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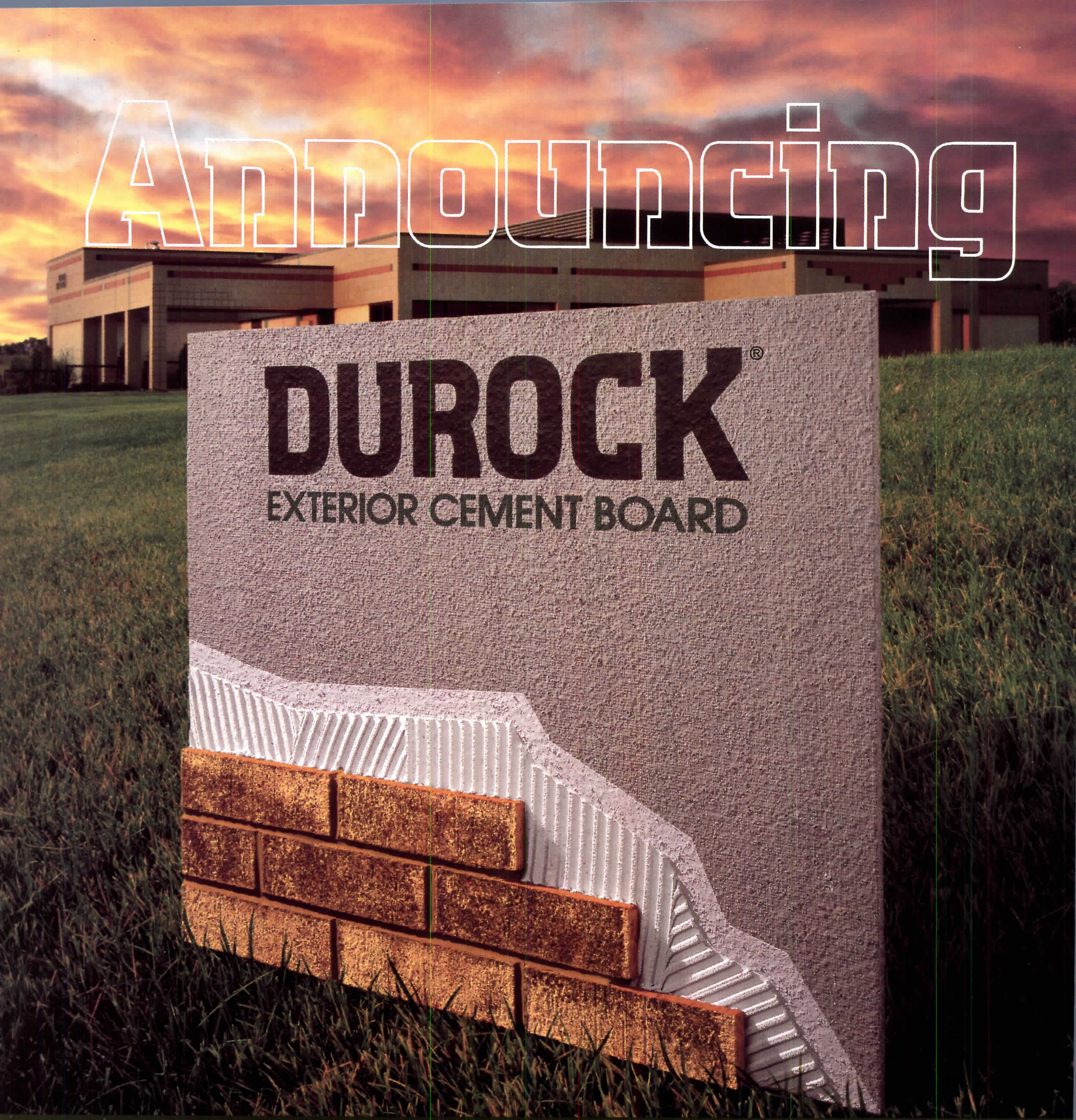
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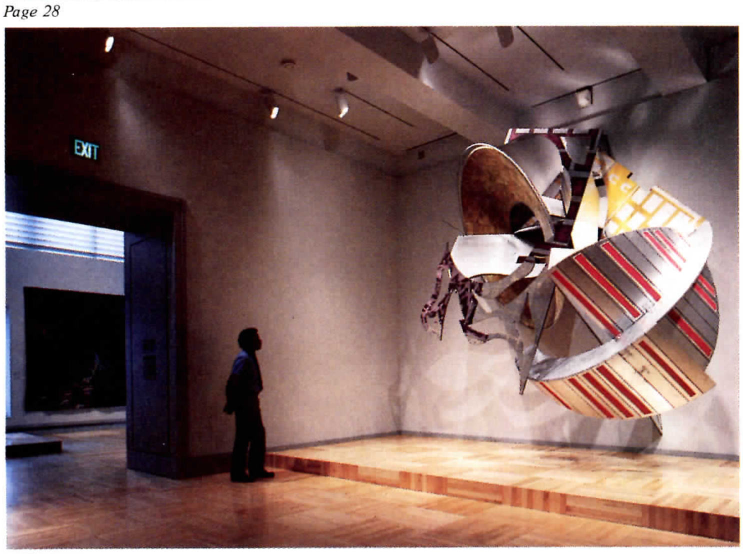

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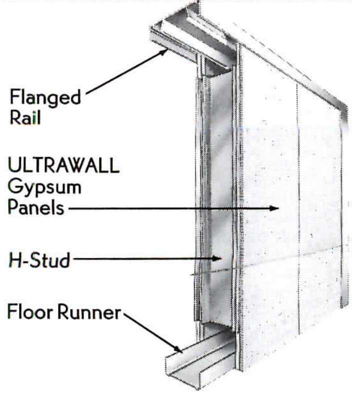

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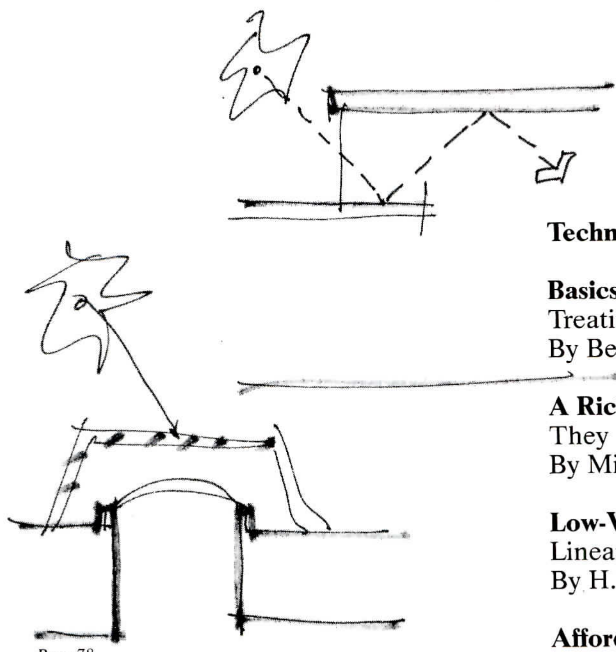

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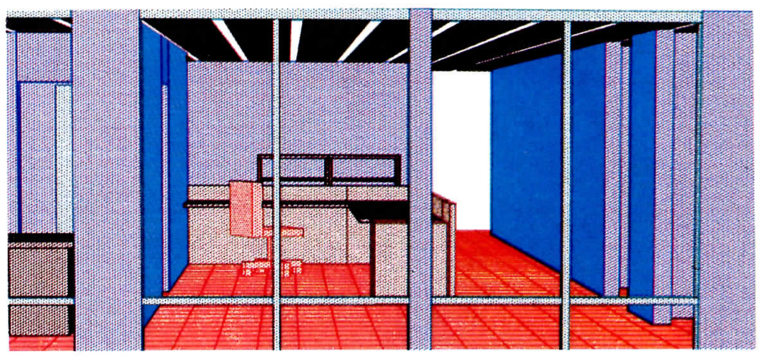

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Cover
Detail of the Museum of Contemporary Art, Los Angeles, by Arata Isozaki & Associates. Photograph © Tim Street-Porter.

News

EVENTS

Mar. 1-5: International Symposium on Offshore Mechanics and Artic Engineering, Houston. Contact: American Society of Mechanical Engineers, 345 E. 47th St., New York, N.Y. 10017.
Mar. 2-6: Conference on Construction Inspection and Quality Control of Building Construction, Madison, Wis. Contact: Philip Bennett, Dept. of Engineering Professional Development, University of Wisconsin-Madison, 432 N. Lake St., Madison, Wis. 53706.
Mar. 3-5: Restaurant/Hotel International Design Exposition and Conference, Chicago. Contact: Bailey Beeken, National Expositions Co., 49 W. 38th St., New York, N.Y. 10018.
Mar. 4-7: Annual Conference of the Air Conditioning Contractors of America, Miami. Contact: ACCA, 1228 17th St. N.W., Washington, D.C. 20036.
Mar. 4-May 31: Exhibition on the Arts and Crafts Movement in America, Boston. Contact: Museum of Fine Arts, 465 Huntington Ave., Boston, Mass. 02215.
Mar. 6-7: AIA Interiors Conference on Interior Design Education, Boston. Contact: Ravi Waldon at Institute headquarters, (202) 626-7429.
Mar. 9-11: Fire Detection and Suppression Symposium, Linthicum Heights, Md. Contact: Lisa Juliano, Society of Fire Protection Engineers, 60 Batterymarch St., Boston, Mass. 02110.
Mar. 9-12: FOSE Computer Graphics Conference, Washington, D.C. Contact: Jackie Voight, National Trade Productions, 2111 Eisenhower Ave., Suite 400, Alexandria, Va. 22314.
Mar. 10-12: Program on the Inspection, Maintenance, and Repair of Wood Structures, Oakland, Calif. Contact: Rolf T. Killingstad, Dept. of Engineering Professional Development, University of Wisconsin-Madison, 432 N. Lake St., Madison, Wis. 53706.
Mar. 11-12: HVAC and Building Systems Congress Conference, Anaheim, Calif. Contact: Association of Energy Engineers, 4025 Pleasantdale Road, Suite 420, Atlanta, Ga. 30340.
Mar. 11-13: Conference on Research Laboratories: Planning and Designing Functional Facilities, Miami. Contact: Dr. Marcy Ullom, School of Continuing Studies, Allen Hall, University of Miami, Coral Gables, Fla. 33124.
Mar. 12: Exterior Stone Symposium, New York City. Contact: Barry Donaldson, Tishman Research Corp., 666 Fifth Ave., New York, N.Y. 10103.
Mar. 14-15: AIA Architecture in Education Conference in conjunction with the Association of Collegiate Schools of Architecture, Los Angeles. Contact: Alan Sandler at Institute headquarters, (202) 626-7573.
Mar. 14-May 17: Exhibition of Wood Sculpture by Rudolf Wachter, New York City. Contact: Blom & Dorn Art Gallery, 164 Mercer St., New York, N.Y. 10012.
Mar. 15-17: Conference and Trade Show entitled "Advanced Residential Construction: Building for the Future," Monticello, N.Y. Contact: Quality Building Council, P.O. Box 541, Brattleboro, Vt. 05301.
Mar. 21: Seminar on "Building for the Work Place: A New Sense of Community," Scottsdale, Ariz. Contact: Frank Lloyd Wright Foundation, Taliesin West, Scottsdale, Ariz. 85261.
Mar. 22-May 24: Edward Larrabee Barnes: Museum Designs Exhibition, Katonah, N.Y. Katonah Gallery, 28 Bedford Road, Katonah, N.Y. 10536.
Mar. 22-26: Solar Energy Conference, Honolulu. Contact: American Society of Mechanical Engineers, 345 East 47th St., New York, N.Y. 10017.
Mar. 22-26: Computer Graphics '87—The National Computer Graphics Association's Conference and Exposition, Philadelphia. Contact: NCGA, 2722 Merrilee Dr., Suite 200, Fairfax, Va. 22031.
Mar. 23-27: Course on the Application of Infra-Red Scanners to Detect Building Energy Losses, San Diego. Contact: Infraspection Institute, Juniper Ridge, Box 2643, Shelburne, Vt. 05482.
Mar. 26-29: Annual Glass Art Society Conference, Philadelphia. Contact: Glass Art Society, P.O. Box 1364, Corning, N.Y. 14830.
Mar. 30-31: Seminar on Indoor Lighting Design Techniques, Scottsdale, Ariz. Contact: Lighting Sciences Inc., 7830 E. Evans Road, Scottsdale, Ariz. 85260.
Mar. 31-Apr. 2: American Institute for Design and Drafting Convention, St. Louis. Contact: AIDD, 966 Hungerford Dr., Suite 10-B, Rockville, Md. 20850.
June 19-22: AIA Annual Convention, Orlando, Fla.
July 13-17: 16th Congress of the International Union of Architects, Brighton, England. Contact: Congress Secretariat, 72 Fielding Road, Bedford Park, Chiswick, London W4 1DB England.

LETTERS

Wood Foundations: Your article, "Wood Foundations—Yes, But . . ." [Nov. '86, page 122] was very timely and accurate. But . . .

(1) In addition to the benefits cited by the Wood Products Promotion Council, wood foundations can be installed year-round (unlike concrete foundations). (2) In the more than 50 years since AT&T first began commercial use of CCA preservative, there is no evidence we know of showing that CCA accelerates corrosion of metal to any significant degree. We recommend hot-dipped galvanized hardware when building with our product (Wolmanized® wood), however. Metal fasteners exposed to the environment are more subject to corrosion. Galvanized hardware is corrosion-resistant above or below grade. (3) CCA-pressure-treated wood for foundations should be treated according to American Wood Preservers' Bureau "FDN" standard. Essentially, this means the wood must be treated to a preservative retention level of .6 pounds per cubic foot. Ordinarily, field cuts of wood treated according to this standard need no end treatment with preservative. For our products, we recommend that only the more-dense species of treated wood—Douglas fir or hemlock—receive such a treatment.

C. Conrad Kempinska
Koppers Co., Inc.
Pittsburgh

Architects and Interior Design: Recent letters and articles have described the shortchanging of architectural employees, "giving away" the profession, and similar concerns. As the manager of the architectural staff in a firm offering both interior design and architecture, I find myself fighting for the status of my profession on a daily basis, and I am convinced that, in the pursuit of short term gains, many architects have indeed given it away.

First, relative to their experience and level of responsiblity, architects are not paid nearly as well as interior designers. This is a direct reflection of the fact that interior design firms have, as a group, refused to take ridiculously low fees for their services and pass the losses down to the employees, as architectural firms have done. In recognition of this phenomenon, many architectural firms are starting up profitable interior design departments, thus making up the losses often sustained from architectural projects.

Second, interior designers are increasing their status from the former role of choosing furnishings and fabrics supporting the architectural concept to a new role that sounds very much like interior *architect.* The District of Columbia government has recently passed a licensing act for interior designers, and other jurisdictions are sure to follow. Architects are "exempted" from the licensing requirement (although it is unclear why and where this new license will be required, since D.C. does not even require an architect's signature on small buildings and large buildings with a structural engineer's signature), but it can be assumed that interior designer firms will market themselves as offering full interior architectural services and will attempt to usurp the role of primary design professional on any work that doesn't involve the building skin.

The interior designer's package may become extremely attractive to clients since architects are tending to downgrade themselves as designers and concentrate on a narrow range of technical and drafting services. It is already the case in many

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Correction: The sculpture located in the lobby of the Willard Hotel's new office wing in Washington, D.C., was incorrectly credited in the November issue, page 51. Albert Paley was the artist of that piece, as well as the lobby door handles.

Lighting the Corridor

It's time to rethink.

New lighting technology makes the old answers obsolete.

Your first true impression of a building's interior comes when you leave the lobby and enter the corridors.

The picture below demonstrates the kind of impression a corridor can make. When you walk into this corridor, every part of it seems washed in a soft, even glow. An effect like this requires exceptionally consistent, comfortable illumination at a high enough level to make the corridor clearly "well lighted."

Contrast this image with the dozens of unfortunate corridors you've encountered over the years: the gloomy hotel corridor, the glaring hospital corridor, the bland office corridor. In each case, the blame falls on an outdated lighting system.

High illumination: up instead of down

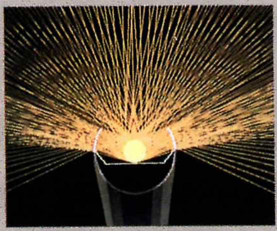
Almost every corridor in America with a high illumination level uses a down light. If the floor is reflective, as in the hospital corridor, you find yourself staring into what amounts to a second set of light fixtures on the floor, throwing uncomfortable light over every surface.

If the floor has a medium to dark carpet, downlights won't reflect light back into the ceiling. The fixtures stand out as glaring spots on a dark surface. You end up with a half-lit space: well-lit floor and lower walls, under-lit ceiling and upper walls.

The corridor in the picture demonstrates a lighting concept developed in the early 1980s and now beginning to gain broad acceptance. A lensed indirect fixture with an unusually wide distribution turns the whole ceiling into a single light source, creating smoother, more pleasing illumination.

The secret to the distribution lies in the Peerless Softshine Optical System. The strip of visible lens at the sides of the fixture has a pleasant, low-brightness glow from a normal viewing angle. But from just above viewing angle, it throws great amounts of light out to the upper walls.

It also makes you feel the corridor is better lit. In a comparison study, Penn State University discovered that a visible lens like the one in the photo raises perceived light levels about 20%.



A corridor light for the 1990s: glare-free illumination plus the sparkle of a low-brightness lens.

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The inviting corridor: much of its personality comes from the soft, cheerful lighting. Note the absence of deep shadows and harsh highlights. The specialized Softshine Optical System of the lensed indirect fixture has an exceptional ability to fill a wide area with pleasant light.

Letters *from page 6*

firms that the principal or management in charge either spurns the esthetic abilities of the architects or, desiring division of labor, insists that the project architect stick to "production" and let the interior designer do the creative work. We mistakenly think, because of the liability involved, that the importance of the technical work is recognized by clients. This is only true when something goes wrong. When everything is going right the client recognizes only how well the design meets his needs and/or impresses other people. So, architects are marketing only the prevention of negative consequences, while interior designers are marketing the positive, i.e. "Here's what I can do to improve your life and justify the expense and risk of doing this project."

In letting this happen, we are relinquishing a large hunk of business in an economic climate that is tending increasingly toward interior renovation rather than new building. Not only that, but when we do put up new buildings they have no unifying *theme*, because one designer does the outside and, another, or several of them, do their own thing all over the inside. Thus, we are also relinquishing the centuries-old tradition that most of us still think of as good architecture.

Louise Jordan Miles, AIA
Washington, D.C.

Design/Build: I have no problem with the design/build concept, but plenty of objections to your sloppy and biased article in the October '86 issue ["Design/Build Methods Mature," page 107]. Christopher Wist made his writing appear to be a balanced treatment of the material by quoting Barbara Rodriguez and Norman Coplan of New York. In reality, he fails to point out that the real problem is not design/build but the way AIA structured its family of documents.

As for history: The AIA convention of 1978 authorized only the removal of barriers so those architects who want to expand their activities into design/build could do so. The subordination of the architect's role to a "broker" was not authorized.

As to the documents: Those architects who play the design/builder role have what they wanted. The documents created an entity that the architects can hide behind—hoping for reduced liability. But the other 98 percent of AIA members have to accept that their services now can (and undoubtably will) be offered to third parties by non-professional brokers. These brokers should (but often will not) hire architects for the phase 1 (schematic design) work. Only when they have the job signed up and preliminary design approved by the client are these brokers obligated to retain a licensed professional who will stamp the construction documents. One does not have to be a "director of legal research" of AIA to realize that the chances for obtaining a fair and adequate fee by the architect have greatly diminished in this process.

As to licensing: It is illegal not only in New York and "some" states, as you have stated, but in 29 states to offer architectural services by a non-licensed person. I firmly believe that your design/build broker fits into this category. Other colleagues, such as Robert Paul Dean, AIA, do not share this view. This question may ultimately be answered only by the courts. But in the meantime, why does AIA—which should represent its struggling architect members trying to improve their compensation level—condone a structure that puts them to such disadvantage?

As to benefits to architects: Looking at the great majority of the AIA members, we have to realize that no good is coming to them from this scheme. Only those will benefit who are in a controlling position of the design/build firms. But did John Portman need [AIA's] help to do what he was already doing so successfully? No, it was a sad day in AIA's history when the board in its wisdom approved the D/B documents. The monster they created was not identified as such in your article.

Laszlo Papp, FAIA
White Plains, N.Y.

