar.

Selkowitz's second energy argument for daylighting concerns the high cost of power disruption. As power has become increasingly centralized, power failures become more critical and, in recent years, we have experienced city, state and regional power system failures. Daylighting is a design option that, at the scale of a single building, can reverse the trend toward greater reliance on remote centralized systems. As such, it has a flexibility and degree of failure tolerance that appears to be important, although it is difficult to quantify.

It is possible, however, to quantify the effects of disruption on worker productivity. High light levels have been sold on the basis of productivity. Assume that an office worker, with appropriate indirect and overhead charges, costs a company $40,000 per year. The worker occupies 100 square feet of space, works 250 days, and thus costs $160 per day, or 20 cents per square foot per hour. Lighting, at 4 cents/kilowatt-hour, costs 25 cents to 30 cents per square foot per year. If a daylit office building is able to continue productive work for even one hour during a blackout or power loss, the dollar savings are equivalent to an entire year's worth of energy savings.

Energy arguments for daylighting are particularly persuasive as we face rising costs and shortages of fossil fuels. Energy has certainly brought new financial support to daylight research and new enthusiasm for the potential of daylight as a design strategy. But energy shortages are not the reason that daylight is important. Far more important is the complement between the natural and artificial environment that daylight facilitates and far more important is the improved quality of design it promises. Daylight is a fundamental architectural form issue. Wright, Aalto, Kahn, Corbusier and other masters knew the functional and esthetic promise of natural light; we are rediscovering it. ☐

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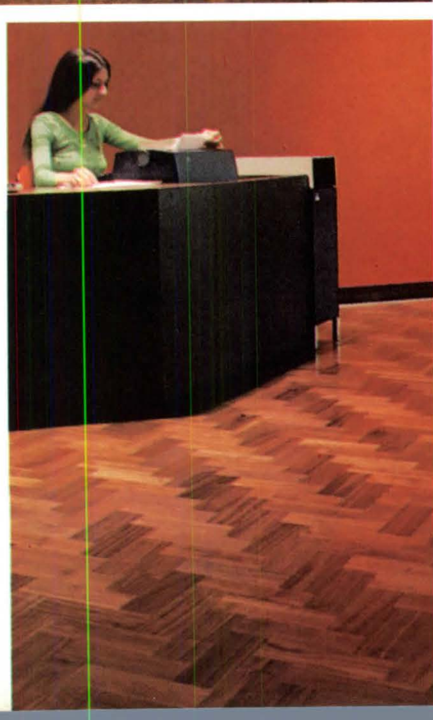

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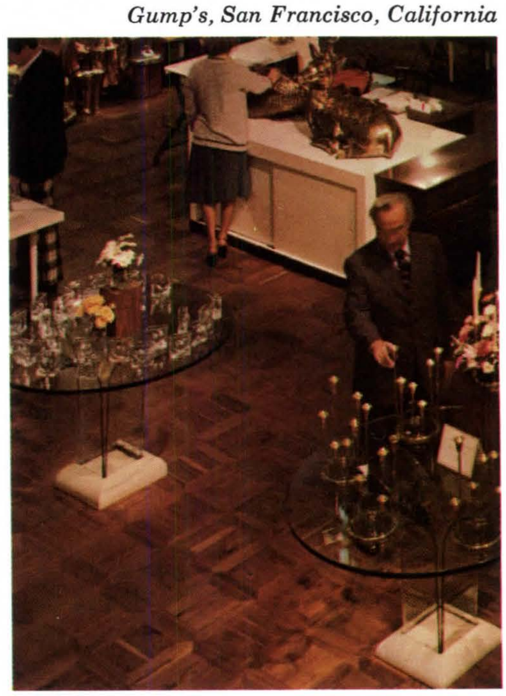

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Government *from page 44*

HUD says the estimates of discrimination are conservative. The study did not include houses for rent or sale by private owners, apartments for rent in duplexes or triplexes or houses advertised by builders or developers. The study reveals nothing about discriminatory treatment in such matters as financing or insurance, focusing on an initial visit to a rental or sales office. Nor are estimates given for the discriminatory practice of showing blacks houses primarily in black neighborhoods and whites houses in all white communities.

Moreover, in instances where both blacks and whites received favorable treatment of any kind, it was tallied in the "no difference" category, even though the balance of an encounter seemed to favor the white. Also, estimated discrimination is reported in net rather than gross terms—instances of favorable treatment were subtracted from instances of less favorable treatment.