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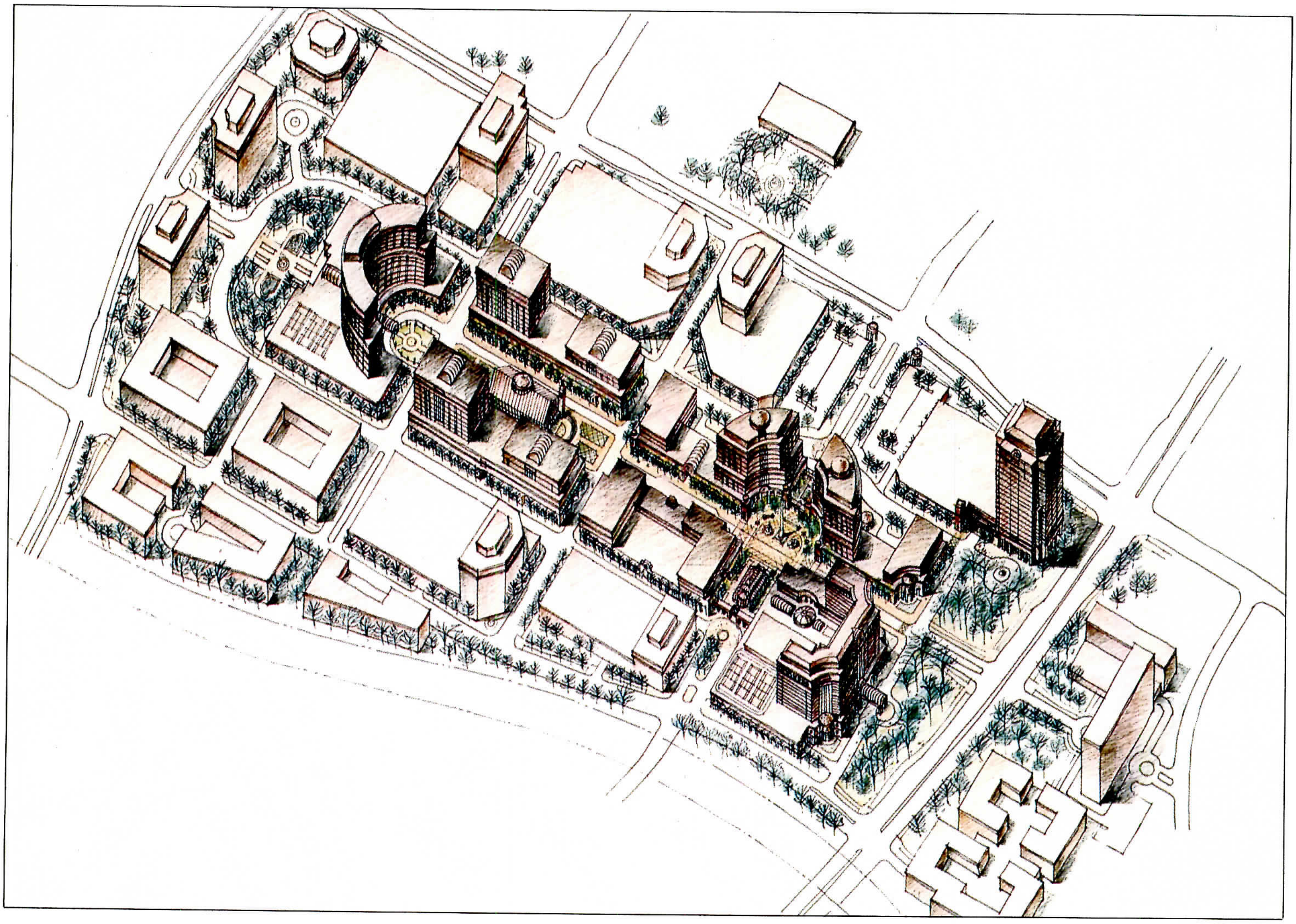


Competitions

RTKL Associates Selected to Design New Town Center for Reston

In the early '60s Robert E. Simon had a vision to create a planned community in Virginia 20 miles west of Washington, D.C., that would serve as a model alternative to suburbia. Using his own initials, Simon came up with the name Reston for his utopian new town.

Last month the current developers of Reston selected a scheme by RTKL Associates of Baltimore over submissions from Skidmore, Owings & Merrill/New York, Kohn Pedersen Fox of New York, and Thompson, Ventulett, Stainback & Associates of Atlanta in an invitational design competition for the first phase of a town center and a master plan for possible future development of the 85-acre site.

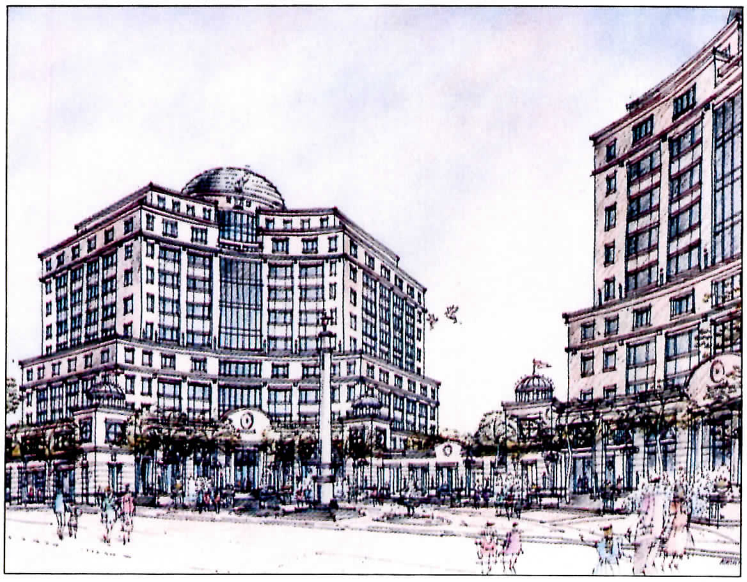
The idea of a town center for Reston is not new; the 1963 master plan by Whittlesey, Conklin & Rossant called for an "urban core" that would ultimately serve as Reston's downtown.

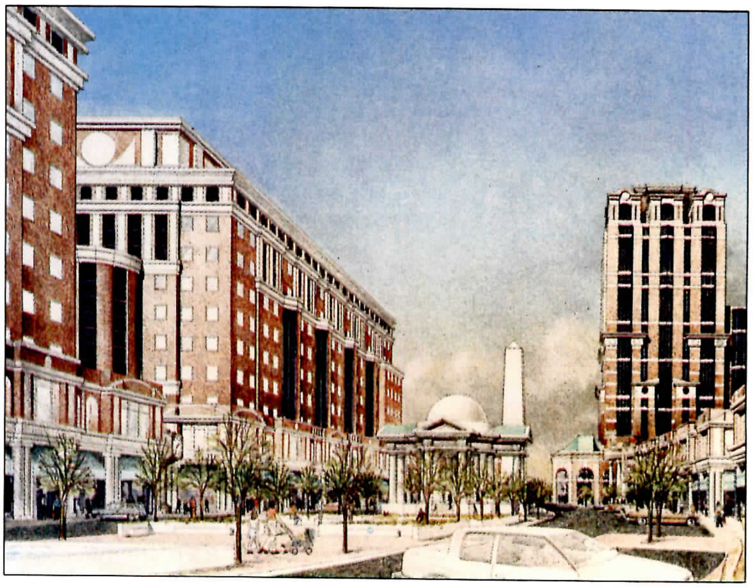
Although Reston is now experiencing a boom in construction, and from a developer's point of view is a great success, the planned community has had a turbulent financial history. Simon, having exhausted his credit, lost control of Reston in 1967, and the initial lender, Gulf Oil Corporation, assumed full financial and operational responsibility. At this time, Reston was made up of housing for 2,500 people plus Whittlesey, Conklin & Rossant's Lake Ann Center, a mixed use project with an arc-shaped cluster of buildings including shops, a library, community center, town houses, and a 15-story apartment building surrounding a 30-acre man-made lake. (Lake Ann Center is still the symbolic center of Reston.)

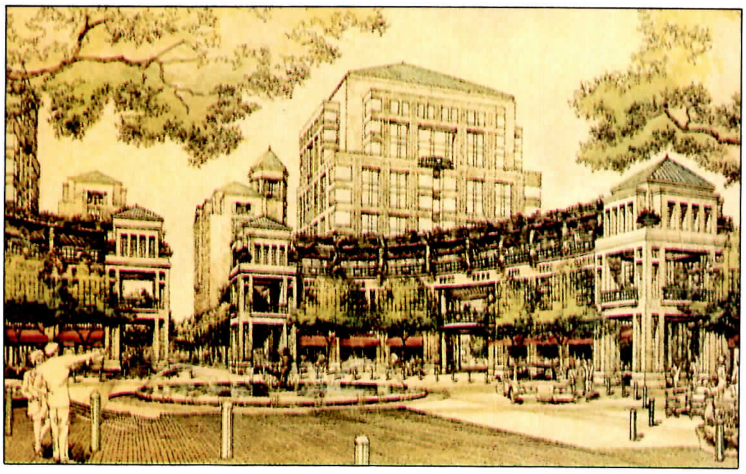
In 1978, Reston Land Corporation, a subsidiary of Mobil Corporation, purchased the undeveloped portions of Reston from Gulf. The proposed town center is being jointly developed by the Reston Land Corporation and Himmel/MKDG.

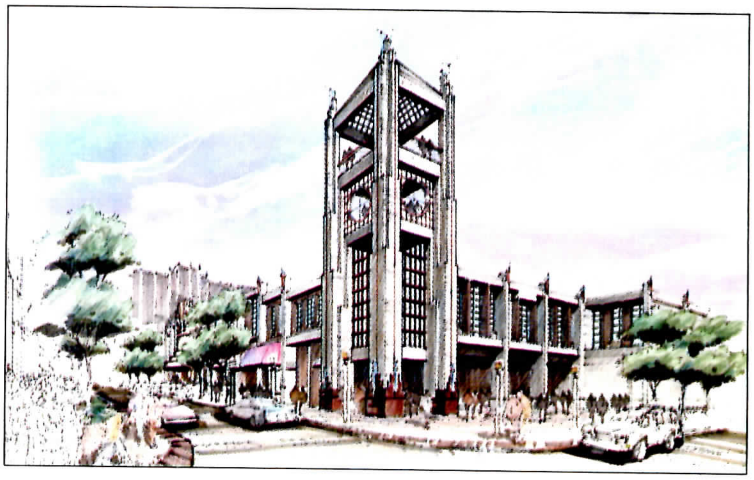
The objectives set by the developers for the town center recall the original goals for Reston, but without Simon's emphasis on social issues. Simon's goals included building a community where people can "live, work, and play" with a complete range of housing meeting the needs of everyone and creating "an esthetically pleasing environment for residents, where structures complement the beauty of the natural land, and open space is within walking distance of every home."

Even though Reston has lost some of the pioneering spirit of its founders, the objectives of the developers of the town center maintain the importance of creating a "pedestrian experience with active, exciting, memorable public spaces" and emphasize a "complementary balance and









integration of the mix of uses . . . and the ability to grow into future phases." The program called for a 500-room hotel, 500,000 square feet of office space, shops, restaurants, movie theaters, space for cultural functions, and a series of parks, all to be placed within an urban street grid.

The two most successful schemes both have a formal design in the tradition of European cities and nearby Washington. RTKL's plan by George J. Pillorge, FAIA, creates an urban statement that is stronger overall than its individual parts. It calls for an axial series of plazas and parks with the central public space defined by the curving facades of the two major office buildings, while the hotel is located along Market Street, the retail spine. There are granite, brass, and limestone accents at the street level. Pillorge said he chose traditional elements and references to "etch a distinct signature on the skyline" and repeated classical details on street level to mark entries and significant corners. However, there is a plethora of domes, cupolas, and colonnades that seem almost randomly placed.

Opposite page and top left, RTKL's plan and town center. Clockwise from top right, schemes by Kohn Pedersen Fox, Thompson Ventulett Stainback, and SOM.

In contrast, David Childs, FAIA, of SOM responded with a more formal composition of four retail buildings grouped symetrically around a central market circle with an office building at each of the four corners. The hotel complex sits at one end of the cross-axis. Childs, who headed SOM's Washington office before going to New York, drew from Washington's elegant vocabulary and the 1901 McMillan Plan without creating a caricature of the capital city.

In comparing the RTKL and SOM schemes, Tom Grubisich, author of a history of Reston, said, "Where the RTKL scheme is very cautious and goes with the latest and safest neoclassical trends, SOM over reached to a too ambitious megadesign. We have had enough of the almost totalitarian designs á la Le Corbusier. We need something more intimate than that."

The other two architects took very different approaches. Thompson, Ventulett, Stainback & Associates drew from the vernacular traditions of a small town with deco-like storefronts of different sizes and heights placed along a Main Street with an office tower on either end. The master plan accommodated future development much as it would naturally evolve. The buildings, however, lacked the sophistication of the other schemes.

The Kohn Pedersen Fox submission is an assemblage of refined brick and limestone buildings with Georgian references. The two largest buildings face inward with curving facades outlining an oval plaza. The scheme lacked a cohesive urban core and a strong main street axis.

The selection of RTKL's scheme follows the pattern of caution on the part of developers that has been characteristic of Reston in recent years. The competition's program and the attributes of the winning design, however, do show that the developers are not ready to forget all of Simon's ideals.—Lynn Nesmith

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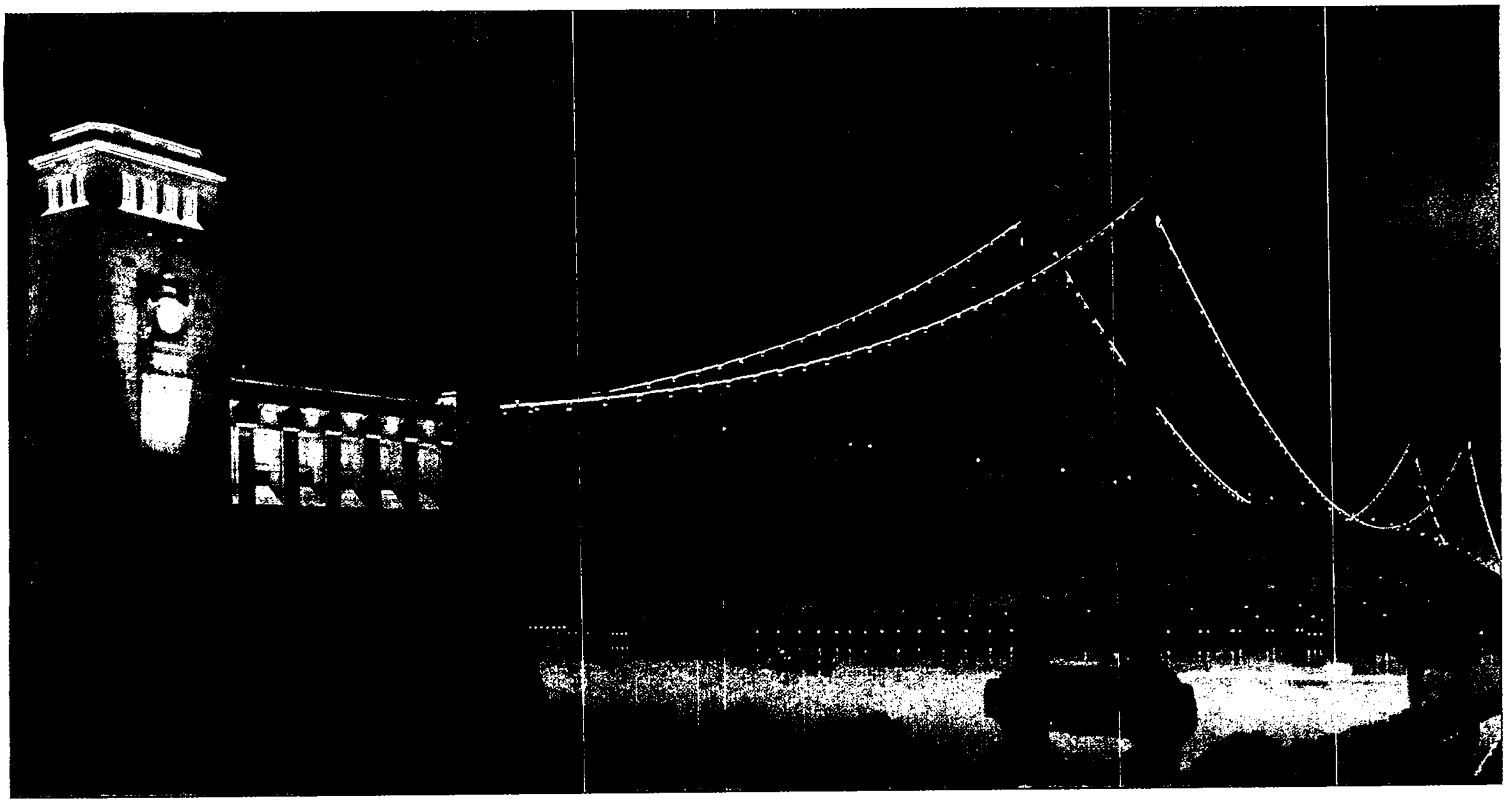

Venturi, Rauch & Scott Brown has won a design competition for the illumination of the Benjamin Franklin Bridge in Philadelphia. The design was chosen from a field of 14 submissions and incorporates several lighting techniques to accentuate the 1926 bridge's suspension and its masonry piers, designed by Paul Cret.

The three components of the design include suspender cable lighting, anchor pier flood lighting, and anchor pier accent lighting.

At the base of each suspender cable along the length of the bridge, pairs of metal halide uplights will illuminate the suspenders and the underside of the cables. Conical reflectors directly under the cables will provide points of light dotting the curve of the cables. The uplights will be programmed for movement, allowing special effects for celebrations or generated by commuter trains as they cross the bridge between the city and New Jersey.

The piers will be illuminated with amber, sodium lamps directed at the masonry surface to highlight the texture of the stonework. Openings in the piers will be cast in a bluish light, articulating their grilles, soffits, and lintels. The lighting scheme is scheduled for completion this September to coincide with U.S. Constitution bicentennial festivities.

The jury for the competition, sponsored by the Benjamin Franklin Bridge Lighting Project, was chaired by Robert Geddes, FAIA, and included Alan Chimacoff, Adele Santos, AIA, James R. Kelley, Judith Tannenbaum, Gary Steffy, and Roger L. Knott.

The Institute

Board Names Ethics Council, Adopts Energy Policy, Education Program

At its December meeting in Washington, D.C., the AIA board of directors appointed a national judicial council to enforce the Institute's code of ethics, approved a revised comprehensive energy public policy statement, and approved funding for an education initiative program.

To oversee the implementation of the AIA code of ethics and professional conduct, the board of directors appointed seven members to serve on the national judicial council. The board also approved bylaw changes to assist with the enforcement of the mandatory code, which was approved at the 1986 convention.

Harry Harmon, FAIA, former AIA secretary who headed the ethics task force, was appointed to serve a two-year term as the council's chair (followed by another year on the council). Other council members and their designated terms are: A. Notley Alford, FAIA, three years; Peter Forbes, FAIA, two years; Samuel A. Anderson, FAIA, two years; Kirk Miller, AIA, one year; Jerome M. Cooper, FAIA, one year; and Thomas L. McKittrick, FAIA, one year.

In other action, the board approved a significantly modified comprehensive energy policy to replace the Institute's 1982 energy policy. The approved policy states that AIA "recognizes the continuing need to increase the energy efficiency of the built environment through energy-conscious design and planning" and is "aware that the inefficient use of finite energy resources has critical environmental, economic, and social consequences."

Under the new public policy, AIA:

- "Supports a balanced national energy policy that reduces waste of non-renewable energy resources while encouraging environmentally sound production of energy sources.
- "Advocates a comprehensive program to reduce energy waste in new and existing buildings and in the overall community.
- "Encourages continuing public and private research and development in all areas of energy-conscious design and technology with emphasis on the performance of the total building.
- "Advocates that energy standards recognize total building energy performance.
- "Encourages a continuing program of education for students, architects, related design professionals, and the general public.
- "Believes all of these policies should result in implementation strategies that can be achieved within a sound economic base with support from both private and public resources."

In response to the Institute's 1986 three-

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The Institute *from page 14*
year initiative to "achieve excellence in architectural education" and to assist schools of architecture in better preparing graduates to practice effectively, the board approved up to $131,500 to fund the program for 1987.

AIA's outgoing president John A. Busby Jr., FAIA, was named chair of a special education task group charged with developing specific project goals. The three recommendations for the architecture education program are: "determine and enable the attainment of the essential knowledge, skills, and capacities an architect must possess to compete in the future; provide for the support and development of architectural faculty; and create opportunities for cooperation between practitioners and educators."

In addition, the AIA board of directors supported more cooperation and joint research projects between AIA and allied organizations, including ACSA, NCARB, NAAB, American Institute of Architecture Students, and AIA components.

The board approved a strategic plan intended to increase public awareness and understanding of the built environment and to set directions for the AIA Foundation, renamed the American Architectural Foundation.

The plan sets as the foundation's five principal functions: "to achieve and maintain financial stability; to keep the Octagon structurally sound and to ensure that it serves as a premier example of architectural restoration; to serve as a clearinghouse to support a local component network for effective public outreach; to serve as a model for giving support to critical projects and programs in architecture; and to identify and seek outside funds to expand national and local outreach programs."

Chicago architect Donald J. Hackl, FAIA, was installed as AIA president. Other 1987 officers are Ted P. Pappas, FAIA, first vice president; Leon Bridges, FAIA, William W. Herrin Jr., AIA, and Robert A. Odermatt, FAIA, national vice presidents; and Philip W. Dinsmore, FAIA, secretary (for a second term). Harry C. Hallenbeck, FAIA, continues in his two-year term as treasurer.

The new board members are: Donald C. Axon, AIA, California region; Paul H. Barkley, AIA, region of the Virginias; Douglas K. Engebretson, AIA, New England region; Robert E. Greager, AIA, Michigan region; Richard W. Hobbs, AIA, Northwest region; Robert H. LeMond, AIA, Texas region; Thomas Nathan, FAIA, Gulf States region; Eleanore K. Pettersen, AIA, New Jersey region; Warren Douglas Thompson, AIA, California region; and Thomas P. Turner AIA, South Atlantic region. Barbara J. Rodriguez, chair of the Council of Architectural Component Executives, was installed as an ex officio member of the board.

Kemper Award to Monticciolo; Young Citation to Bond

Joseph Monticciolo, FAIA, has been selected by AIA to receive the 1987 Kemper award, and J. Max Bond was chosen recipient of the Whitney M. Young Jr. citation for 1987. The awards will be presented at the AIA national convention in Orlando, Fla., in June.

The Kemper award recognizes a member of the Institute "who has contributed significantly to AIA and the profession of architecture." The first architect to direct a HUD area office, Monticciolo, during his 25-year tenure, was instrumental in raising the quality of public housing.

He also consistently championed design creativity and the expansion of architects' stature and influence in government, according to the awards citation.

To counteract affluent suburban communities' reluctance to provide required relocation housing for displaced low- and moderate-income families, Monticciolo developed the first scattered-site low-income public housing project in the U.S. He also helped establish the first low-income public housing cooperative in the country—New York City's Forest Hills project. Largely through Monticciolo's insistence, HUD began to require that project analysts be professional architects.

As production coordinator for the New York Housing Assistance Administration, Monticciolo developed many low-income housing projects outside of New York City. By 1973 he was responsible for assisting and promoting development of 36 projects in suburban Nassau and Suffolk counties. As architect for the Federal Aviation Administration, Monticciolo implemented a space management program to improve the appearance of over 300 field offices.

Monticciolo has held elected and appointed positions within AIA for 15 years. "The members of AIA and the public are beneficiaries of his creative programs," said his nominators. "In a system that frequently discounts creativity, Joe has consistently devised strategies to elevate the authority and increase the influence of architects. . . . He serves as a true role model for what an architect can accomplish in government."

The Young citation, named in honor of the late civil rights leader and head of the National Urban League, is presented to "an architect or architecturally oriented organization in recognition of a contribution to social responsibility." Bond is recognized for his "outstanding, perhaps unequaled, contributions to architectural education, architectural practice, and architecture in service of government," said his nominators.

As executive director of the Architect's Renewal Committee in Harlem from 1967-69, Bond campaigned for a revival of low-cost housing in that part of New York City. Bond's architectural projects have demonstrated a concern for socially responsible urban design; two examples are Bolgatanga Library in Ghana and the Martin Luther King Jr. Memorial Center for Non-violent Change in Atlanta.