The data were collected in the spring of 1977 and are based on treatment given to 600 trained auditors—300 blacks and 300 whites—when answering housing advertisements in local newspapers. Overall, 3,264 audits were conducted. The teams were virtually identical in all respects except race.

The study focused on housing availability because differential treatment is in violation of the Civil Rights Act of 1968 and because differential treatment is the "most fundamental form of discriminatory practice that a black apartment seeker might encounter."

Both white and black auditors would request an apartment of the same size at a rental complex. If a first choice was not available, they asked for the same second choice. If that was unavailable, they asked what was. "For all items," the report says, "the white was favored more frequently than was the black. For example, both members of audit teams were treated no differently 40 percent of the time in terms of the number of apartments the agent volunteered were available; however, when differential treatment occurred, more units were volunteered to whites 42 percent of the time, but more units were volunteered to blacks only 18 percent of the time."

The study also says that there is a "small but statistically significant tendency for blacks to have waited longer for an interview, to have had a shorter interview, not to have been asked to be seated, not to have been offered a business card and not to have been invited to call back."

The study does not answer the question of whether racial discrimination has changed over time, but "it does provide a baseline for future research. . . ."

Construction Begins This Month On U.S. Embassy in Moscow

After years of disagreements over cost estimates, the U.S. and the Soviet Union have finally signed a contract for the construction of a new American embassy in Moscow, with construction to begin late this month. In 1969 and in 1972, the two countries had signed a two-part treaty for new facilities in Moscow and in Washington, D.C. (see Oct. '78, p. 106). Although the residential portion of the Soviet complex in Washington is now complete, the Americans have been behind in getting construction going at a site on the Moscow River.

The Soviets had asked for $80.2 million to build the American complex (architects: Skidmore, Owings & Merrill and Gruzen & Partners), at which the Americans balked. Under the contract signed on June 30, Soyuzvneshtroyimport, a major contracting firm in the Soviet Ministry of Trade, will build the American complex for $54.6 million, plus $3.8 million for architectural and engineering services. According to a State Department press officer, agreement was finally reached "on changed quantities of materials to be used."

This opens the way for the Soviets to occupy completed residential and recreational facilities and a school which had been barred by the State Department. Work has not yet begun on the Soviet chancery in Washington.

News/Education

Salvadori Finds Biggest Rewards In Teaching E. Harlem Children

Mario Salvadori, professor emeritus of civil engineering and of architecture at Columbia University, has been teaching engineering and architectural students for half a century, but he has found that "the mind of a 12-year-old is much more open to new ideas than an adult's and need not be limited by an impoverished environment." Salvadori, author of *Mathematics and Architecture, Statics and Strength of Structure, Structure in Architecture* and other books and now a principal of Weidlinger Associates, a consulting engineering firm in New York City, carried the basic principles of architecture and engineering to minority children in an East Harlem school. The project, and all that has happened since the initial effort, he says, demonstrates that "imagination can transcend environment and that children surrounded by urban decay can realize the promise of building something beautiful."

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When the New York Academy of Sciences asked its members if they would be willing to teach schoolchildren scientific disciplines, Salvadori, a pioneer in the technology of reinforced concrete, volunteered to teach a three-month course in architectural structures to 7th and 8th graders. He admits that on the first day he was "scared stiff." But during that first 80-minute session, the children learned "how the weight carried by one column is supported by the column under it, one floor below. By the end of the session," Salvadori says, "the youngsters were able to determine how many million pounds are supported by a single column at the foundation level of the World Trade Center."

After his "heady" session, Salvadori brought in Columbia students to help and such tools as paper, string, wood, foam rubber, glue and Erector sets. "Years ago, I concluded," he says, "that the subject of architectural structures could be taught without the use of mathematical tools, and that often my architectural students had not seen the structural woods because of the mathematical trees. I then decided that a purely physical approach could, and should, be used when teaching architectural structures."

With this approach Salvadori taught the 28 children who volunteered for the course (it ended with a maximum capacity of 30 students) about the effects of gravity and wind loads on structures, the concept of dynamic or impact loads, the principles of suspension bridges and other "pretty heavy stuff," as he calls it. The children used Erector sets to make trusses, arches, suspension bridges, high-rises. Probably the highwater mark was the concluding session, Salvadori says, when a TV crew and reporters came in and watched the children build a six-foot arch bridge out of an Erector set and receive certificates from the American Society of Civil Engineers.