A founding partner of Bond Ryder James Architects, Bond is also dean of the City College's school of architecture and environmental studies and is the sole architect member of the New York City planning commission. Bond graduated from Harvard in 1955 and received his master's degree in 1957. In 1958-59 he was a Fulbright fellow.

Bond was a professor for 16 years and chairman of the architecture graduate program at Columbia University; there "his design studios were sought out and he personally spent endless hours informally advising both minority and majority students," said his nominators.

"Max has conducted his entire career as a role model to younger minority students. His intelligence and talent, combined with discipline and energy, have enabled him to contribute in many different ways to the fields of architecture and planning," said his nominators.

Twelve Foreign Architects to Receive Honorary Fellowships

AIA has named 12 architects honorary fellows of the Institute for their "esteemed character and distinguished achievements." The honor is conferred upon architects who are not U.S. citizens and who do not practice in this country. The 12 will receive their honorary fellowships at AIA's annual convention this June in Orlando, Fla.

The architects are:

- Rifat Kamil Chadirji, founder and president from 1952 to 1978 of his own firm Iraq Consult, an urban planning adviser to the Iraqi government, and a writer on architectural theory.
- Philip Sutton Cox, winner of the Royal Australian Institute of Architects' gold medal in 1984, founder of the Australian firm Philip Cox & Partners Pty. Ltd., and author of nine books on architecture.
- Tobias Faber, head of the Danish Royal Academy's Architects School since 1974, where he has served as a professor since 1951, and author of numerous books on Danish architecture.
- Sir Bernhard M. Feilden, a leading historic preservationist through his private practice, author of the 1982 book *Conservation of Historic Buildings*, and an influence in the restoration campaigns on Chesterfield's historic center, the spire of Norwich Cathedral, and the west front of St. Paul's Cathedral.
- Rudy P. Friesen, past president of the Royal Architectural Institute of Canada and founder of his own firm in 1975.
- J. Zhong Feng, dean of the architec-

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ILLUSTRATION: K. PACKLICK DESIGN: BONNELL DESIGN ASSOCIATES

They couldn't believe their eyes.

The Institute *from page 16*
tural faculty at Tong Ji University in Shanghai for 25 years and currently vice chairman of the committee on textbook approval for China's ministry of urban and rural construction and environmental protection.

- Imre Makovecz, Hungarian architect and architectural philosopher, responsible for the design and construction of a series of inns, hotels, restaurants, and stores for rural cooperatives.
- Ignacio Diaz Morales, founder of the school of architecture at the University of Guadalajara and a practicing architect in Mexico for 63 years.
- Monica Pidgeon, publisher in England of a series of audiovisual programs on famous architects and former editor of the *RIBA Journal.*
- Ivor Prinsloo, director since 1974 of the school of architecture and urban planning at the University of Cape Town in South Africa, a supporter of equal access to education, and the architect of low-cost housing in his private practice.
- Jose F. Reygados, recent president of the Federation of Colleges of Architects of the Mexican Republic.
- Masayoshi Yendo, head of his own firm and president of the Japanese Architects Association for the past four years.

Exhibitions and Conferences

'What Could Have Been' Designs Closely Resemble What Actually Is

"What Could Have Been: Unbuilt Architecture of the '80s," an exhibition of architectural drawings and models, opened during CONDES '87, the annual contract design show at the Dallas Market Center, before starting a tour of museums around the country. The exhibit was organized by Lorry Parks and Roberta Mathews of Grace Designers in Dallas and was curated by Houston architect Peter Jay Zweig.

They began by calling on "around 80" well-known architects. "We asked them to send us the projects that were closest to their hearts," says Parks. There were three requirements: The projects had to have been designed for sites in the U.S., had to date from after 1980, and had to be unbuilt. Twenty-seven responded with material. In addition, the organizers decided to expand the boundaries of the show by including projects by two environmental artists whose work often overlaps with the concerns of architecture.

One of these artists is Alice Aycock, whose "Roebling Monument" is a 14-foot-long kaleidoscope set into the layered, hemispherical base on a 28-foot-square courtyard.

Some of the architectural work contributed to the show is only sparingly illustrated. Philip Johnson, FAIA, for example, sent a small, tantalizing model for an unbuilt Neiman-Marcus department store in Honolulu (ample, nevertheless, to show that borrowings from Claude-Nicholas Ledoux still strike Johnson's fancy).

Others, however, responded with a profusion of image. Chicago architect Thomas Beeby's "Lithograph for Chicago Art Institute" depicts a slain warrior laid out before the shrine of a Cretan goddess under a rising moon: art by an architect, a private, almost kitschy, evocation of a mythological past without relation to physical space.

Helmut Jahn's contribution includes an eight-foot-tall elevation drawing of his Columbus Circle tower proposal for New York City, and Venturi, Rauch & Scott Brown has a photo-montage of the firm's Marconi Plaza project in Philadelphia. Among the most striking of the projects in the show are the models and exquisitely detailed drawings prepared by Michael Graves, FAIA, for a new municipal complex in Phoenix, and by Gwathmey Siegel & Associates for the additions to the Guggenheim Museum in New York City.

One example of the now-you-see it, now-you-don't architectural play, tweaking our expectations about skin and structure, is New York City architect George Sowden's playful skyscrapers that look like inlaid furniture.

Ettore Sottsass' proposal for Snaparazz, a restaurant in San Francisco, drawn by an Italian comic-book illustrator, depicts the adventures of Mou and Lou, a couple of prototypical Snaparazz customers, as they move through the restaurant's varied environments. Less ephemerally presented is a proposal from 1981 by Stephen Holl Architects to construct a retail arcade and a collection of housing blocks, "offering the widest possible range of social-economic coexistence," atop a derelict elevated rail line in the Chelsea area of Manhattan. The fact that, in one way or another, each of these proposals represents a failure adds a bittersweet quality to the show.

Taken together, "What Could Have Been" illustrates the divisions and conflu-
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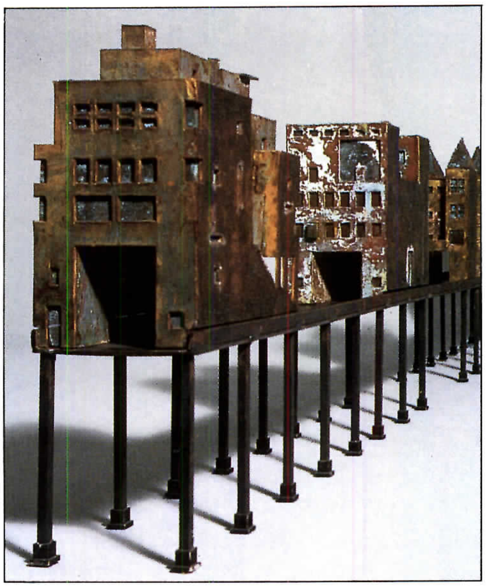
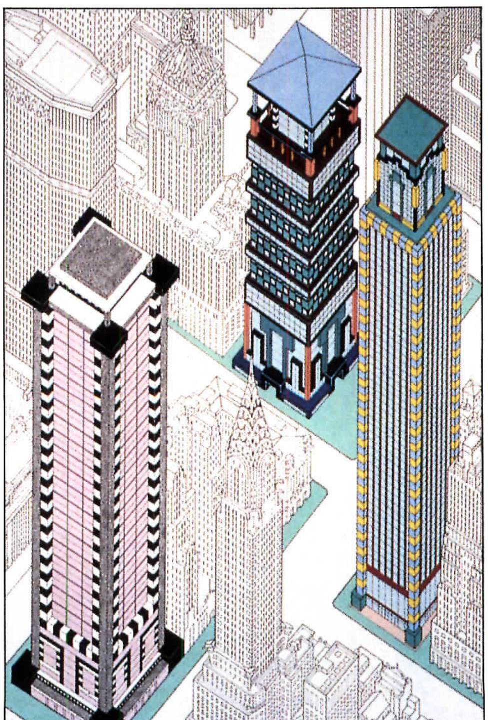


Left, Holl's model of his proposed housing over abandoned elevated train tracks. Below, Beeby's surreal vision of a Cretan shrine. Below left, Sowden's view of midtown Manhattan with his three fantasy towers in relation to the Chrysler and Pan Am buildings.



Exhibitions *from page 18*

ences in design trends—from somber neoclassicism at one extreme to tinkertoy constructivism at the other—that have been explored by some of the decade's architectural style makers. As such, the show holds few surprises. Indeed, it demonstrates that what might have been pretty much resembles things as they have turned out, give or take a couple of fancy houses and restaurants, some stripy high-rises, and a civic building or two.

After closing in Dallas, "What Could Have Been: Unbuilt Architecture of the 1980s" will travel to the Brooks Museum in Memphis, the Art Institute of Chicago, and the High Museum in Atlanta.

—Joel Warren Barna

Mr. Barna is editor of Texas Architect.

UIA Congress scheduled for July in Brighton, England

The 16th Congress of the International Union of Architects will meet July 13-17 in Brighton, England. The theme of the convention, which meets every three years, will be "Shelter and Cities: Building Tomorrow's World," planned to coincide with the United Nations' international year of shelter for the homeless.

The keynote speaker for the congress will be the prime minister of Sri Lanka, Ranasinghe Premadasa, who has worked to focus attention on the desperate housing conditions around the world and has been a driving force in his own country's campaign to provide one million dwellings for the poor. Also scheduled to speak on social issues relating to architecture is Terry Waite, secretary to the Archbishop of Canterbury and best known for his efforts to secure the release of hostages taken in Iran, Libya, and Lebanon.

In addition to the theme sessions, a variety of programs is scheduled, including lectures by Norman Foster, Hon. FAIA, Richard Rogers, Hon. FAIA, and Charles Correa, Hon. FAIA. An exhibition drawn from the drawings collection of the Royal Institute of British Architects will be staged in the Royal Pavilion Art Gallery, and a student program will be based at Brighton Polytechnic. Other exhibitions will include a display on shelter and the problems of inner-city housing, an exhibit staged by the Commonwealth Association of Architects, displays from the 93 member countries of the UIA, and a major trade show of building materials, furniture, products, and publications.

A series of pre- and post-congress study tours ranging from one to four days is also planned. Tours are scheduled on the arts and crafts movement, the work of Sir Edwin Lutyens and Sir John Soane, English landscaped gardens, new towns, historic cathedrals and churches, London's docklands, and medieval architecture. In addition, tours are planned to Scotland, Cambridge and East Anglia, Durham and Northcumberland, Bath and the West Country, and Oxford and the Cotswolds.

For more information, contact the Congress Secretariat, 72 Fielding Road, Bedford Park, Chiswick, London W4 1DB, England. Details on the congress are also available from James A. Scheeler, FAIA, at AIA headquarters (202) 626-7315.

BRIEFS

Concrete Design Award Winners

Nine buildings and three bridges were cited by the Prestressed Concrete Institute in its 1986 awards program. The winning buildings are:

• 800 Douglas Entrance, Coral Gables, Fla.; Spillis Candela & Partners, Inc. (architect/structural engineer).
• Charlotte-Mecklenburg Government Center Parking Structure, Charlotte, N.C.; J.N. Pease Associates (architect/structural engineer).
• Arbor Circle, North and South, Parsippany, N.J.; Kohn Pedersen Fox Associates (architect) and Severud-Szegezdy Consulting Engineers.
• Alewife Station Transportation Facility, Cambridge, Mass.; Ellenzweig, Moore & Associates, Inc.; (architect) and LeMessurier Consultants Inc. (structural engineer).
• 777 Mariners Island Office Building, San Mateo, Calif.; WZMH Group (architect) and Robert Englekirk Consulting Structural Engineers, Inc.
• McCarran International Airport Parking Garage, Las Vegas; TRA Consultants, Inc. (architect) and Edward P. DeLorenzo and The Benham Group (associate architect/structural engineer).
• Erie County Holding Center, Buffalo, N.Y.; Cannon Design in association with The Ehrenkrantz Group & Eckstut.
• Meyer Center, Pleasanton, Calif.; Langdon Wilson Mumper Architects and Brandow & Johnston Associates (structural engineer).
• Executive Place, Westmont, Ill.; A. Epstein & Sons, Inc. (architect/engineer).

The three winning bridge projects are the Glenwood Canyon Bridges, Glenwood Springs, Colo.; Annacis Cable Stayed Bridge, Delta, British Columbia; and Rt. 62 Over White's Creek, Morgan County, Tenn.

Grants for Architecture Research

AIA has established an Institute scholars program to provide direct support for collaborative research projects between practitioners and faculty at schools of architecture. The objective of the program is to improve education through joint research that will be useful in both teaching and practice. General areas of research include: design methodologies, building systems and technologies, management and practice, and architectural education. The program is open to project teams composed of an AIA member teaching in a

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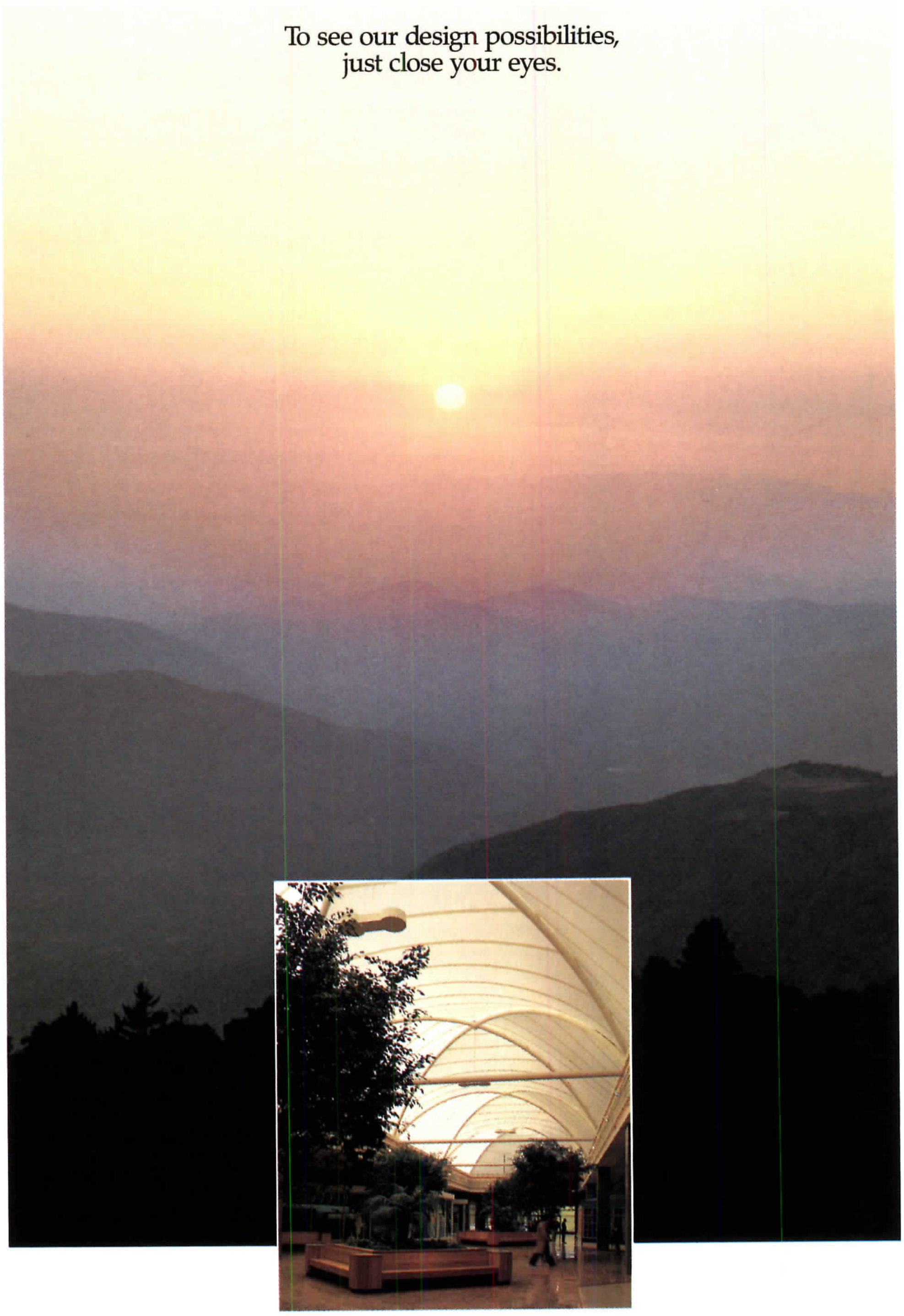

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Briefs *from page 21*

professional program in architecture and an AIA member in practice. A $5,000 award will be presented to each member of the winning team for 1987. Application deadline is April 15, and the winners will be announced May 15. For more information, contact Karol Kaiser at Institute headquarters, (202) 626-7356.

Albert Kahn Fellowship Recipient

Peter Hugo Baldwin, a fifth-year student at the University of Michigan, has been chosen to receive the first Albert Kahn Associates fellowship. The grant will provide financial assistance during Baldwin's last two years in the university's professional program in architecture.

State and Local Government Awards

The Ford Foundation has cited 10 state and local governments that developed new approaches "to difficult social and economic problems." The foundation initiated the program to recognize the responsibilities of state and local governments in meeting the needs of the public. The recipients are the State of Arizona for its ground-water management code; Los Angeles County for the distribution of surplus food to the needy; State of Illinois, one program to increase the adoption of minority children and a second program to improve nursing home care; Leslie Public Schools, Ingham County, Mich., for an education program for rural teen-age parents and their families; State of Minnesota for a program to encourage state employees to suggest ways to improve public services; New York City for a program that is helping rehabilitate juveniles in detention; Rochester, N.Y., for a video catalog to ensure fairness in property assessment; State of North Carolina for a program that is helping disabled people lead more productive lives; and St. Paul, Minn., for an experiment to avoid premature nursing home confinement of the elderly.

ADPSR Design Competition

The Architects, Designers, Planners for Social Responsibility/Northern California chapter is sponsoring a design competition for "bomb shelters." Registration deadline is Feb. 15; entries are due April 1. For more information, write ADPSR/Northern California Chapter, 120 Howard St., B-726, San Francisco, Calif. 94105.

Urban Design Traveling Fellowship

Ronald M. Druker, president of the Druker Co., a real estate development firm in Boston, has established a traveling fund for urban design students at Harvard University's graduate school of design. The fund will provide travel and living expenses for one student annually to advance studies contributing to urban design. Contact Graduate School of Design, Harvard University, 48 Quincy St., Cambridge, Mass. 02138. □

ARCHITECTURE

As we had hoped and intended, the varied forms of this magazine's content—built work, theory, practice, technology, etc.—are becoming steadily more integrated one with another. In this issue's treatment of lighting, for example, we present on the immediately following pages several examples of a building type to which lighting design is particularly crucial, the ubiquitous museum. From this account of what is being done we move in the Technology and Practice segment to a discussion of "how"—in terms of the tools and techniques of both natural and electrical lighting—and, importantly, the blending of the two. In all, we feel it is a nicely happily rounded package.

And in addition to the museums there are some other cultural facilities; and in addition to lighting, interiors, news, and an extensive update of the CADD software evaluations that began in ARCHITECTURAL TECHNOLOGY magazine. Speaking of which, the March issue will be all but entirely devoted to technical subjects. *D. C.*


WALLS THAT LAYER

Moore on Moore in Moore

He designs a major retrospective on his work for galleries of his design.
By Robert Campbell, AIA

It's hard to imagine a better introduction to the work of Charles W. Moore, FAIA, than an exhibit of Moore's architecture housed in a new museum of Moore's design. Such a conjunction occurred at the Williams College Museum of Art in Williamstown, Mass., which opened in October with the first major retrospective ever held on this 61-year-old architect. There is something very Moore-like about the idea of a Moore exhibition in a Moore museum, as if a festive box were contained in a festive box, or as if the exhibition were one of those collections of miniatures with which Moore likes to furnish his architecture. The ironic play between exhibit and building offered many insights into the work of this playful and ironic architect.

Moore seems somehow always to have retained, despite his intellectual sophistication, a child's open-eyed wonder at the world. Thus it was fitting that the exhibition began with his childhood, with an extraordinary notebook—"Chuck's Book," according to the neatly cut-out lettering on its handmade wooden binder—kept by Moore in adolescence. Referring to architecture as "my vocation," the book includes an amusing and touching catechism of questions and answers:

"1. How much money will I earn? Depends entirely upon business. Usual rate of 6 percent of cost of buildings designed.

"2. Where will I go to school? University of Michigan, Massachusetts Tech, Georgia Tech.

"3. How much will it cost to go to school? About $700 to $1,000 per year. About $3,500 to $5,000 all five years.

"4. How many hours a day will I be working? Depends on business; irregular.

"5. What subjects should I take in school to prepare me for my vocation? As much math as possible, French or German, physics, English & history, electives to total 15.

"6. Where would be the best place to practice my vocation? A town slightly larger than Battle Creek (population 50,000-150,000)."

"Chuck's Book" served as a prologue to the exhibition, and the exhibition served as a prologue to the museum building itself. In the exhibition were drawings and photos and models of all the once-shocking, now familiar buildings designed by Moore with his many collaborators, from the early houses around Berkeley to the great breakthrough of the Sea Ranch Condominium—obviously, 22 years later, a masterpiece and the most imitated American building of the 1960s—and on to Kresge College at Santa Cruz, the Santa Barbara faculty club, Piazza d'Italia, the Wonderwall at the New Orleans World's Fair, St. Matthew's Church in Pacific Palisades, the Hood Museum at Dartmouth College and many others. Special attention was paid to the eight houses that Moore has designed so far for his own use in a peripatetic life—houses that display the risky tension, the willingness to seem flippant or crazy, that has characterized Moore's career. Also on view, created especially for this exhibit, were a series of watercolor plan/section drawings of Moore's buildings and another series of fantasy drawings, mostly of domes, cupolas, and towers; neither set was very interesting.

Left, 'Walls that Layer,' one of the 11 'Palaces of Memory' that illustrate architectonic themes of Charles Moore's work.

What was much more interesting, and indeed the highlight of the exhibition, was an amazing group of what Moore calls the palaces of memory. The name is apparently lifted from a book, *The Memory Palace of Matteo Ricci,* written by a former Moore colleague at Yale on the life of a Renaissance Jesuit missionary in China. The name is misleading; Moore's palaces have nothing to do with memory. Instead, each brilliantly illustrates some quality of architecture. Each is a sort of shrine, four or five feet high, looking like a cluttered stage set and made of painted cardboard and found objects such as toy soldiers, electric trains, dollhouses, and much more. The themes illustrated in the 11 palaces include "Aedicules that Center," "Space that Leaks Up and Out," "Water that Pools and Connects," "Geodes that Reveal," "Walls that Layer," "Stairs that Climb and Spread," etc. My favorite is "Chocolate Sundaes," which looks like an overloaded Gothic pulpit but which—like Moore's work generally—is more profound than at first it seems. Its caption reads in part:

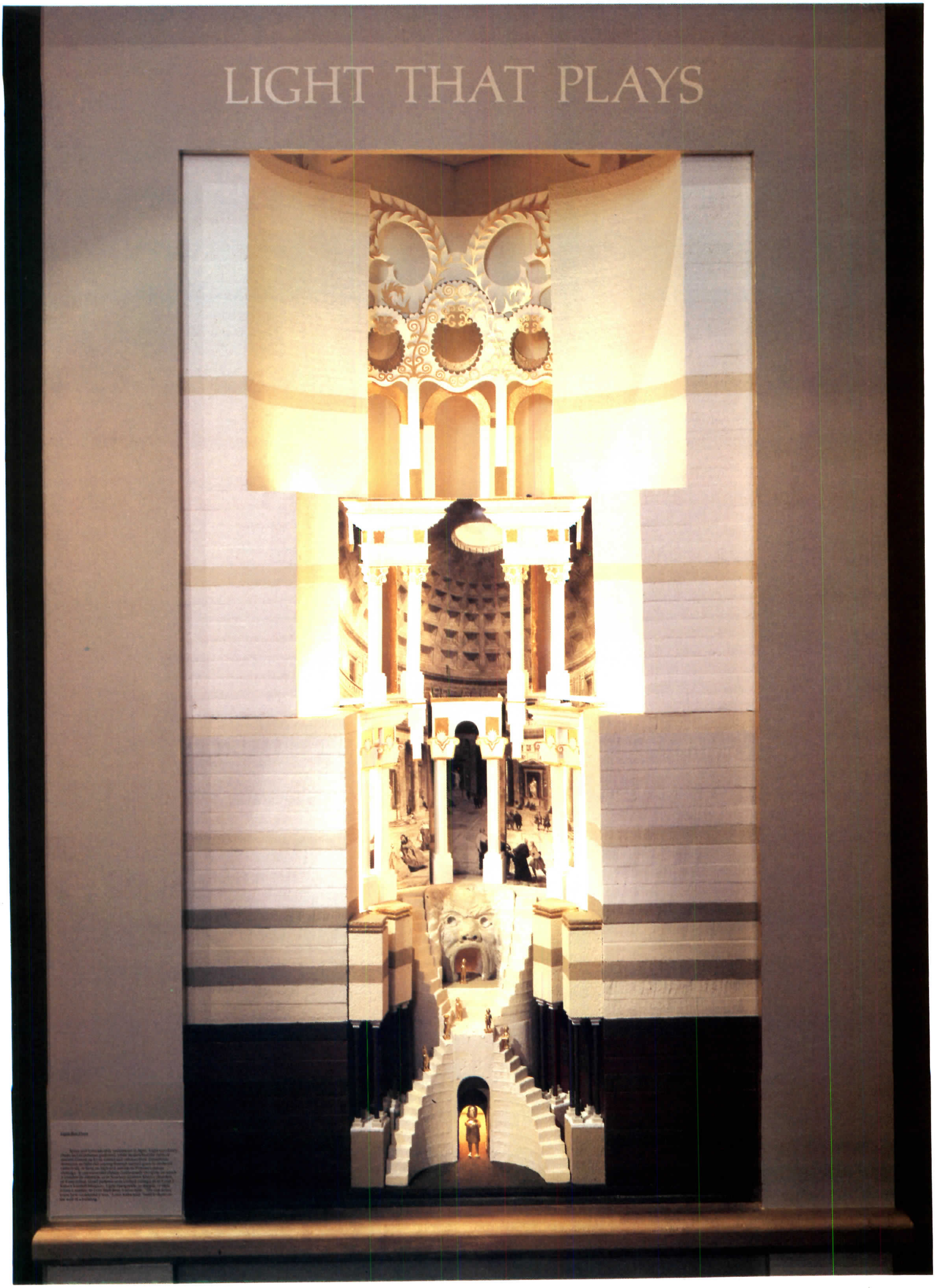
"Donlyn Lyndon has noted that the way I design a building is rather like eating an ice cream cone on a hot day, licking frenziedly at the drips that threaten to spill. Maybe that is why I keep looking for buildings that honor the images of the chocolate, or even the hot fudge sundae. The image is a top-heavy one, of course, of roofs and chimneys and dormers and bays, all bigger than the chaste and smaller base on which they tumble and slide. A very few medieval towns do this, as their buildings search upward for light."

Taken as a group, the memory palaces are a marvelous introduction to the sensory qualities of architecture. They were the perfect introduction, too, to the rest of the Williams museum, which might almost have been designed as a further illustration of some of these themes.

Stairs climb and spread at Williams, walls layer, space leaks up and out. The stairs, in fact, are the first thing you notice when you come through the front door. As richly complicated as the terraces of a hilltown, they are the heart of the museum, connecting its three levels both literally and visually while providing any number of nooks in which to sit or stare across space at some bridge or crow's nest on the other side. Approaching the stairs at the entry level, you look down to the student lounge, up to the main galleries, or right to the reception desk; the stairs thus orient your perception of the whole museum, providing a clear center for a building that otherwise might seem (as do some of Moore's) too labyrinthine. The stairs occupy a triangular atrium where the museum's two grids meet, and the space of this atrium rises to skylights far above your head where light seems to hang in the air like a luminous cloud.

Opening off the stair atrium are the galleries. If the stair space is a chaotically picturesque assemblage of white plaster arches and keystones and bridges and brackets that collide at odd angles, filling the air with a sort of architectural meringue (or perhaps an architectural food fight), the galleries are very different. They are simple, symmetrical, rectangular or octagonal volumes, recalling the geometric rooms of an Adam-style mansion. At the major floor, the top one, they are strung together on a single long axis that runs the full length of the building and threads them

LIGHT THAT PLAYS



Photographs © Steve Rosenthal

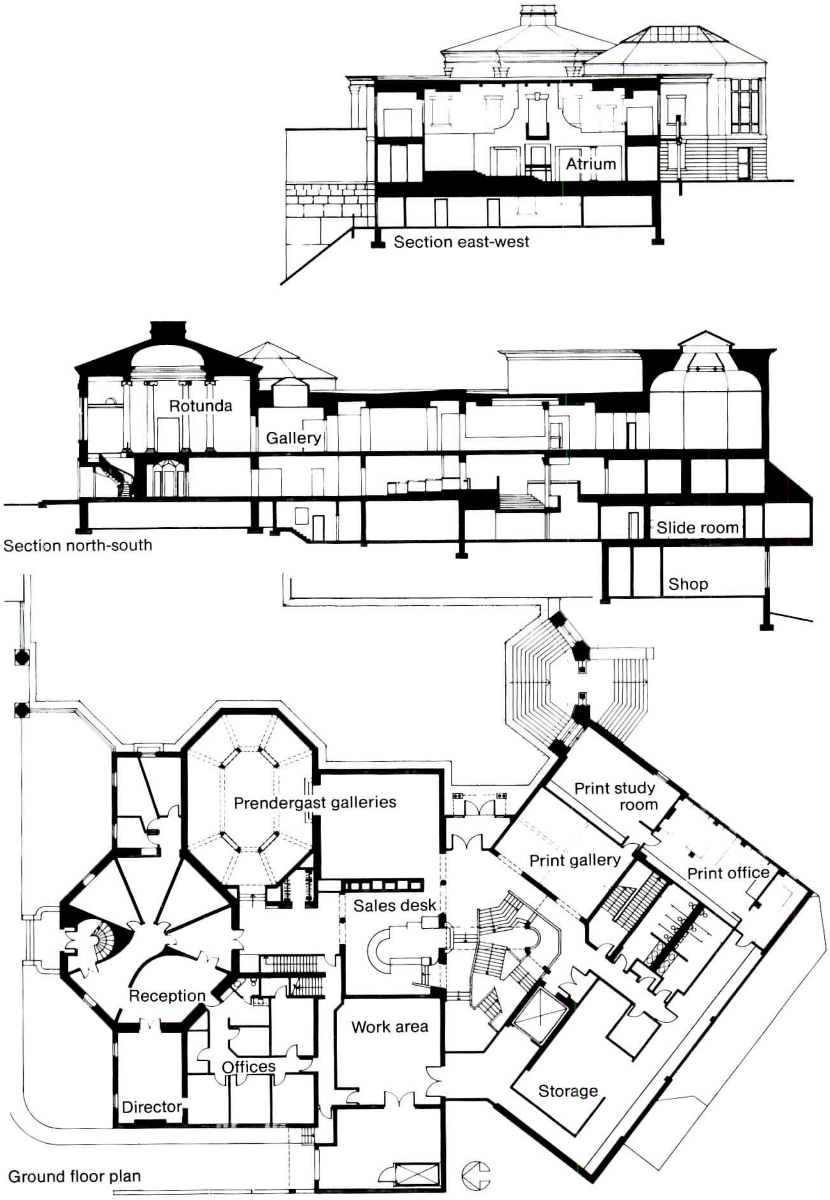
Left, another in the 'Palaces of Memory' series of model/photo/drawing montages, this one illustrating 'Light that Plays.' Above, view of exhibit in Williams museum's 20th Century Gallery.

together as a wire threads a row of beads; the axis crosses the stair atrium as a bridge. The galleries are serene, well-proportioned spaces, skylit wherever possible, classical in feeling and a pleasure to inhabit. The experience of moving back and forth between the prismatic galleries and the organic atrium is delightful, as are the unexpected long views that so often open up. If both the galleries and the atrium lack the rich inventive color and detail of Moore/Centerbrook's other recent museum, the Hood at Dartmouth, they perhaps gain something in unity and peacefulness.

Not all of the Williams museum is new. What grew into the museum was originally built as an octagonal library, Lawrence Hall, in 1846. It had already acquired several accretions and become a museum before Moore and his associate, Robert Harper, FAIA, of Centerbrook Architects and Planners of Essex, Conn., began work. The architects have renovated everything that existed while adding new spaces—not only galleries but the usual offices, classrooms, and support areas—that add up to more than the former museum. In doing so they have picked up the theme of the Lawrence Hall octagon, producing variations on it in several galleries. They have also picked up the major shapes and details of the exterior, carrying the rustication, the brick, the string courses, the white cornices, and shallow pitched roofs from the old parts of the complex to the new, though with enough jogs and changes to remind you which is which.

As so often in Moore's work, the museum is least interesting on the exterior. Partly this is because a proposed entrance courtyard hasn't yet been built (a victim of budget problems). As things now stand, you can't easily find the main entrance, which is tucked out of sight from the street. When the courtyard is in place, an outdoor grove of tall Ionic columns that support nothing—"ironic columns," as Moore calls them—will emphasize the new front door, recalling the real Ionic columns that still stand inside Lawrence Hall where they form a kind of circular sacred grove in the original 1946 top-floor octagonal room. There will also be a sculpture by Anne and Patrick Poirier (previously sited in Germany) that represents a giant Doric column that has fallen in pieces on the ground; the pieces ingeniously lead you around the building to its entrance. Until then, the only marker at the entrance is a rather timid Palladian gazebo. Other "ironic columns" already exist at a rear entrance: These appear to support a little house-like room (actually the student lounge) that projects forward from the facade, until you notice that a gap of several inches of air separates the columns' shafts from their capitals. The jokiness here is perhaps a little thin, and the exterior in general gives a sense that small white pieces of architecture have been applied at random to a brick box.

The Moore exhibition, curated by Eugene J. Johnson of Williams, has moved to another Moore museum, the Hood at Dartmouth, where it will be until March 15, then moving to the Deutsches Architekturmuseum in Frankfurt. An excellent catalog is published by Rizzoli. Taken together, the show with its memory palaces, the two Moore museums in which it will have been installed, and the catalog offer a unique opportunity to savor the work of this architect whose buildings, sometimes frustratingly imperfect, remain always instructive and pleasurable. Charles Moore has indeed practiced in a town slightly larger than Battle Creek. He has influenced our view of the world.



Below, view of circulation gallery at entry level with reception desk at center; right, view from top level across circulation gallery showing the crisscross and weaving of spaces and pathways. Both views show addition's interior punctuated throughout with whimsical, Moore signatures, such as freestanding walls, juxtapositions of classical and modern architectural forms, layers that peel away revealing old and new, and theatric devices to designate entry, procession, and arrival.

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Left, view from top level of bridge in direction of Class of 1954 Gallery; below, corner of 20th Century Gallery with octagonal skylight and entrance to East Gallery at left; bottom, one of the Pendergast galleries directly below 20th Century Gallery contrasting with natural light-filled galleries above.

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Left below, original 1846 rotunda of museum; left above, gallery just south of rotunda; right, 1983 addition's southeast entrance has 'ironic' columns with floating capitals.

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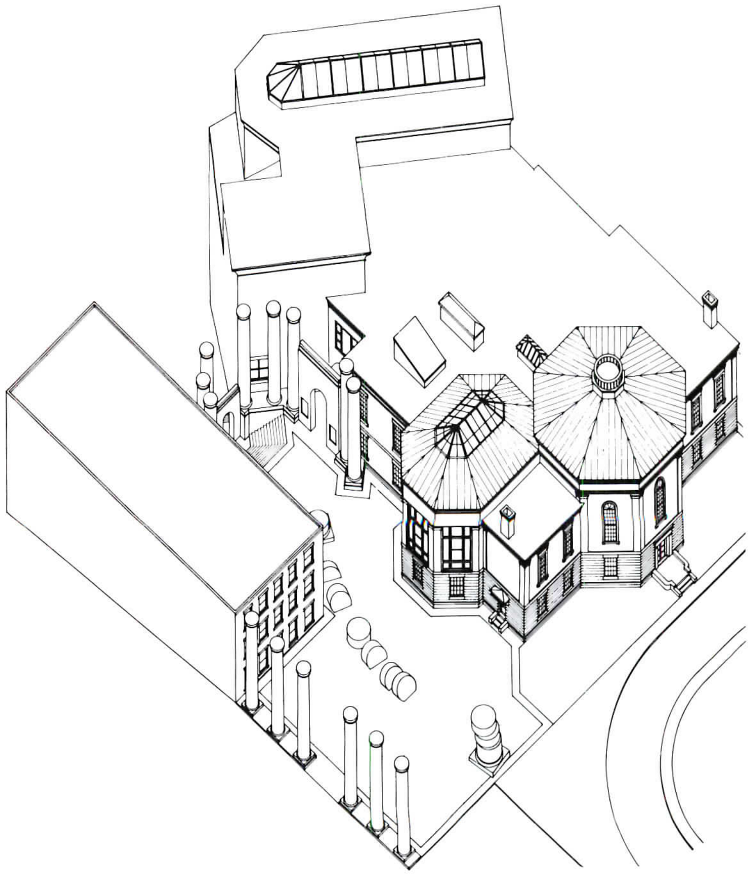
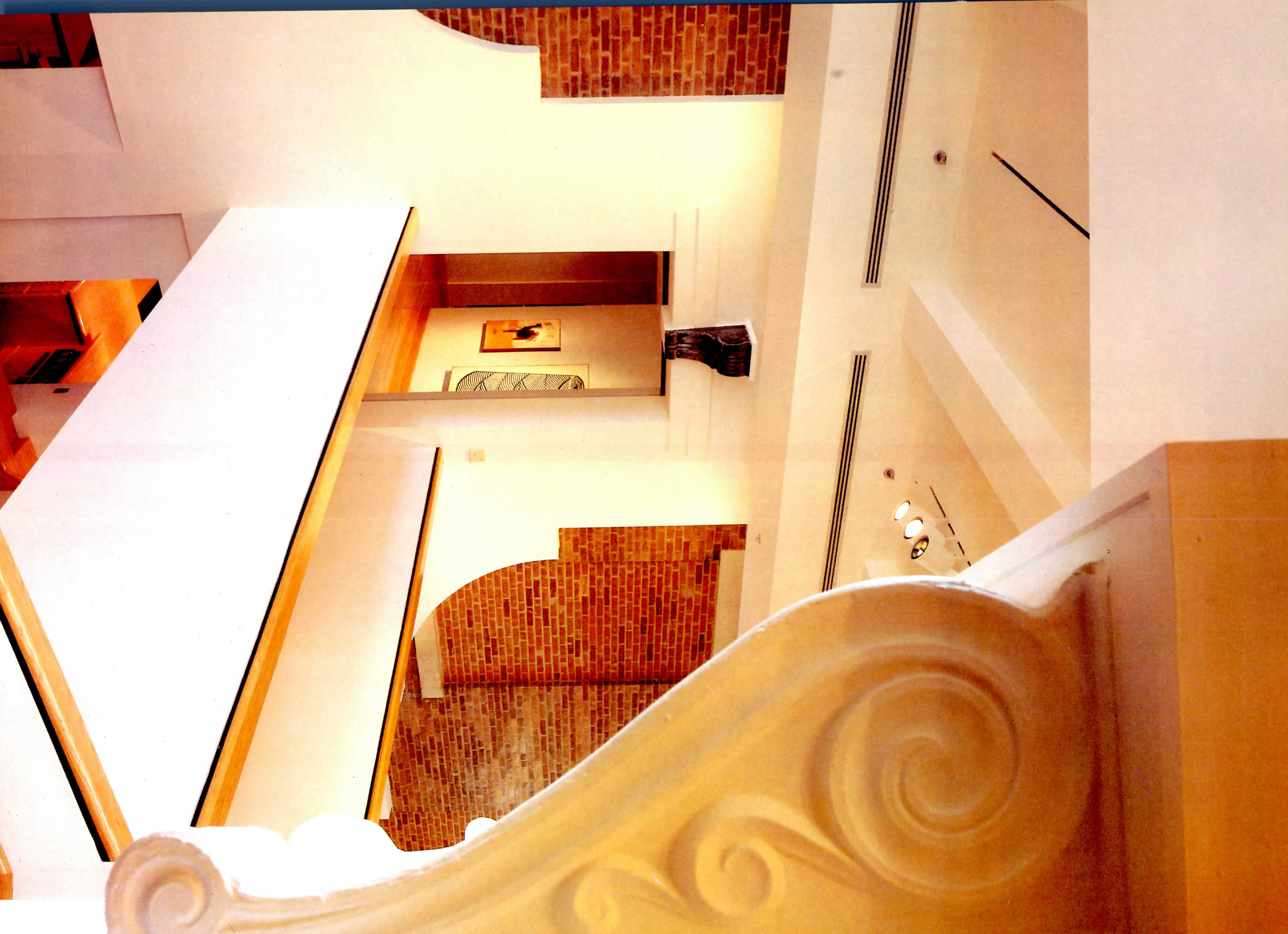
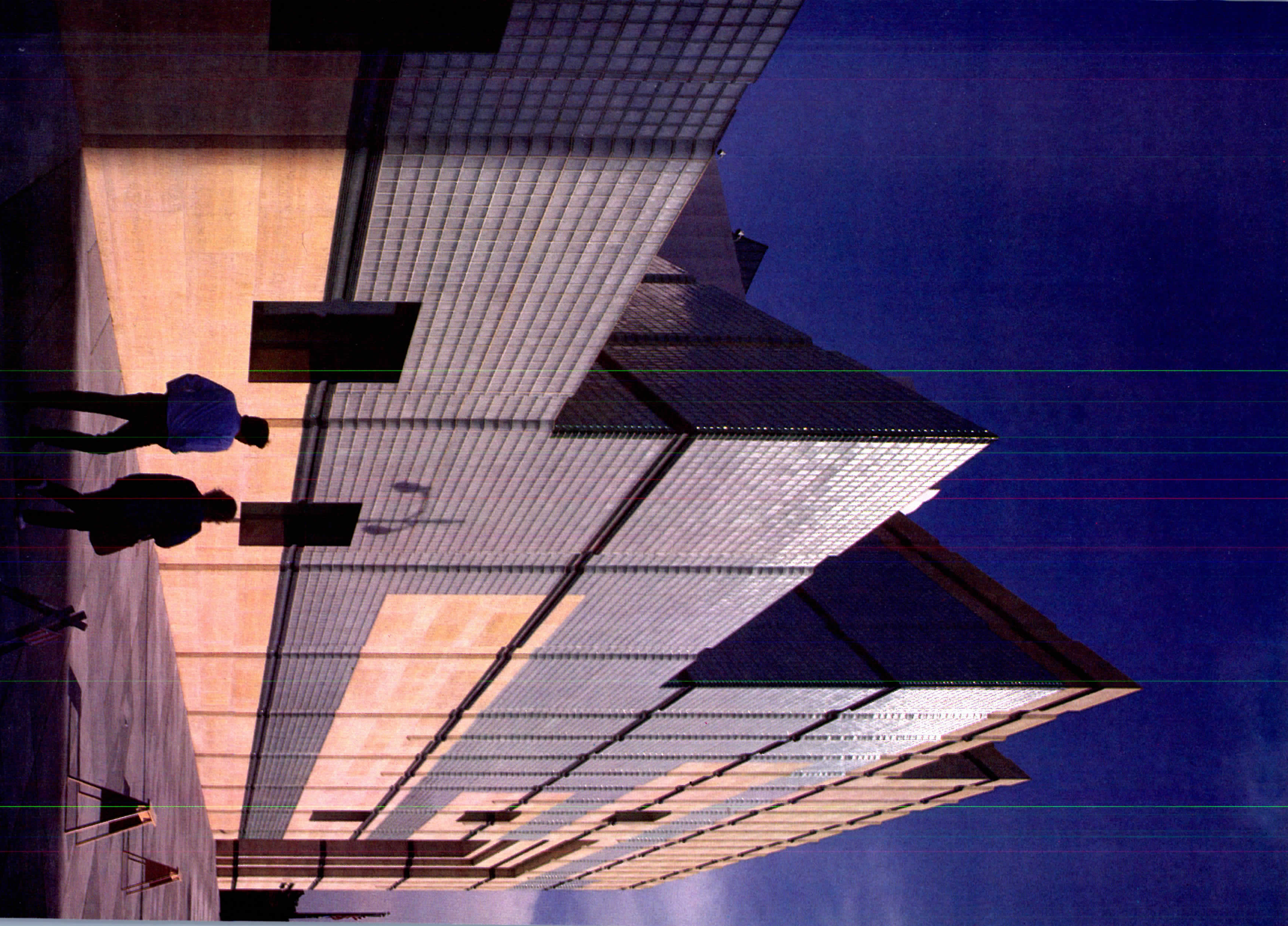
Above, inserted 20th Century Gallery from northeast picks up banding and detailing of older building, while banners signal attention to east entrance, left. Right, detail of top level's exposed brick wall of 1927 addition, whose new entrance is marked by white portal. □







L.A. Art: Dissimilar Duo

'Complementary paradoxes' in the California city's two new modern museums.
By John Pastier

During the last several years, there has been an extraordinary museum-building boom in the United States and Europe. But even in this context, it is a remarkable stroke of coincidence that two major buildings devoted exclusively to modern art opened in the same city within a fortnight of one another last fall. Despite their close physical proximity, however, these two structures and their parent organizations show notable dissimilarities in most important respects.