Salvadori calls this first experience in teaching children "the most rewarding of my entire career. Rarely have I had a group of students so eager to learn." And being the pioneer that he is, Salvadori went on. He has taught New York City teachers to carry on his concept and he has continued to teach schoolchildren. He also prepared a teaching manual. One byproduct concerns the graduate students who worked with Salvadori on the project. They "discovered how much one learns by teaching," Salvadori says. "They also found that preparing models we used for demonstration purposes was a concrete way of making their own theoretical knowledge physically clear."

And what of the younger students who have been transported into another world of exciting new ideas? Well, one 13-year-old girl said it was "interesting" to learn why the Leaning Tower of Pisa leans. "Half of the ground is sand and water, and the other half is hard," she explained. And another, who wanted to go on and on, said, "The only thing I didn't like was nothing at all." And as for Salvadori himself, he says, "As a professor of architecture, I have enjoyed building a new bridge to the children of New York."

Exxon has donated funds for a film to show the way Salvadori has motivated the so-called underprivileged youths to enter mathematical and scientific fields. Salvadori has offered the film, where feasible, for loan to AIA chapter meetings. His address is Weidlinger Associates, 110 E. 59th St., New York, N.Y. 10022.

Trying to Keep Colleges Urban

HUD and the American Association of State Colleges and Universities (AASCU) are developing policies and strategies to keep institutions of higher education in central cities. A model set forth in a "memorandum of understanding" will "encourage direct state college and uni-

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Education *from page 118*
versity relationships with cities and will lead to increased college and university participation in its revitalization of cities," said HUD Assistant Secretary Robert Embry.

Under the agreement, AASCU will encourage its member institutions to renew their commitment to central cities by retaining and, where feasible, expanding their facilities in cities rather than in outlying areas. AASCU also will call upon its members to offer a variety of educational and cultural programs for inner city residents and officials.

HUD will endeavor to effect a "coordinated federal response" to the efforts of the institutions to carry out strategies and programs consistent with the Administration's national urban policy, will give technical assistance where required and, when relevant, will help in securing federal financial assistance through available grants and loans.

News/Preservation

Guidelines Set Forth to Buy, Develop, Use Historic Buildings

The Secretary of the Interior sets standards for programs under his authority that affect cultural resources listed or eligible for the National Register of Historic Places. These standards must be used by state historic preservation officers and by the heritage conservation and recreation service to evaluate grant-assisted proposals, reuse proposals submitted by state and local governments for the transfer of federally owned surplus properties listed on the register, and to determine if a rehabilitation project is certified in accordance with the Tax Reform Act of 1976 and the Revenue Act of 1978.

"The Secretary of the Interior's Standards for Historic Preservation Projects, with Guidelines for Applying the Standards" was issued recently. Developed by W. Brown Morton III and Gary L. Hume, the guidelines have been designed to help individual property owners formulate plans for the acquisition, development and continued use of historic properties in a manner consistent with the standards. The guidelines may be applied to buildings of all construction types, sizes and materials.

Among the general standards to apply to all treatments undertaken on historic properties listed in the national register are:

- "Every reasonable effort" shall be made for minimal alterations in seeking a compatible use for the property or to have it used as originally intended.
- All structures and sites "shall be recognized as products of their own time," and alterations without historical base should be avoided when possible.
- Wherever possible, deteriorated architectural features shall be repaired rather than replaced.

The document also outlines specific standards for acquisition, protection, stabilization, preservation, rehabilitation, restoration and reconstruction. For example, one of the protection standards says that when an architectural feature is removed, it should be recorded and, if possible, stored for future study or reuse. A rehabilitation standard says that contemporary designs for alterations and additions shall not be discouraged if they do not destroy significant historic, architectural or cultural material and if such design is compatible with the size, scale, color, material and character of the property.

The publication also lists recommended and not recommended actions for use in applying the various standards. For example, it is recommended that storm or insulating windows be used to protect the historic fabric, but "inappropriate new window or door features

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Preservation *from page 120*
such as aluminum storm and screen window combinations are not recommended if they require the removal of the original windows and doors."

Also it is recommended that landscape features be retained; the removal of lighting devices, telephone poles, painted signs or other street furniture is not recommended if it is important to the historic setting. Nor is the removal of old plantings, fencing, walkways and outhouses recommended. It is also recommended that interior stairways be enclosed where required by code in such a way as not to disturb the original character.