The Los Angeles County Museum of Art is a large and long-established institution concerned with the full range of Western art and certain aspects of Eastern art. The Museum of Contemporary Art is a virtual infant, devoted to art since 1940. Both museums retained architects based thousands of miles away, but in opposite directions. LACMA used Norman Pfeiffer, FAIA, of Hardy Holzman Pfeiffer, New York City, while MOCA went to Tokyo for the services of Arata Isozaki, Hon. FAIA.

LACMA's Robert O. Anderson Building is a large addition to (and part of a major reorganization of) a 21-year-old midtown complex of buildings designed by the Los Angeles firm of William Pereira, while MOCA is a freestanding structure within a large and still incomplete downtown urban redevelopment project designed by Arthur Erickson, Hon. FAIA.

The two buildings represent complementary paradoxes. HHPA's building was clearly intended to proclaim a major presence on Wilshire Boulevard, but its virtue resides entirely in its interior spaces. Isozaki's largely underground facility was meant to be self-effacing and internalized, but its greatest strength lies in its ingratiating exterior. LACMA could be called an immense disappointment with welcome compensations, while MOCA is a well-crafted success despite some minor reservations.

Below, new LACMA building angles in front of old one.

The Anderson Building's external form and relationship to its setting fall surprisingly short of any minimum standard that one would expect from an institution devoted to the visual arts. Of course, the art world can embrace even esthetic failure by labeling it kitsch, or to use a more dated term, camp. Viewed through such a lens, HHPA's product may strike some people as interesting. Dr. Tyler Owlglass, Ph.D., holder of the Andy Warhol Chair of Contemporary Design Theory at the Golden State Institute of Technology at Azusa, is a leading proponent of this viewpoint. Rather than belabor readers with my own rigidly old-fashioned assessment of these aspects of the building, I will quote at some length from a lecture that Professor Owlglass delivered at the institute on Nov. 31 of last year.

"The Anderson Building is a droll send-up not only of the mid-1960s structures that encircle it, but also of the state of architecture today. It recognizes the futility of relating to existing buildings that aren't all that old, and, rather than taking sides in the debilitating battle of modernism vs. postmodernism, it pokes fun at both schools equally.

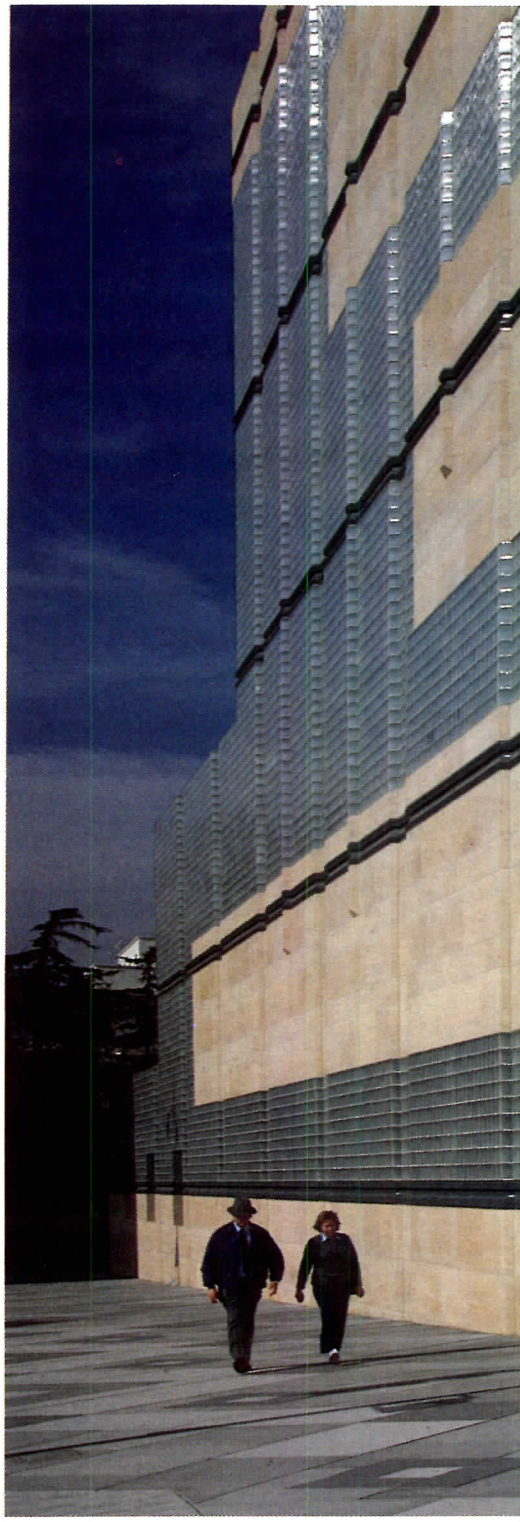
"At the same time, it is a serious cultural statement. It is a semiological commentary on the 1960s, a time that saw the birth of the older museum building as well as the Hardy Holzman Pfeiffer firm, and constitutes an equally dense exegesis on its city and on our own decade.

"The '60s was an era of great turmoil, but Pereira's saccharine and formalistic buildings did not reflect that fact. By brusquely disrupting the composure of the older buildings, by plunking itself down noisily in their midst with overt disregard for their form and scale, the HHPA addition can be thought of as the architectural equivalent of a '60s sit-in.

"It is also a teach-in that scrutinizes the sins of the older design. The first of these is its derivative nature; Pereira's pavilions, orig-

Photographs by Allen Freeman

Right, the Anderson Building's superscale becomes most apparent at close range, particularly at the open portal with its white porcelain panels. Bottom photo shows second-level sculpture terrace.



Photographs by Allen Freeman

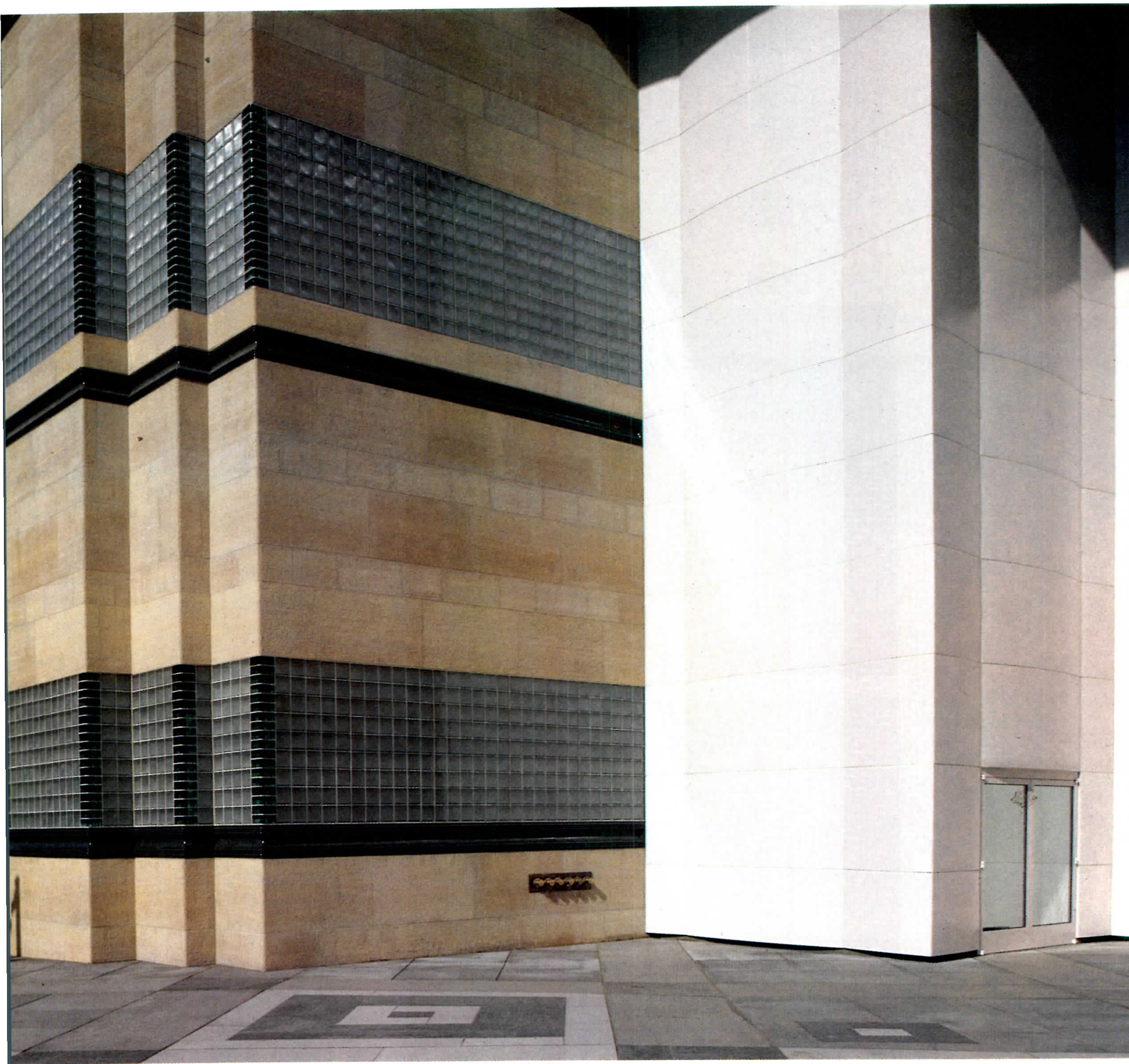
inally floating in pools of water, were uncannily similar to Minoru Yamasaki's earlier science buildings at the 1962 Seattle World's Fair. HHPA underscores this borrowing by multiple borrowings of its own. The entry court's donors' wall recalls the Vietnam Veterans Memorial in Washington. The liberal use of glass block recalls HHPA's own Best Products headquarters in Richmond, and the sawtooth roof over the courtyard is taken from their Hult Center for the Performing Arts in Oregon, which is near Seattle, the source of the original museum's form. The bulging porcelain panels are superscale versions of fluted pilasters from a WPA moderne post office.

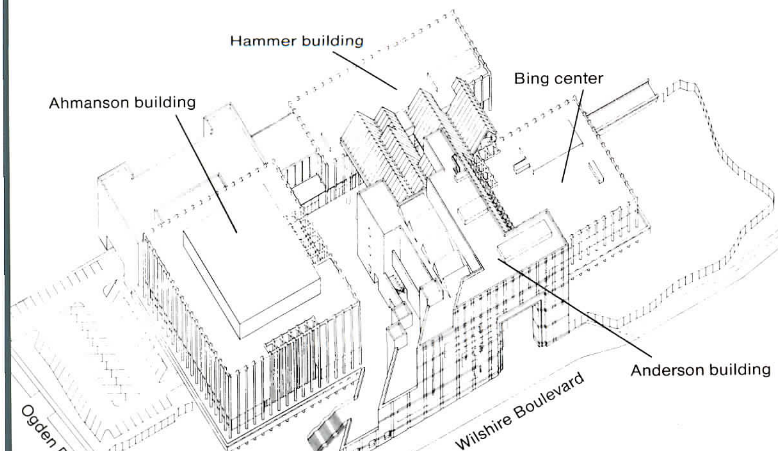
"Another sin is the old building's fussy proportions, and by using its constricted 10-foot structural module decoratively on parts of its building, HHPA has held that fussiness up to public scrutiny. Indeed, the older building is the very embodiment of that quintessential '60s phenomenon—high camp—and the newer one brings the phenomenon up to date.

"But the new building's strongest indictments concern its time and place. It is well known that Los Angeles exemplifies urban chaos, where incompatible land uses and building forms exist cheek by jowl, and where good and bad taste fight never-ending battles. In its modest way, the HHPA design attempts to encapsulate this bewildering complexity in a single structure.

"Similarly, this period in architecture is quite bewildering, with modernists, pragmatists, contextualists, preservationists, postmodernists, new wavers, and high-technicians all contending for supremacy. The Anderson Building does its best to give each of these factions equal space. One may argue that its signature gesture, the grandiose entrance 'gateway,' is postmodern, but I must point out that this element is badly undermined by the porcelain-panel intrusions that take up more than half its width and thus destroy its effectiveness. Wherever any particular stylistic gesture occurs, it is immediately negated by one representing an opposed philosophy. The building says, and rightly so, 'a plague on all your houses.' I especially like its approach to context: Current plans are to re-clad the older buildings to be more sympathetic to the new structure.

"If all this formal contradiction, this pushing and tugging, these



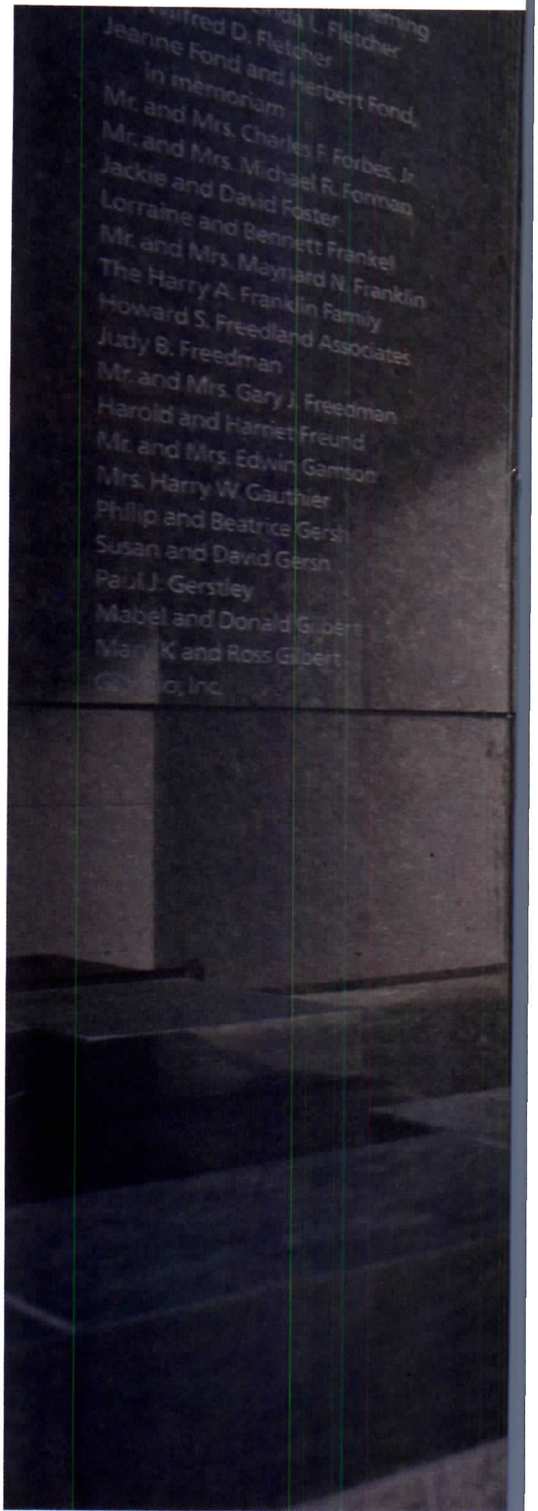


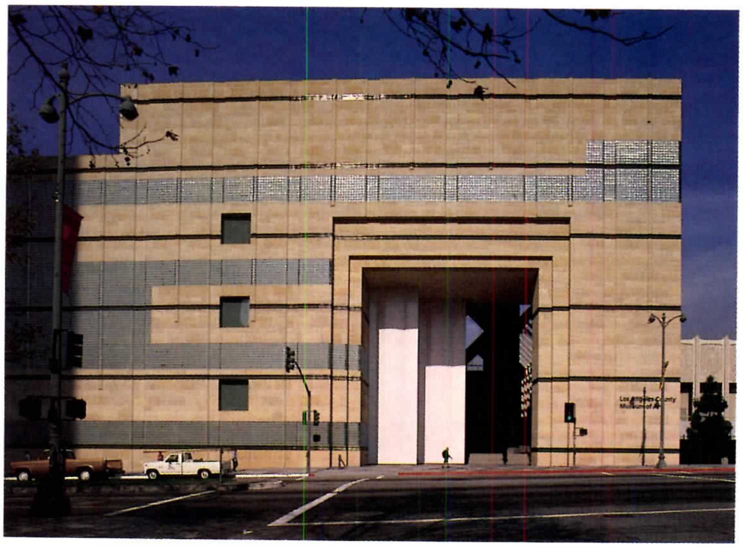
meaningless rhetorical gestures and creation of gigantic scale and less than pleasant spaces, is an imposition on the museum's patrons, that is also fitting for a museum. One school of thought has it that art is meant to challenge the complacency of its viewers, and this design certainly does that. Another posits that art must embody order and integration, and this building permits the works displayed inside to seem eminently so in comparison."

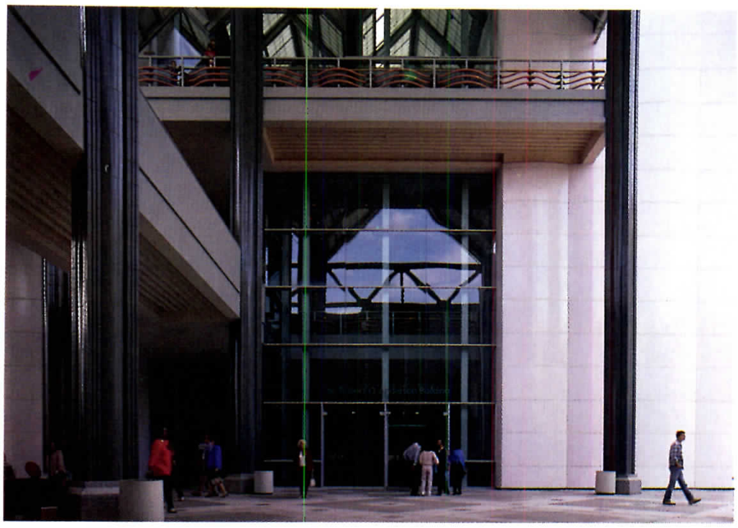
Of course, Professor Owlglass' provocative remarks don't present the entire picture. The existing LACMA buildings were not easy ones to which to relate visually. And, despite the startling deficiencies of the design on the outside, its interiors are generally successful. The gallery spaces are calm and composed, and employ a nice variety of devices to bring light and even views into the galleries.

These include floor to ceiling expanses of exposed glass block, high strips of glass block screened by interior louvers, standard gallery skylights centered on top-floor ceilings, concealed lower floor skylights that unexpectedly illuminate odd corners of galleries, view windows boldly inserted into gallery walls, and in

Below, axial view shows asymmetrical layout of entry court. Right, donors' wall in this court rises above linear pools opposite fluted porcelain wall (bottom photo). Entrance to the building is on the elevation opposite Wilshire (middle photo) after passing under second-level bridge that connects the addition to the central Pereira pavilion.







one case, a protected glass curtain wall that lights a small ceramics gallery. This repertory of devices creates a diversity of viewing experiences and shows a welcome concern for the museum-goer, who, in addition to the proverbial sore feet, is subjected to ocular fatigue in most large institutions.

One might suggest that in our century, natural lighting is more an architectural device and an amenity for patrons than it is a tool for art display, especially in the case of modern art. Experiencing the effects of well-thought-out daylighting at LACMA and MOCA certainly supports such an opinion. Artificial lighting is always available in sufficient quantity and quality to be independently sufficient for evening viewing, and those same lights are on fully or partially during the day. One may argue that museum lighting should duplicate the light under which the art work was made, but the vagaries of natural light make such a correspondence unlikely, and many modern works were created under artificial light.

Of course daylight contributes greatly to the process of seeing painting and sculpture, but it is an even stronger factor in deter-

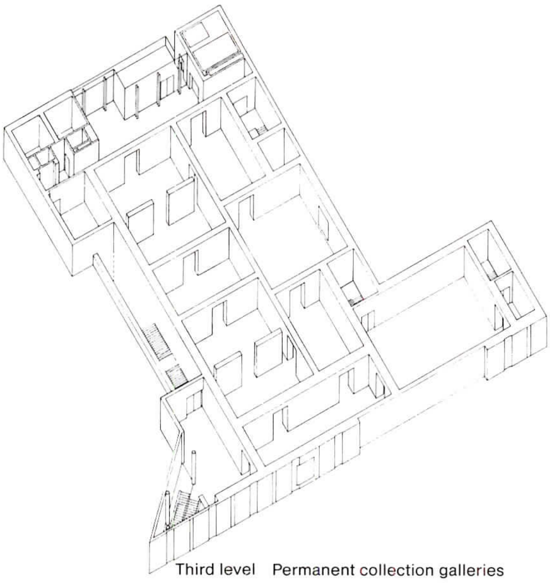
Photographs by Allen Freeman

mining how one feels about the gallery space and the process of using the museum. In the Salvatori Gallery, an elegantly simple Anderson Building room devoted to minimalist art, the introduction of daylight through high louvered strips on two opposite walls is the crucial factor in the creation of an architectural space that is arguably on the same plane of artistic achievement as the works within. (That claim would be asserted even more strongly but for the obtrusive presence of a fire exit door accompanied by the requisite illuminated sign.)