Single copies may be purchased for $2.30 from the Government Printing Office, Washington, D.C. 20402 (stock number: 024-016-00105-2).

DEATHS

Sherman W. Bowen III, Sikeston, Mo.
Milton V. Bradley Jr., Atlanta
Lynn James Callahan, Salem, Ore.
Boris Rosenfeld, Newport News, Va.

Douglas Haskell, FAIA, architectural writer and editor, died on Aug. 11 at the age of 80. His involvement with architecture began just after he was graduated from Oberlin College in 1932. He visited the Bauhaus group in Germany and also befriended and came under the influence of such architects and planners as Frank Lloyd Wright, Lewis Mumford, Henry Wright and Clarence Stein. Haskell's first venture into architectural journalism took the form of a long article in 1928 on Frank Lloyd Wright for *Architectural Record,* a magazine for which he was a writer and editor until 1949.

In 1930, when, for the most part, only specialized journals concerned themselves with architecture, Haskell wrote his first column for *The Nation.* In it he defined architecture as a concept "of man working upon the whole of his environment to put it into habitable, workable, agreeable and friendly shape."

Haskell was with *Architectural Forum* from 1949 until 1964, first as architectural editor, then as editorial chairman and finally as editor. "One reason the *Architectural Forum* was different from all other architectural magazines, before or after," says Peter Blake, who succeeded Haskell as *Forum* editor, "was that Doug was different from all of his contemporaries. He knew more about the real origins of modern architecture in America than almost anyone else. While all the rest of us were convinced that modern architecture had been invented more or less in Western Europe and then brought to Harvard in the 1930s by people like Gropius, Doug would talk about the significance of the Grand Central complex, about Rockefeller Center, about people like Henry Wright and Clarence Stein."

Nathaniel Owings, FAIA, who knew Haskell as *Forum* editor and worked with him on the first Pennsylvania Avenue advisory commission, says, "We've always had a problem of having an editorial approach in architecture which is slanted toward one style or another, one building or another or even toward architects as a whole. Doug thought in terms of the country as a whole, of architects working in the service of the nation, rather than the other way around."

Haskell was valued not only for his insistence on taking what Owings calls the big view, but also for his "continual insistence on ferreting out the news—no minutiae were too small for him to get involved—for finding and discovering promising architects, taking stands, speaking out," in the words of Pietro Belluschi, FAIA. His habit of speaking out put Haskell into conflict with many, but as Lewis Mumford points out, "A happy thing about our relationship was that we differed very severely, but it was in the right spirit, which so many people had in those days. We didn't want to kill each

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A dash of dazzle in a shopping center.
ELEVATOR BY DOVER
It's quite a trip for shoppers when they move from the main level to the promenade level of the Rolling Acres Mall in West Akron. Designer James B. Heller of Keeva J. Kekst Associates combined glass, chrome, and incandescent lamps to create a "vista" elevator that dazzles and delights. At the heart of these glamorous trappings is a Dover IVO Elevator, the high quality, pre-engineered Oildraulic® elevator made for add-on or new construction of three stories or less. For more information on the complete Dover line of traction and hydraulic elevators, write Dover Corporation, Elevator Division, P.O. Box 2177, Dept. G, Memphis, Tenn. 38101.
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other because we had differences of opinion."

Although Douglas Haskell was not an architect, he was admitted to the Institute as a corporate member in 1953, was made a fellow in 1962 and was again honored in June with a medal for his efforts to "inspire and influence the profession of architecture through his writings." He was also an adjunct professor at Pratt Institute and Columbia University and a proponent of urban revitalization, public architecture and preservation. "For years, including during my own presidency of the AIA," says Morris Ketchum, FAIA, "the Institute has been worried about how to interest the public in architecture, how to make people understand it and appreciate what it can do for them. Suddenly, the job's done for us through landmarks preservation, a cause which Doug strongly inenced through his talks across the country.

"We must learn to say, 'Doug was,' " says a longtime friend and colleague, Chloethiel Woodard Smith, FAIA, "but the ideas of this brilliant, vital man will remain present tense. Doug gave to so many—professional colleagues and friends—a new sense of architecture as a 'whole' experience, beyond the confines of technology and observed form."

BRIEFS

C. William Fox, AIA, a Philadelphia architect and member of the faculty at Temple University, has been appointed chairman of the architecture department in Temple's college of engineering technology.

The Concrete Reinforcing Steel Institute in its fifth annual awards program has added a new category of energy-conserving design. Structures eligible for awards are of cast-in-place concrete, with conventional reinforcing bars as the predominant reinforcement. Deadline for entries is Oct. 29. Contact: CRSI, 180 N. LaSalle St., Room 2110D, Chicago, Ill. 60601.

William L. Porter, AIA, dean of the school of architecture and planning at the Massachusetts Institute of Technology, will relinquish the deanship at the end of the 1980 academic year, resuming his duties in teaching in the school's environmental design program.

More than 100 architects participated in the third Olympic architects national tennis championships during the AIA convention in Kansas City. The affair is sponsored annually by Olympic Stain. Charles F. McAfee defeated Charles L. Willis in the singles finale and then joined with Marshall E. Purnell to take the doubles. Beverly Twichell teamed with Avis E. Halfinger to win the women's doubles, and then with husband Seth took the mixed doubles crown. Women's Susie Graves.

The life and works of Thomas Ustick Walter, architect of the U.S. Capitol dome and wings and AIA's first vice president and president from 1876-1886, is the topic of a major exhibition at The Athenaeum, 219 S. Sixth St., Philadelphia. The exhibition will run from Oct. 29 to Dec. 28.

The Preservation Society of Charleston, S.C., will sponsor its annual fall house and garden tours on Oct. 10, 11, 12, 13, 18, 19, 20, 26 and 27. Proceeds go toward preserving the city's architectural heritage. For information, contact: Preservation Society, P.O. Box 521, Charleston, S.C. 29402.

Houston will lead the nation in multifamily housing starts this year, according

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RIVERSIDE GENERAL HOSPITAL CHOOSES LOW PRESSURE SODIUM

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Dr. Paul Cavalli
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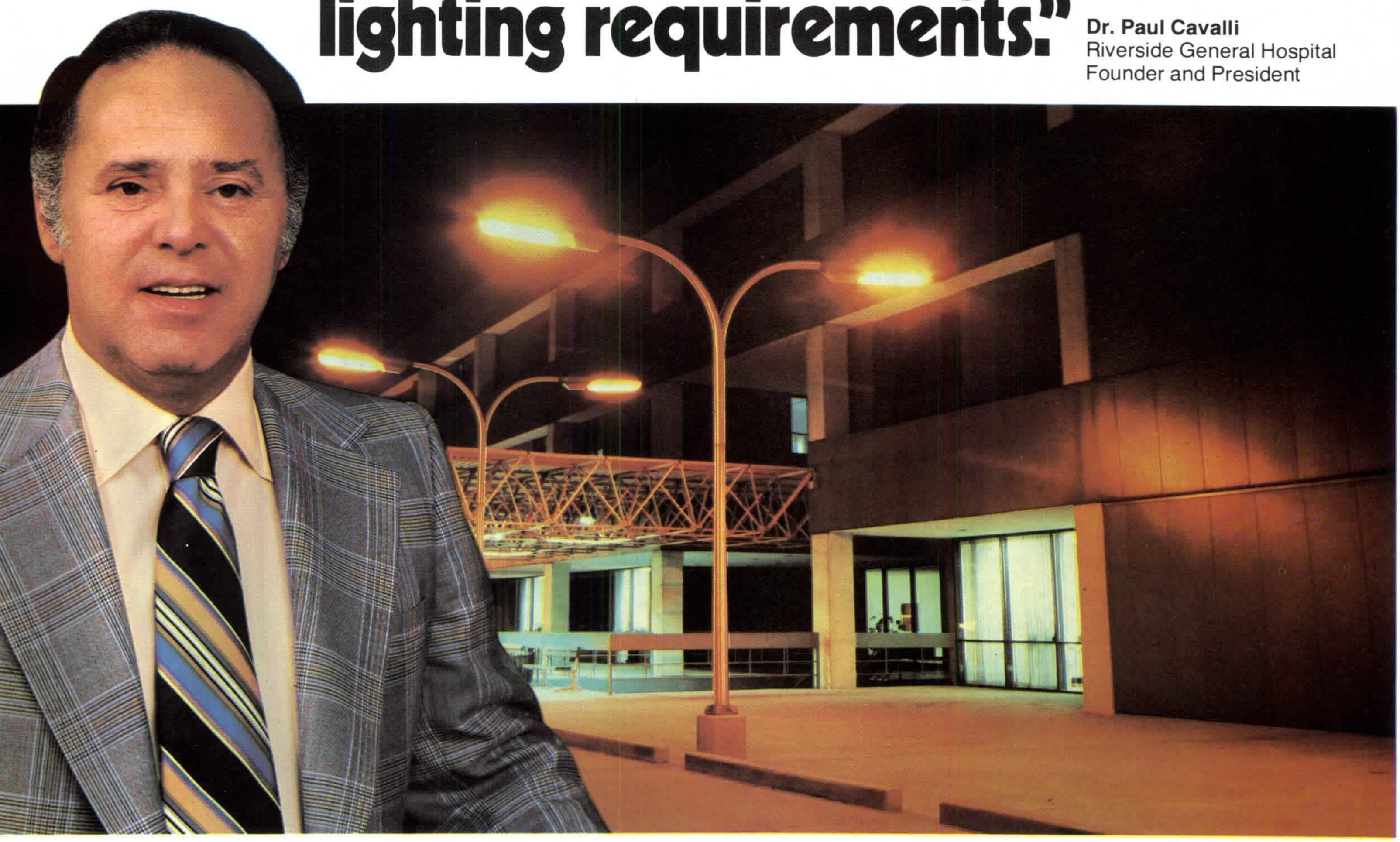