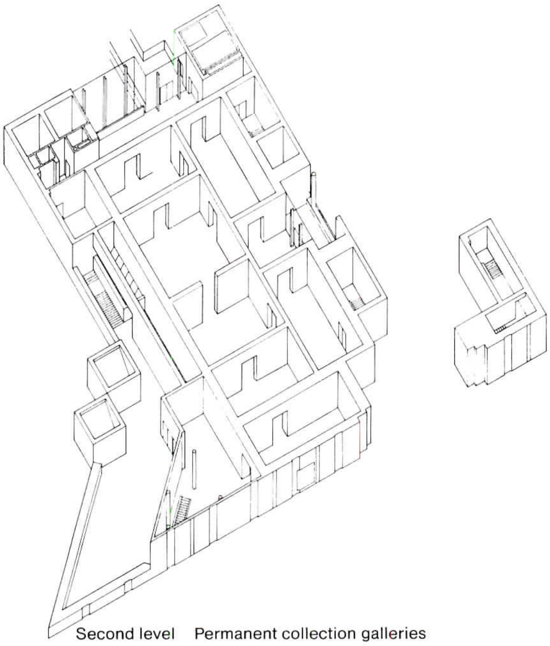
To call natural lighting an amenity for patrons is not to trivialize it, but rather to recognize its role as a civilizing element beyond its utilitarian value in helping display art. Similarly, the provision of view windows gives visual and psychological relief, as well as creating a possibly ironic metaphor for art by mimicking the form and placement of a painting while using "the real world" as its subject matter.

Given the Anderson Building's innovative daylighting mechanisms and its aspirations to hipness on the exterior, the gallery interiors are for the most part surprisingly conservative. Sharply modeled moldings are used as baseboards and frames for the door openings, and one section of galleries is arranged in a rigid Beaux-Arts *enfilade* rather than the less symmetrical and freer disposition that has come to be traditional in spaces devoted to contemporary art. Perhaps the reasoning was that such a tastefully postmodern treatment was a way of being as contemporary as possible. On the other hand, there is an enormous visual disparity between the architectural manifestations of postmodernism and the art works that fall under that rubric, and it seems accurate to say that most postmodern art works are still best displayed in large, neutral, minimalist spaces, just like their modern predecessors.

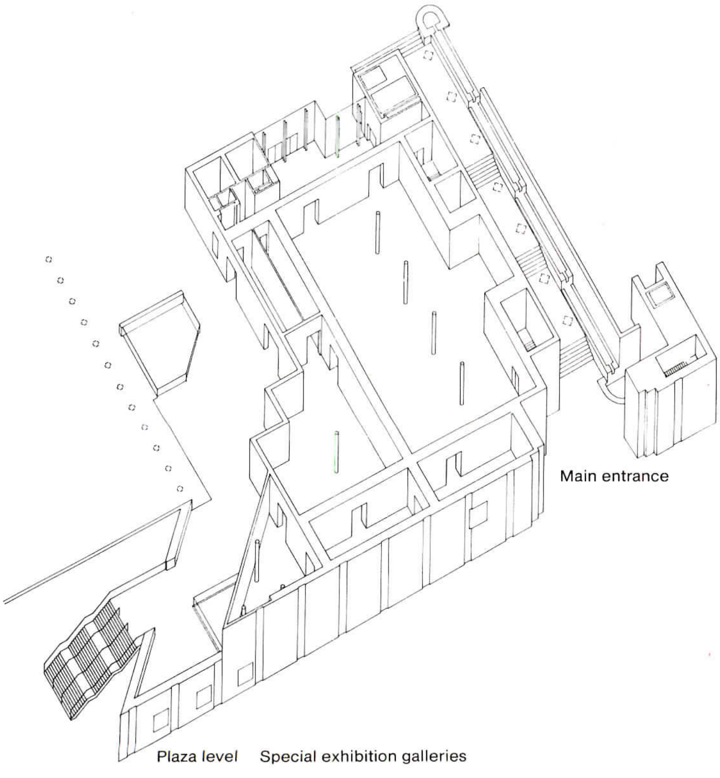
This is a somewhat subtle point, since the Anderson Building's postmodernism is muted and its spaces, except for those within the 45 degree angle zoot that forms a gratuitous prow for the structure, are generally pleasant and functionally workable. And while it is regrettable that the taste and restraint that mark the interiors are in such short supply outside, we can be thankful that the situation is not reversed.



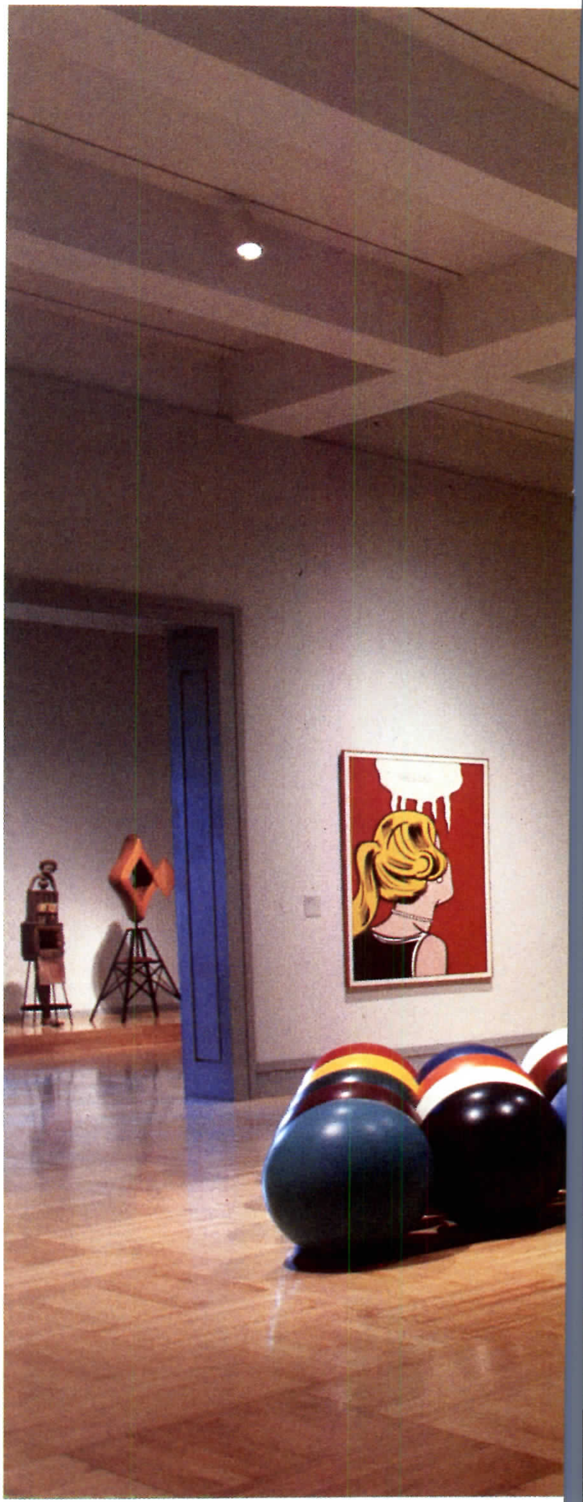
Third level Permanent collection galleries

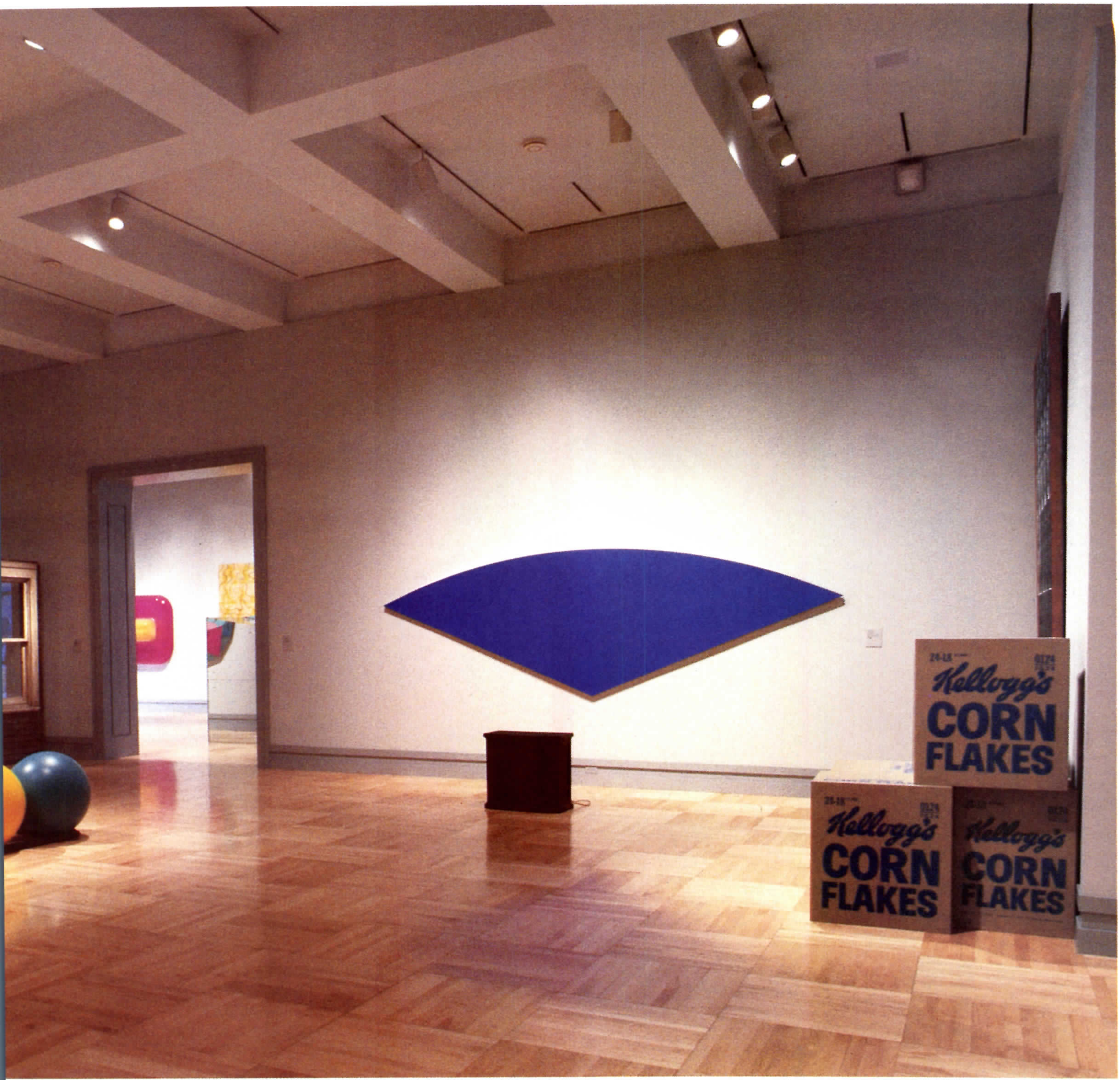


Second level Permanent collection galleries



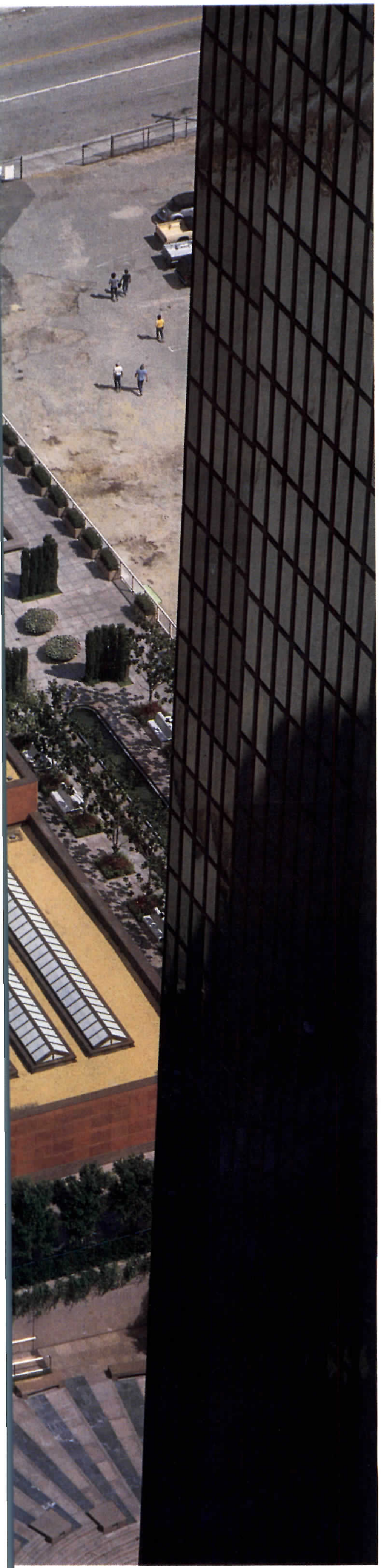
Plaza level Special exhibition galleries





Photographs by Allen Freeman

Above, a second-level gallery with coffered ceiling. Left and far left, two third-floor rooms with natural lighting, one through ceiling louvers and the other through wall slats behind a long strip of glass block on the Wilshire elevation.



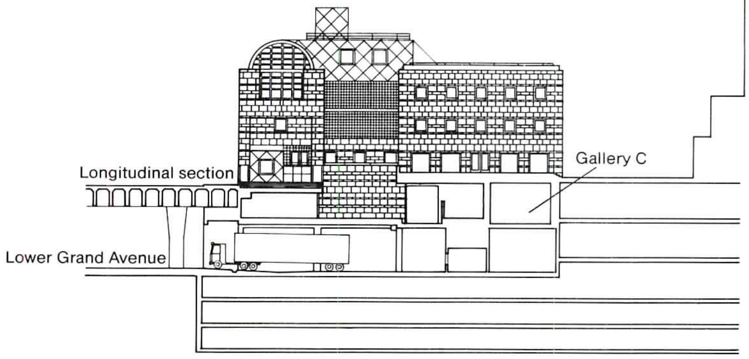
Shortly after the Anderson Building opened, I observed a young couple asking a ticket booth attendant if it was the Museum of Contemporary Art. Yes, she replied, contemporary art and traditional too. I had to tell them that the destination they sought was five miles away, and then reflected on the irony of a LACMA employee being unaware of the other, better new museum building in town. In comparison to the museum on Wilshire Boulevard, Arata Isozaki's building for MOCA is virtually a boutique. It is small, sophisticated, meticulously crafted, and quite seductive as an element of an otherwise ponderous urban-renewal cityscape. Seeing its suave and witty exterior, one would hardly expect that it grew from circumstances at least as difficult as those of the Anderson Building.

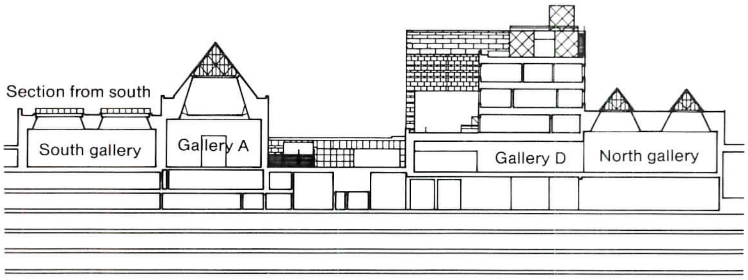
Although it was built on vacant land, MOCA's physical possibilities were highly constrained. Its site is small, and there were stringent conditions imposed by the architect and the developer of California Plaza, the still largely unbuilt redevelopment project of which it is a part. MOCA's origins stem from an inventive application of the Los Angeles Community Redevelopment Agency's requirement that 1.5 percent of the construction budget on downtown renewal projects be spent on public art. Given a billion dollar price tag for California Plaza, the agency reasoned that an arts facility would be a more productive use for the $15 million public art component than a plethora of plaza sculptures and lobby paintings. At the same time, a new museum was in the process of formation, and the city cemented the connection between the two elements by earmarking the arts money for the museum building.

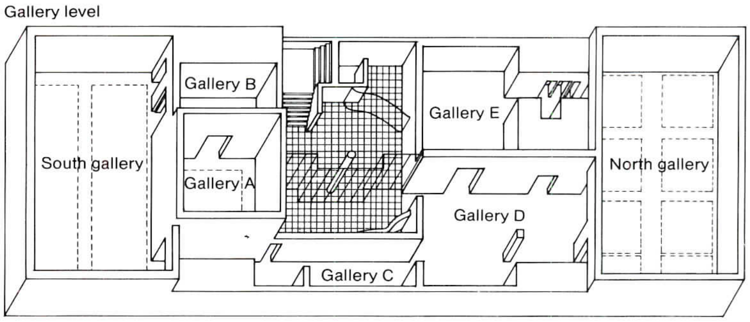
Unfortunately (or perhaps fortunately), California Plaza architect Arthur Erickson proposed a drive-by museum in which 40-foot-high glass walls would permit motorists to glimpse immense paintings while cruising down Grand Avenue. This vision prompted the MOCA trustees to seek their own architect, and, after the usual junketing and arguing for favorites, they selected Arata Isozaki to do his first American building. Isozaki was soon immersed in the complex and inscrutable Western world of redevelopment bureauracy and corporate politics. His design had

From above, Museum of Contemporary Art appears as a series of platforms upon which are placed variations on pyramidal forms. Oblique view, below, shows skyscraper context.

Photographs © Tim Street-Porter





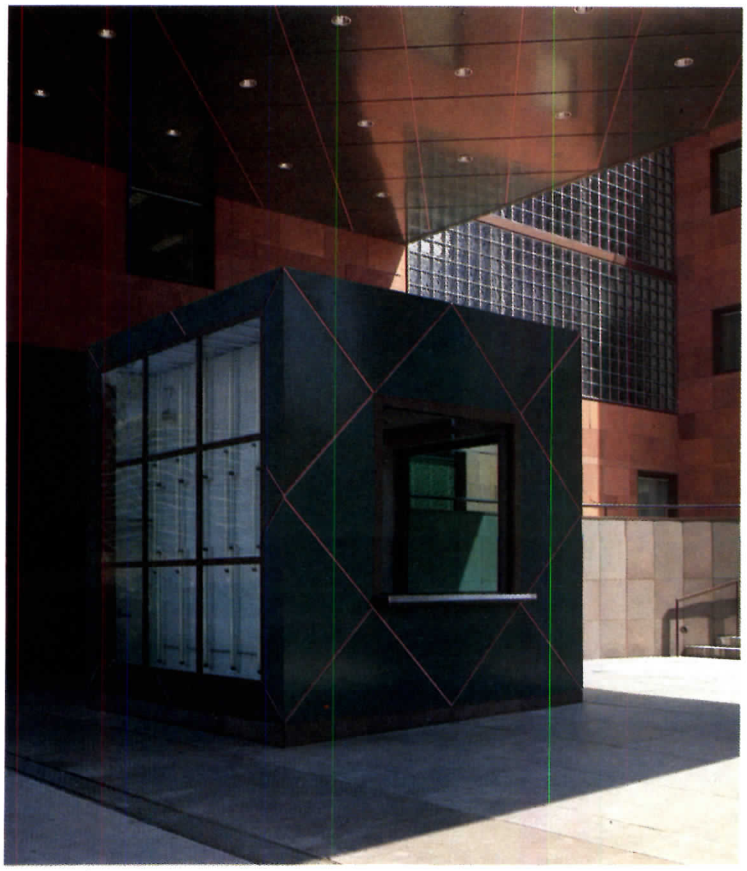


to meet the requirements of the redevelopment agency, the private developers, their architect, and MOCA's board of trustees.

Given a constricted site, he was required to keep his building low and split it into two sections so as to enhance the visibility of the much larger California Plaza complex. Additionally, he encountered basic philosophical disagreement from MOCA trustee Max Palevsky, a million dollar donor and head of the architecture committee. At one point, after producing 35 variants on five basic schemes, he submitted a "final" design that left him very dissatisfied, and he seemed to be on the verge of resigning. Sensing a crisis, the MOCA board reorganized its building review process. Palevsky quit and asked for his money back, and Isozaki set to work on design number 36, a design that he felt comfortable in calling his own.

MOCA's building is largely below grade, and its exhibit floor is entirely so. The building is actually embedded in the California Plaza parking garage. (Here, as in other respects, associated architects Gruen Associates were of great assistance.) The neatly arranged architectural forms that one sees from the street are only the tip of the iceberg: pyramidal skylights serving the galleries below and administrative and support spaces constitute the museum's visible presence. What we have is an architectural bonsai in which a carefully pruned miniature building is used to symbolize the larger museum landscape.

MOCA's signature element is the barrel-vaulted library and board room on the street side of the administrative wing, but the secondary motif of pointed skylights represents the heart of the design. To enter the museum, one must descend into a sunken court that connects to the lobby. From there one may enter either half of the museum. The northern portion is the larger one,



Photographs © Tim Street-Porter

Far left, courtyard from entrance level with vaulted board room, stacked over the library, towering above. Left, 'ticket cube' at Grand Avenue level. Above, entrance lobby with doors at right.

and its main gallery is lit by eight large pyramid skylights. The southern wing's largest space, equal in size to that of the north, is served by a dozen strip skylights. It adjoins a square gallery capped by a huge pyramidal skylight that peaks 60 feet above the floor, and a smaller, golden-section rectangle lit by two smaller pyramids. The principal north and south galleries also exhibit golden-section proportions, and this Renaissance-based geometry is an indication of Isozaki's grounding in Western culture. (Another is the wiggly line of the courtyard and plaza stair parapets, which the architect calls a "Marilyn Monroe curve.") The circulation is arranged in a squared-off spiral pattern that proceeds counterclockwise if one enters the south galleries first, a movement path said to be traditionally Japanese. All this geometrical rigor and subtlety is best manifested if the gallery spaces are left unobstructed, but the inaugural MOCA installation, scheduled to last for a full year, subdivides the major spaces so that Isozaki's clarity is not easily sensed.

The museum's natural lighting is not as dramatic as one might expect. Art conservation requirements, and, at times, the shadow of a California Plaza office tower, result in a softer light than implied by the bold skylight forms. (LACMA's daylighting is also modulated by the moving shadow of a skyscraper across the street.) Here is where the esthetic (as opposed to technical) advantages of daylighting are clear, for Isozaki often makes the skylights a spatially integral feature of the galleries and thus underscores the ability of light to define architectural form.

As a consequence of Isozaki's intellectually ambitious gallery layout and the mandate to split the building in two, the link between the north and south sections is highly problematic. Devoid of natural light and too wide to be just a corridor but too narrow to be a real gallery, this space is the design's weak link in both senses of the word. Part of the problem seems to stem from a curatorial decision regarding light levels, for even at night the space seems dark in comparison with other galleries.

While one must admire Isozaki's accomplishment inside, it also leaves one with the feeling that something is missing. Possibly this is a subtle product of the art in the opening show and its installation. But it may also be a consequence of architectural minimalism, for, aside from the ceilings in the naturally lit galleries, there is nothing to see but white walls, pure proportion, and neutral space. Realizing that it is the art that counts, one still wishes for a bit more from the container. Perhaps this is a residue of the early trustee pressure on Isozaki to be as anonymous as possible in the service of the museum's collection. If so, it was a mistake, for architecture is also a powerful art, and Isozaki could have given MOCA a bit more.