"We compared the costs of mercury vapor and low pressure sodium for our new outdoor lighting installation," said Dr. Paul Cavalli, Founder and President of the Riverside General Hospital in Secaucus, New Jersey.

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to projections of the National Association of Home Builders, achieving 29,300 units. Second place will go to Los Angeles, with 26,000 units, it is predicted.

Charles H. Warner Jr., FAIA, a principal in the New York City firm of Warner Burns Toan Lunde, has been elected an associate of the National Academy of Design.

The National Association of Women in Construction will install Arlean McPherson of Fort Wayne, Ind., as its 24th president.

"The Architectural Index for 1978" is now available. It is a reference tool that gives the user quick access to the contents of major design periodicals, including the AIA JOURNAL. It is available for $10.50 per copy from *Architectural Index,* P.O. Box 1168, Boulder, Colo. 80306. Editor and publisher is Ervin J. Bell, AIA.

Paul Thiry, FAIA, of Seattle has been awarded an honorary doctor of arts degree by Lewis & Clark College.

The Association of University Architects has elected Clifton J. Marshall, AIA, architect for the University of Kentucky, as its president for 1979/80. At its recent annual conference, AUA conferred upon Bruce H. Jensen, AIA, its distinguished service award, given annually to persons "in recognition of a significant contribution in building and planning for higher education." Jensen is architect for the University of Utah.

The National Endowment for the Arts has selected five American artists for the fourth year of its U.S./United Kingdom bicentennial exchange fellowship program. Among the American winners is Thomas McGrath, an architect from Beverly Farms, Mass. Among the British winners is architect Geoffrey Wigfall who plans to study the use of timber on America's West Coast.

Kassel Slobodien, AIA, of Mamaroneck, N.Y., is a winner in this year's international Nikon photo contest. Slobodien's abstract color images were on display in August at Nikon House in New York City. He says he is not an architectural photographer, but uses photography "as an art expression."

The "new CIAM 1979," an international congress of architects and planners, will meet on Oct. 27-28 at Ryerson Polytechnical Institute in Toronto. The theme of the congress under the sponsorship of the Congres International d'Architecture Moderne (CIAM) will be "an integrated architecture at the human level." The session is open to students and professors of architecture and planning, to professional architects and planners and to scholars in general. For information contact New CIAM 1979, 49 Alton Ave., Toronto, Ontario M4L 2M3, Canada.

October 9 is the deadline for receipt of nominations for the AIA/Association of Collegiate Schools of Architecture fifth annual award for excellence in architectural education. Contact: Jeffrey M. Chusid, ACSA, 1735 New York Ave. N.W., Washington, D.C. 20006, (202) 785-2324.

Louis de Moll, FAIA, former president of the Institute and current president of the International Union of Architects, has received an honorary fellowship from the Hungarian Society of Architects, the first U.S. architect to be so honored.

"Considering a Career in the Construction Industry" is a booklet recently published by the National Association of Women in Construction. Contact: NAWIC, 2800 W. Lancaster, Fort Worth, Tex. 76107. □

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