On the exterior, where the externally imposed restrictions were greatest, Isozaki rejected minimalism in favor of a rich palette of materials and forms, and combined those elements adroitly and with a dignified flair.

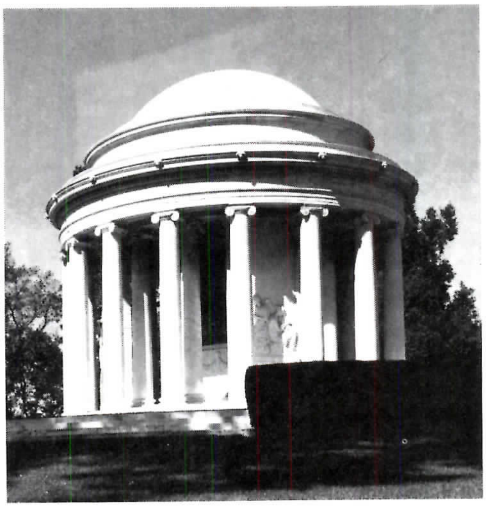
Essentially a private institution, MOCA's greater architectural achievement is embodied in its public face and communal spaces. LACMA, a public entity, restricts its architectural accomplishments to its interior. To Professor Owlglass and other observers accustomed to the wondrously indirect workings of Los Angeles, such paradoxes will come as no surprise.

Left, Gallery A, immediately off entrance lobby (previous page), is positioned under the largest of rooftop pyramids. Below, South Gallery is lit by a row of 11 pyramidal skylights. Right, stairs connect two office levels; library is off upper landing. □

Photographs © Tim Street-Porter

Harmonious Addition to an 'Arcadia'

A new gallery at the Huntington garden compound in California. By David Gebhard



In the 1920s, the Henry T. Huntington Library and Art Gallery in San Marino, Calif., was discussed and seen in a fashion almost identical to that now being experienced by the J. Paul Getty Museum. Both institutions were conceived by determined, highly successful businessmen; each reflected the strong esthetic predilections of its founders; and both institutions were established with financial resources viewed with apprehension and envy. Like Getty, Huntington and those who worked with him (such as Sir Joseph Duveen) plunged into the art, book, and manuscript market and purchased in a grand, almost wholesale manner. Thus, they not only acquired many of the "classics" of 18th century English painting—works by Gainsborough ("Blue Boy"), Lawrence ("Pinkie"), Romney, Reynolds, Rayburn, and others—but also extensive collections of books and manuscripts—the E. Dwight Church, the Lewissohn, Halsey, Hoe, and Stewart Judd collections, and even the Frank P. O'Brien collection of Beadle's dime novels. When, in the '20s, the Huntington collection was given to the public, it was referred to as "the largest and most costly of all collections of books, manuscripts, and paintings devoted to English and American literature, American history, and British art. . . ."

As with Getty and his new museum, Huntington located his art collection and library within his own estate in San Marino. In contrast, though, to Getty's Malibu site, the Huntington estate was extensive—540 acres—and was acquired and developed decades before this northeastern section of Los Angeles fully evolved into an upper middle class enclave.

As one should rightly expect in the arcadia of Southern California, the landscape and its architecture of both the Huntington and the Getty are as much of an attraction for visitors as the collections and the buildings that house them. This quality was noted of the Huntington in the '20s, with its orange groves and avenues of royal palms. The gardens were laid out in 1904 by William Hertrich and then extensively enlarged by the landscape architect and planner Wilbur David Cook, with later revisions and additions by Beatrice Farrand and Ralph Cornell. Eventually Huntington contained a Japanese garden, a cactus garden, a Shakespeare garden, and a Zen garden.

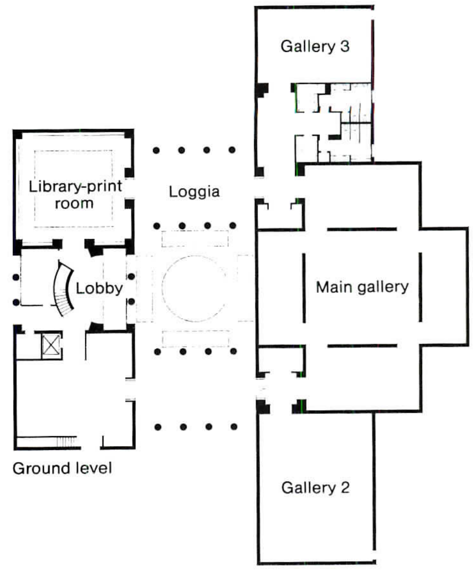
Within these lush gardens, architects Myron Hunt and Elmer Gray built in 1910 a Beaux-Arts version of what was then referred to as a Georgian house for Huntington. This was followed in 1925 by a "Renaissance inspired" separate library building designed by Hunt and H.C. Chambers. Like most, though not all of Hunt's work, the house and the library are correct versions of the Beaux-Arts traditions, but at best tend to be on the lifeless and dry side. The blandness of these Beaux-Arts exercises is dramatically brought home when one wanders through the gardens and seemingly by chance (as occurs with follies in an 18th century English garden) comes across the circular, open domed Huntington mausoleum, which was designed in 1925-1929 by John Russell Pope. Any feeling of boredom one may experience with the classical tradition is set aside; for here the tradition is, in every sense of the term, vital and alive. The proportion, the interpretation of the orders, the details, are not just correct, they coalesce to create an object that is simply beautiful. The open circular domical pavilion was a theme that Pope had continually returned to throughout his long career, and in its own miniature way the mausoleum, with its terraced plinth and marble benches that seem to grow organically out of it, matches his much admired masterpiece, the 1937-1941 Jefferson Memorial in Washington.

Over the years continual changes and additions have been made to the Huntington, but like the 1981 Orientation Building by Whitney Smith, everything was kept reserved and low keyed. In 1980, the Huntington received a gift from the Virginia Steele Scott Foundation to establish a museum and study center that would present American art in context with its existing collection of British art. Early on, it was decided that this new

Dr. Gebhard, author of numerous books on architecture, is an instructor of art history at the University of California, Santa Barbara.

Above, John Russell Pope's Huntington Mausoleum. Below, the nearby Virginia Steele Scott gallery. Right, the gallery's loggia.

Photographs© Marvin Rand



activity and collection were to be housed in a separate building to be situated north and somewhat west of the former Huntington residence (now the principal art gallery). The Huntington board and staff, together with members of the Virginia Steele Scott Foundation, interviewed a number of Southern California architects, and from this group proposals were requested from three: Charles W. Moore, FAIA, Thomas R. Vreeland Jr., FAIA, and Paul Gray, AIA (of the Santa Barbara firm of Warner & Gray). All three architects provided models and presentation drawings that responded to the specifics of the program. From this group, Gray was selected to design the new building. As Robert R. Wark, curator of the art collections of the Huntington, observed, one of the essential ingredients of the program was "that the new building must harmonize with the existing ones, preserving and enhancing the existing mood of the place."

Gray's original scheme was a classically inspired, U-shaped building dominated by a central portico embraced between the two wings of the building. In the interview process and as the project progressed, a number of essential requirements were altered, so that the final design was substantially changed. Much of what had been programmed to be placed underground was brought to the surface, and eventually new activities were added to the building, including space for the Southern California Research Center of the Archives of American Art. The architect's response to these new needs was to completely redesign the project. This process of change was a major one, for the complex was transformed from that of a small classical building set down in a garden to that of a garden pavilion—an open domed loggia set between a pair of corniced classical volumes.

While the architect certainly looked carefully at both Hunt's earlier house and library buildings with their use of the Ionic order, his attention was drawn more pointedly to the Huntington mausoleum. Employing the circular domed theme of the mausoleum, Gray expanded on a theme that Pope himself had used for several projects—an open colonnaded space, balanced on two sides by closed or open forms. This was the approach that Pope had taken in his 1911 submission for the Lincoln Memorial in Washington and for the 1916 Memorial Building at Newark, N.J. A similar approach had been taken by other exponents of the Beaux-Arts tradition, one of the closest to Gray's being McKim, Mead & White's 1914 winning design for the McKinley memorial birthplace building at Niles, Ohio.

Gray, in his design for the Virginia Steele Scott gallery, emphasized the idea of a garden pavilion even more by rendering his dome with a light filigree of metal with an infill of glass and by continuing plant materials right through his open columned space, thus reinforcing the interdependence of building and garden.

Like Pope, Gray did not simply wish to restate, unaltered, the earlier versions of the classical tradition. His obvious intent was to abstract the tradition: to encourage the visitor to respond to it as both ancient and new. The three stepped forms to the west that house the galleries and the single volume to the east that contains offices and study space assume a strong classical pose, primarily as an outcome of their use of "correct" proportions and by their sparce references to tradition elements—the plinth, cornice, and entablature. For the Ionic order of his mausoleum, Pope had turned to the theater of Marcellus, which he had measured and drawn during his stay in Rome. And in a like manner, some 50 years later, Gray turned to Pope's interpretation as a point of departure for his own personal variation on the Roman Ionic order. The resulting design of Gray reflects what Pope accomplished in his design of the mausoleum.

Within both the galleries and the office-study wing of the Scott gallery, an identical classical reticence is continually encountered. In contrast to the dryness and coldness so often encountered in 20th century reworking of the classical tradition, the interior spaces that Gray has realized are really quiet, warm, and intimate—almost domestic in feeling. Their wood floors and mellow oak paneling have surprisingly lent themselves with ease to a tradition we generally have been taught to think of as diametrically opposite to Beaux-Arts classicism, that of the turn-of-the-century arts and crafts. In the study/office wing, chairs and tables by Gustav Stickley's craftsman workshop, along with those of other exponents of the American arts and crafts, seem perfectly at home in this setting. And a further union of the classical and the American arts and crafts is now being planned as a permanent exhibition in one of the three adjoining galleries.

The division of the Scott gallery into three separate parts—an open entrance rotunda, a gallery wing to the west, and the office/research wing opposite—not only is successful in establishing the garden pavilion atmosphere, but is equally successful as a response to utilitarian consideration of use. Each wing can be opened and closed separately, and each has its own highly specialized natural and artificial light and climatic controls. The open colonnaded loggia works well as a space that draws visitors in from the garden and thence gently guides them to the galleries or to the research and office wings opposite. The openness of this scheme is obviously made possible by the mildness of the climate of Southern California; but equally it reflects the traditional approach taken over the centuries by Mediterranean architects. Such openness was frequently employed in the 'teens and '20s in public buildings in California; then it was generally abandoned by exponents of post World War II International Style and only in the last few years has it come back into vogue. As Robert R. Wark of the Huntington commented, "In appearance the building respects and harmonizes with its environment while achieving an identity of its own." Thus, Gray's building aptly demonstrates that individuality of character need not be lost in the continuing search for design and environmental contextualism. □

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Lighting Design And the Life of Museums

And some lessons for other building types. By Barbara Knox

Natural light, the light of the sun, lies at the core of the art of lighting design. As Louis Kahn so aptly noted of the Kimbell Museum, "Light, this great maker of presences, can never be brought forth by the single moment in light which the electric light bulb has. Natural light has all the moods of the time of day, the seasons of the year . . . so the museum has as many moods as there are moments in time and never, as long as the museum remains as a building, will there be a single day like the other."

For the Kimbell Museum, which has taken its place as an American classic, lighting designer Richard Kelly played a key role in formulating the solution for Kahn's initial concept—the so-called "natural light fixture." Kelly developed a perforated anodized aluminum reflector that diffuses natural light, which enters via a slit in the barrel vault, to 1/20-1/40 its natural brightness. Not intended as a primary means of illumination, the natural light fixtures, for which Kahn felt such respect ("I really feel it is a tremendous thing"), are rather meant as generators of ambiance. The system of track lighting, which is activated virtually continuously, works as the primary system of illumination.

This scheme—the complementary system of natural and electric lighting—has become the classic approach to museum design; virtually every museum project in the past 15 years has been a daylighting job as well as an electric lighting challenge. This re-emergence of daylighting as an issue in museum design is significant for reasons that range from the pragmatic to the philosophical.

"Daylighting went away for a while," believes Washington, D.C., lighting designer Claude Engle, "because it's a very difficult source to deal with." Paul Marantz, the New York-based lighting designer most recently responsible for lighting at the Museum of Contemporary Art in Los Angeles, (page 48) concurs: "There were relatively inferior daylighting technologies for the first 'wave' of museums that were built in this country in the first decades of the century. Too, museums were thought of as very classical spaces where rooms must have strictly controlled, even light."

These considerations, combined with rapidly developing lighting technologies, resulted in a period of infatuation with electric light—a period that culminated in the highly dramatic museum exhibitions first popularized by the Metropolitan Museum of Art in New York City. "That new philosophy—which I pinpoint at the time Lemar Terry left Saks to become the lighting designer for the Met—was basically 'put on a show,'" believes Marantz, a principal in Jules Fisher & Paul Marantz Architectural Lighting Inc. "Terry brought with him retail display techniques for high drama exhibits—that is, they were ostensibly quite dramatic, but actually quite boring." Terry, dubbed "The Prince of Darkness" for his dramatic light/dark style, continues to work on the Oriental gallery at the Metropolitan, though William Riegal assumed duties as lighting designer more than six years ago.

The real issues of daylighting and its relation to museums hinge not only on the architectural concept, but the concept of the museum as well. "In effect, you have to push the gallery itself to decide what it is," says Engle. "Certain public galleries like the Louvre or the National Gallery require a constancy. If you come to see the Mona Lisa, for instance, you don't want to leave feeling gypped because it was a cloudy day and you couldn't see it perfectly. But most galleries have a fairly consistent constituency." The implications of such a consistent constituency are twofold: changing exhibits, requiring differing lighting, are important; and, change within the gallery itself becomes important. "Suddenly you're saying 'Aha! There's nothing wrong with people going to galleries and seeing things in a different perspective, in a different light every time they go,'" continues Engle.

Consider the case of I.M. Pei's East Building for the National Gallery, also an Engle project. Because natural light was integral to Pei's concept, Engle was left with two primary challenges, neither of which directly concerned the lighting of art, per se. During the day, the potential for a tremendous amount of light in the atrium posed a transition problem between atrium and galleries, which feature dramatically lower light levels. To solve the problem, Engle recommended a "light lock," or a transitional space similar to that found in European cathedrals. This allows the visitor to go from a brilliantly lit space into an essentially black box, and, finally, to emerge into a more dimly lit space. In the East Building, the visitor walks from the atrium into a space that has no artificial lighting but only the natural light that reflects into it from the atrium. Thus, the transition to the 30 to 50 footcandle levels common to the galleries (as opposed to the approximately 1,000 footcandle level of the sunlit atrium) is not nearly as jarring.

The second challenge, that of dealing with the building as a nighttime space, was to achieve a sense of transparency. In order to achieve a cohesive whole—that reads from both inside and out—Engle treated the structure itself as a piece of sculpture, and then developed his lighting solution.

"I feel strongly that figuring out the problem is 99 percent of the answer," explains Engle. "Once you know what you want to do, the technology is usually pretty straightforward." In the case of the East Building, the answer lay, not in technology, but in approach. The key became lighting the one continuous wall that exists in the project. Because of the very light stone used on the building, light bounces off the wall, creating subtle effects of its own. Transparency is ultimately achieved because the outside of the building is slightly brighter than the inside. When you are inside, you can see through to the outside. On the other hand, because one philosophically wants to think that there's more light inside—so it appears that there is something in there to look at—Engle takes advantage of spotlighting on trees to give the illusion of visual importance inside.

The issues of gallery lighting represent much different sorts

Ms. Knox, a freelance writer in New York City, is editor of Lighting Dimensions, *a bimonthly magazine published for lighting designers and specifiers.*

of problems. While natural light is considered highly desirable, its presence in galleries is often anathema to curators and conservation personnel. Systems for the manipulation of daylight have consequently become the target area for design and development, Marantz points out—in the Portland Museum of Art's Charles Shipman Payson Building (for which he and Richard Renfro won a 1984 Lumen Award) ambient daylight in the gallery is introduced via an octagonally shaped lantern. The circumference of the lantern is fixed with a two-foot-wide band of louvers that prevents any direct sunlight from striking the paintings. Instead, the light is redirected upward, onto the dome, and rerouted down into the space as diffuse light. Track lighting located on the facets angled at 45 degrees to the gallery supplements the diffuse daylight and provides increased illumination for the exhibition pieces. As with all his projects, Marantz developed the scheme through extensive modeling on the site.

For James Stirling's Sackler Museum in Cambridge, Mass., however, the daylighting solution takes a much different form. Here Engle as lighting designer was primarily influenced by the gallery's role as a teaching facility. Also, space constraints that leave galleries stacked atop one another limit the means of access for natural light.

Top floor galleries benefit from abundant natural light delivered into the space via linear light monitors. Rising above the roof line, the monitors feature solid pitched roofs, four-foot-high glass walls, and a suspended fragment wall that flares out at the bottom toward the parallel walls of the gallery. A horizontal plane encloses the bottom of this structure, forming the center of the gallery ceiling. The sloping sections of the fragment wall distribute natural light into the gallery and also enclose HVAC equipment.

Because of the Sackler's role as teaching gallery, this diffuse light solution becomes particularly effective. The lighting focus is actually shifted away from the wall and onto a teaching zone, which can begin anywhere from three to 30 feet in from the gallery wall.

Engle backs up his natural light with a series of 100-watt A-lamps placed directly under the clerestory windows and focused on the reflector wall of the light monitor, which results in a pleasant glow along the internal surfaces of the monitors. A track system supplements exhibition lighting.

In the Oriental galleries of the Sackler, however, Engle introduces horizontal light via a "hole punched in the wall. It was a classic debate between architect and curatorial staff and lighting designer," recalls Engle. "Should we have a hole in a wall, which precludes hanging any art there, or should we have proper lighting? Finally, happily, the museum decided to have a good room with good lighting and deal with any other problems that that window might cause."

It is within these discussions between curatorial and lighting people that still other issues of lighting gallery spaces emerge. As Engle recalls, J. Carter Brown, Hon. AIA, director of the National Gallery, felt strongly that the pictures looked better in natural light. This in turn caused Engle to begin an exploration of why. Why do pictures look better in natural light? According to Engle, light from a point source will not reflect off the surface of a painting, but rather reflects out of the pigment itself; skylight, emanating from many directions, does not allow the viewer to stand in any one spot to avoid the surface reflection, which is white. So, whereas light reflecting out of the pigment itself de-saturates the color of the painting, the diffuse quality of the natural light enhances those same colors. "Daylight is the light of conception," remarks Marantz. "It definitely has the best color rendering properties of any light source."

However, there remains the basic problem of light and art: All light is destructive. Conservation is a part of any museum, with more stringent care taken to protect more light-susceptible items. But, whereas the Illuminating Engineering Society (IES) recommends a standard of 20 footcandles for galleries concerned with the ill effects of light, many conservation experts recommend levels as low as 5 to 7.5 footcandles—a light level that effectively leaves the artifact in the dark. Such alternatives as sensors that activate lights when a viewer approaches, or actual shields around an object—such as a curtain or doors—have been explored by many museums. But, these artifact-saving devices can also be viewed as contrary to the most essential notion of museums, which is to allow works of art to be seen. "It's my experience that people are hesitant about approaching a darkened object," says Metropolitan Museum lighting designer William Riegal. "We want people to leave here remembering the art, not remembering lights flashing on and off, or curtains sliding open and shut."

In the final analysis, the whole process of museum lighting is one that relies upon a set of variables; the daylighting/artificial lighting formula can be viewed as a veritable constant, but within that range, solutions vary widely. "When I taught lighting design, my students hated me because I had no rules to give them," says Riegal. "It always depends on the budget, what part of the country you're in, what the purpose of the gallery is. . . . There are no right answers."

If there are any lessons to be learned along the way, the growing knowledge of natural light and how to deal with it seem to top the list. Applicable to virtually every public-use complex, the philosophies of daylighting have had dramatic realization in projects like the HongkongBank, where a much touted "sun scoop" pulls daylight 30 floors down and into an 11-story atrium. In such an instance, where one can stand in the middle of a towering, urban structure yet still see one's own shadow cast by the sun upon the surrounding granite, the power of natural light is evident. As Kahn said, "The cloud that passes over gives the room a feeling of association with the person that is in it, knowing that there is life outside the room. . . ." If, as Marantz believes, natural light is a language we have become proficient in, it appears to be a welcome tool with which to imbue all types of architectural spaces with life. □

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Carnegie Hall: Better Than Ever

A major restoration augments its virtues and softens its faults. By Sharon Lee Ryder

Less than six months ago, the interior of Carnegie Hall stood in ruins, its 800,000 cubic feet of space filled with scaffolding, plaster dust, and construction rubble. As chunks of concrete were carried out the front, tons of hardwood flooring, dry wall, and sheet metal ducting were carried in the rear. A gaping hole in the facade at the corner of 57th Street and Seventh Avenue, where the coffee shop stood, gave passers-by an unexpected glimpse of hard hats wielding crowbars.

Twenty-nine weeks later on Dec. 15, the hall was resplendent. Crisp details, long lost under too many coats of sloppily applied paint, now stood out in vivid relief highlighted by warm white paint, gold leaf, and glazing. The sweeping arc of the proscenium arch stood majestically free of its curtain. Gone was all the clutter on stage, the scruffy plywood panels surrounding the orchestra, and the overhead canvas panels. In place was a new ceiling; the detailing and carving on the rear of the stage was restored like that of the hall.

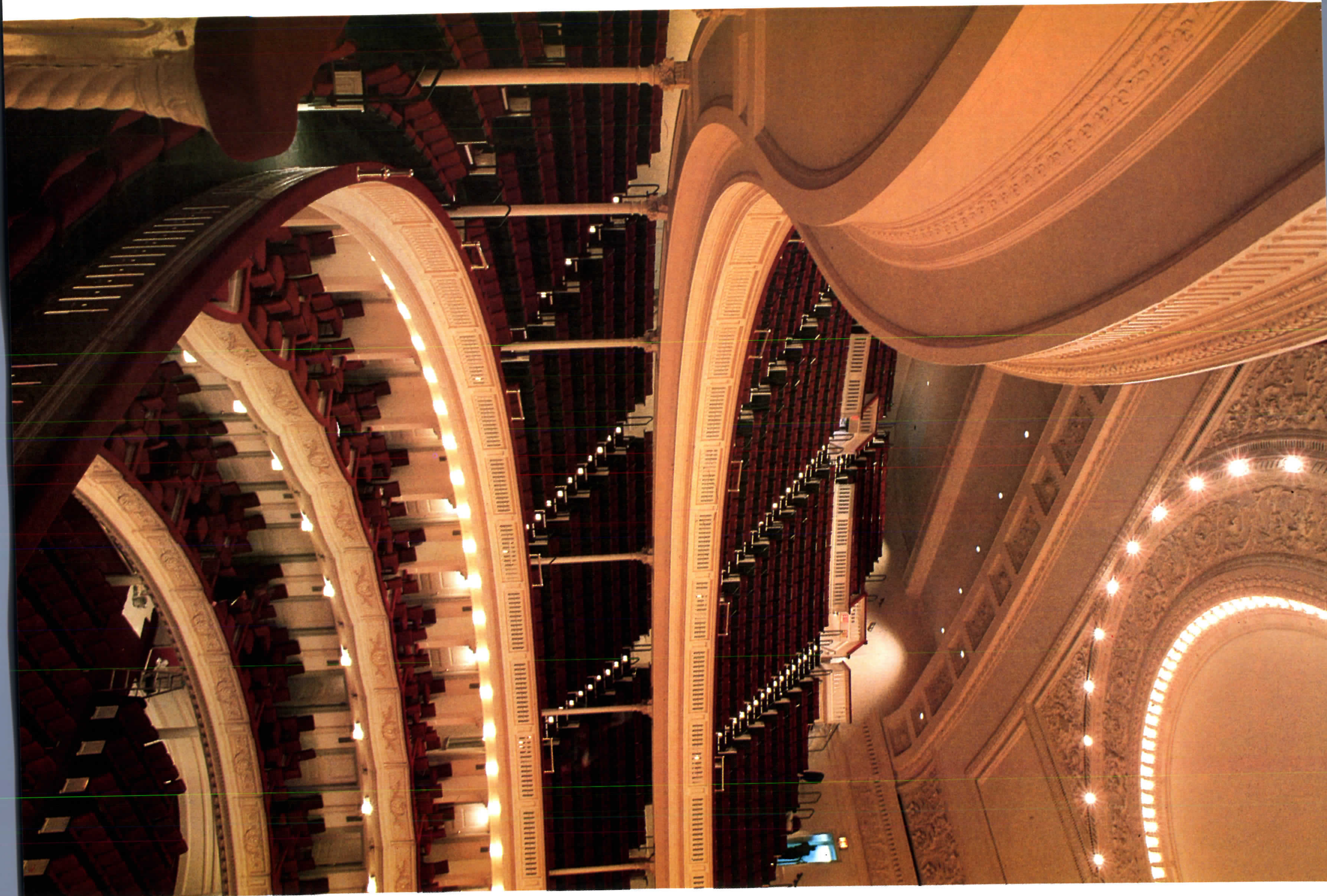
This was not the first time that Carnegie Hall had witnessed major construction and renovation work. The building has been almost continuously in some state of change, beginning a mere three years after its completion in 1891. When Andrew Carnegie first proposed to build the hall as a home for the Symphony Society, his concept included rental income from other uses on the property, which would help to subsidize the cost of running the hall. The first change to occur was the removal of the original mansard roof in 1894 (it didn't contribute a great deal to the overall architectural character) and replacement with a series of north-facing skylights, creating a whole floor of double-height studio spaces above the hall. The small lot on the corner of 56th Street and Seventh Avenue, a holdout from the original purchase of land, was finally acquired, and a 12-story tower was erected along the 56th Street side of the building containing commercial, office, and studio spaces. Some two years later, Carnegie, in keeping with his entrepreneurial spirit, added an eight-story tower on the opposite side of the building, increasing the amount of rentable space even further.

Highly unorthodox for its time, Carnegie Hall clearly was the prototype of mixed use buildings, which planners have espoused in recent years as a way of new development to underwrite artistic uses. Following Carnegie's initiative, more ground floor space was converted to lucrative retail use in 1929, remaining there until this most recent renovation when the space was needed for a variety of uses related to concert activities.

But even such foresight on the part of Andrew Carnegie was not to spare Carnegie Hall from the threat of demolition in 1957. When the plans for Lincoln Center were unveiled, the hall was considered obsolete. Its owners decided to demolish the building, replacing it with a '50s style high-rise office building faced with red metal panels. So inevitable did its demise seem that *Life* magazine reported it as a fact. Others, however, felt differently. Tchaikovsky had conducted the opening concert, Mahler also conducted there, and Heifetz made his debut there in 1917 at the age of 16. Rubinstein first performed there in 1906, while Paderewski, Horowitz, and Toscanini have graced its stage. The

Left, the venerable 57th Street marquee. Below, the main hall during a rehearsal from the highest tier. Gone is the curtain between stage and parquet. Ceiling lighting is new.

Allen Freeman



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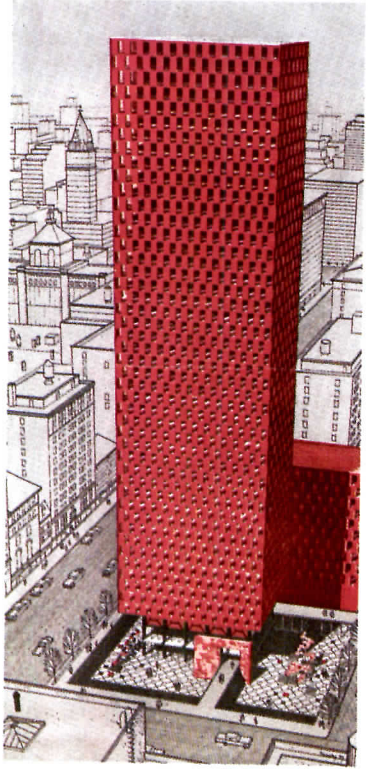
Left, the sweeping tiers of the main hall. Below, Carnegie Hall as it looked circa 1910 and, far right, the same view today. Right, drawing published in Life *magazine of a 44-story office building sheathed in a checkerboard of bright red porcelain panels that was to replace the hall in 1959. Architect for the unbuilt skyscraper was Pomerance & Breines.*



Allen Freeman

hall was, in fact, a repository of musical memories; its walls had seen and absorbed the works of many of the 19th and 20th century masters. So it was little wonder that New York City's musical community protested. In 1960, the hall was spared the wrecker's ball, and a non-profit corporation set up to operate the facility under a $1 per year agreement with the city, which had taken over ownership.

Beyond saving a landmark of musical heritage, little did they know they were also saving what would turn out to be the only hall in New York City with good acoustics. Philharmonic Hall was less than a success from the moment it opened and, in spite of several remedial efforts, it could not attract the major performers or orchestras there. The newly formed Carnegie Hall Corporation benefited from this, building a strong organization that presented many of the world's great orchestras, conductors, and performers. But the winds of fortune are continually shifting between the two organizations; Lincoln Center was now attracting much more of New York's philanthropic support, a fact brought home when Avery Fisher gave $10 million to finance the last major renovation of the hall, which now bears his name. With the completion of this renovation in 1977, a concerted effort was made by the proprietors of Lincoln Center to bring the major orchestras there; not only were they offering improved (if not great) acoustics and higher fees, but their technical and backstage facilities for performers were much more spacious and their lobby and public amenities superior in size to those of Carnegie Hall. As a result, the Carnegie Hall Corporation decided, as early as 1978, to look at the feasibility of upgrading its own facilities and to develop a master plan to carry out what amounted to almost a $50 million investment that would see it, a nearly 100-year-old building, well into the 21st century.

The task of assessing the physical needs of the hall and developing a master plan fell to Paul Byard, AIA, a partner in the firm of James Stewart Polshek & Partners. It was a job fraught with much complexity. Carnegie's own exuberance had produced an equally eclectic building; a concert hall wrapped on two sides by unique studio spaces linked by an almost Kafka-esque series of corridors that meander diagonally across the site. The sixth floor magically changes to the eighth as one descends a few steps and the 12th becomes the 14th—the only two points where the two towers connect. Nothing was typical or conforming, circumstances that must have caused the architects as well as the building department many nightmares.

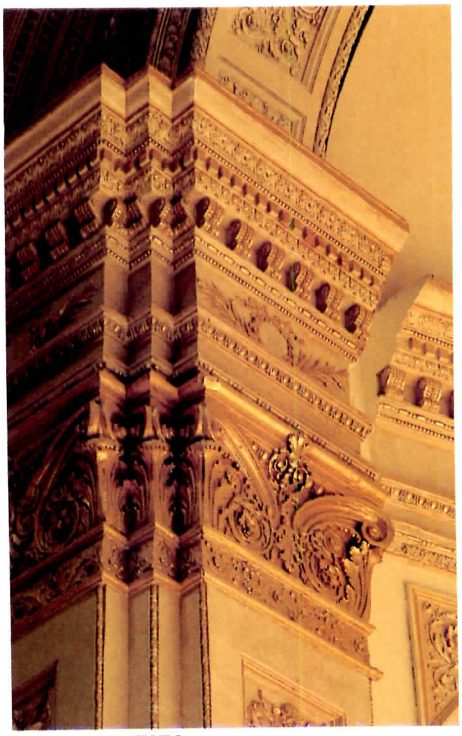
The concert facilities had their own set of problems. Constrained by the site, there was little room for any sort of expansion. When the hall was originally built, the lot at 56th Street was not part of the assemblage. Carnegie made the decision not to sacrifice the size and volume of the hall, so instead the public lobby space was reduced to almost miniscule proportions sandwiched between the back wall of the parquet and the 57th Street sidewalk. There was no access for the disabled; no airconditioning, rendering the hall unusable for several months during the summer; the stage had been increasingly altered to accommodate reflector panels, lighting, and speakers, all hidden behind a curtain hanging down from the proscenium arch; there was virtually no backstage area, no direct access for instruments from the sidewalk, no adequate toilet or dressing facilities for performers. What there was plenty of was extraneous noise from subways, fire trucks, ambulances, and irate taxi drivers. It was also a job fraught with potential controversy: How do you alter a space that, even for all its shortcomings, was revered as a standard of musical excellence throughout the world, its acoustics the standard by which many other halls were judged? It was a situation just asking for trouble.

The strategies adopted were ingenious. Most obvious to the public was the alteration of the lobby spaces, which were nearly doubled in size. By eliminating the many sets of steps and lowering the floor level to that of the sidewalk, the space could be extended under the parquet floor where expanded box office facilities are located. Access into all parts of the hall was then located at two points, the extreme left and right sides, up a short set of steps through a ticket taking control that then separated balcony and dress circle patrons from those in the parquet and boxes. Unfortunately, all 2,800 patrons must pass through two 6x10-foot stair landings, creating traffic jams in the lobby more monumental than any that had existed in the previously cramped location.

A new ground level backstage entrance was created, along with elevators for moving instruments up to the stage; new dressing room and toilet facilities were installed in newly configured space one floor above the old ones. But the most significant expansion occurred in the actual backstage area. By taking over the space formerly occupied by the Carnegie Tavern, located along the 56th Street side of the hall, both sides of the stage could now be reached by going behind the stage rather than across it.

The centerpiece of the renovation, however, was the main hall itself, and much of what was done there goes largely unnoticed, as it should. In addition to the restoration, painting, and gilding of the detail, airconditioning was installed in the

Right, fresh gold leaf detailing high above the stage. Below, an original longitudinal section through the main hall. Opposite page, the enlarged lobby; the floor of this room is now the same level as the sidewalk and the box offices extend under the parquet floor.



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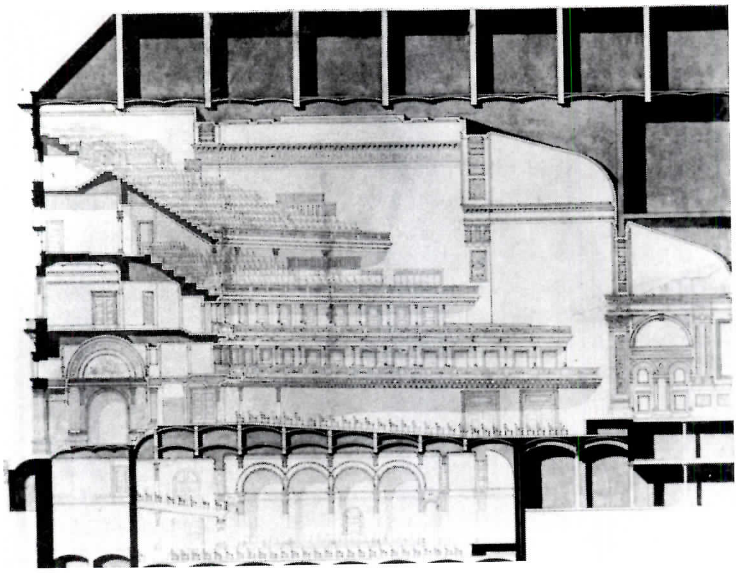


hall by threading the ducts (large enough to drive a sports car through, says project architect Joseph Fleischer, AIA) between the hung plaster ceiling of the hall and the terra-cotta vaults that support the studio spaces overhead. New lighting was installed in the ceiling of the main hall, eliminating the many rows that had been rigged up at the ends of the balconies. The old wood floor was torn up and a new one installed along with new seats.

Everyone concerned with the job termed the approach a refurbishing rather than any effort to do a faithful restoration. The interior had seen numerous changes in the course of nearly 100 years, many of them simply because of fashion. Descriptions of the hall, published when it opened, told about a rose and salmon color interior, which was long since changed, much to everyone's relief. No one ever considered recreating this color scheme, but less as a matter of taste than one dealing with the psychology of change. If the color changed substantially, people might well think the sound had also.

The most obvious changes to the main hall involved the stage ceiling. Having suffered numerous alterations that began as a small hole to accommodate lighting for a film called "Carnegie Hall," it ended up with such a large hole that little of the ceiling was left. In its place was a space that contained rigging for lighting as well as a vast network of speakers for the electronic organ, all hidden from view by canvas panels and a curtain hung behind the proscenium arch. Architecturally, the desire was to visually unite the stage with the main part of the house, to make it all one room rather than appear to be two separate ones. With the decision to remove all the paraphernalia, including the curtain, and rebuild the stage as it was originally came the justifiable concern with what these changes would do to the hall acoustically. No one would dispute that the acoustics were already good; no one gave any thought about attempting to improve them.

The man chosen to take on this assignment was Abe Melzer, an Israeli physicist who began a practice in acoustical consulting after taking a degree in music. His charge from the Carnegie Hall Corporation to whom he reported was to watch over the proposed architectural changes and allow no compromises that would adversely affect the sound. His work included the design and construction detailing of the new stage ceiling, and seating (the old foam rubber had a different absorptive density than the new polyurethane foams, so many modifications had to be made before the new chairs would be identical to the old in their acoustical properties). He was also given the task of isolating the hall from outside noise insofar as that was reasonably possible.

He is not a practitioner with a dogmatic approach to acoustics or elaborate theories of how sound works. He says he can't explain why the sound in Carnegie Hall works, since many of its architectural features don't conform to the more commonly held ideas of what produces good sound. Instead, he describes his approach as being 20 percent pure physics, 40 percent psycho-acoustics (the subjective response to sound qualities), and 40 percent experience and luck.

But as luck would have it, when Itzak Perlman raised his bow to begin the first public concert in the new hall, the first sounds that were heard were those of a passing siren, albeit much less loudly than before. Even 1,400-pound doors costing astronomical amounts of money were insufficient to completely eliminate the noise, although the infamous subway rumble is now virtually inaudible. While charged only with making certain that the quality of sound in the hall was maintained, Melzer has, in fact, succeeded in improving it. After hearing three concerts and a rehearsal in the hall, and singing in it once, my conclusion is that the sound is richer, warmer, better blended, much more what one would expect from a hall this size, shape, and age. It remains the premier place to hear music and, given its illustrious history, it is also nothing less than it deserves.

The man responsible for completing this remarkable renovation for Carnegie Hall within the tight time and budget constraints is Lawrence Goldman, whose office is full of flow charts constituting a master schedule that breaks down every aspect of the work to be performed. Although the project was two years in the planning, he did encounter unforeseen obstacles. Parts of the building had to be shored up during demolition to stem imminent collapse. The lath and plaster along the second tier disintegrated when holes were drilled for small picture lights. Everyone from Goldman to the architects and acoustician was hindered by the lack of original drawings and documentation on the building. But not every surprise was a nasty one. The original stained glass windows in the lobby were discovered under plywood paneling that has been nailed up so long ago no one was around who remembered what was there; the only damage to them was from the nails.

Goldman credits centralized decision making (he made most of the decisions) with helping to expedite the job, but also says that there was a degree of missionary zeal on the part of everyone responsible for the work. Some people practically moved into the hall for the duration of the job, while one 63-year-old plasterer worked 10- to 12-hour days almost eight weeks running to complete the stage ceiling.

Carnegie Hall is clearly a place that elicits such dedicated actions. What has been accomplished there is the transformation of an old, tired, and tattered hall into a space of physical splendor that can now rival the quality of the music presented there. The city, for its $1 a year rent, has been given a wonderful gift. □

'Palladian Villa In an English Landscape'

A new center for the Alabama Shakespeare Theater in Montgomery. By Robert A. Ivy Jr., AIA

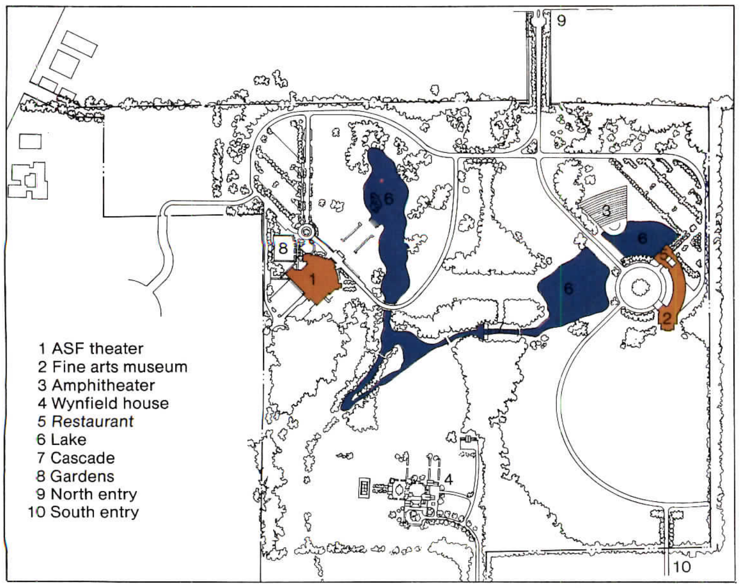
No one drawls from the stage at the Alabama Shakespeare Festival, and local dialect is absent from the architectural vocabulary of that organization's new home. The Carolyn Blount Theater, designed by the Atlanta firm of Blount/Pittman & Associates, houses the Southeast's only full-time classical repertory company in a state-of-the-art playhouse near Montgomery, Ala. Building and site are integrated in an idealized English landscape, creating an ensemble that transcends parochialism yet remains true to place.

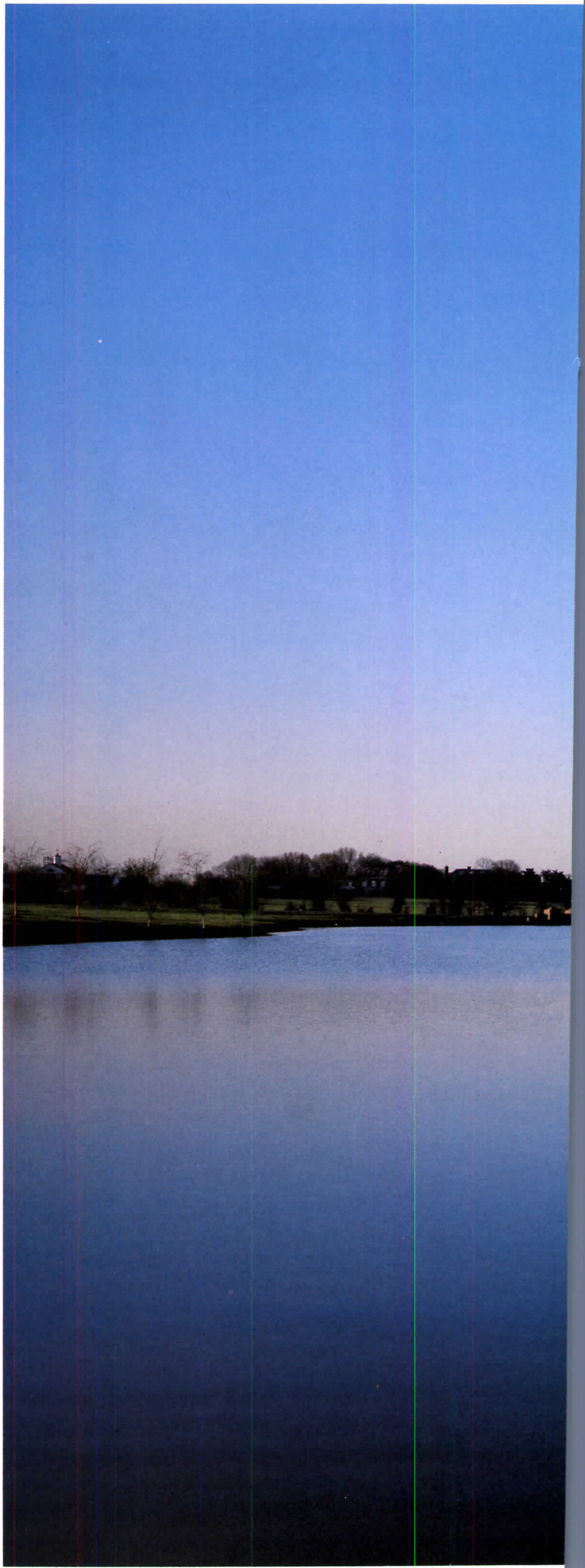
Control of the choices of planning professionals for site and building were in the hands of an unusual client/benefactor: The 97,000-square-foot building and the land it sits on were the gift of one man, Winton M. Blount, chairman of one of the nation's largest construction corporations. The theater complex forms one element of a new 250-acre cultural park for Montgomery, Blount's hometown, carved from the property surrounding Wynfield, the Blount estate.

No radically new ground is broken here; in daylight, the building appears to be a Palladian villa set in an English landscape. The theater is a direct descendant of Palladio's Villa Poiana south of Vicenza, right down to the five circular openings, oculi that arch above the entrance. From the exterior, this contemporary building comfortably wears its neoclassical garment, much like the best residential adaptations of Georgian architecture in the 1950s.

Unlike its 16th century precursor, however, the building stretches from a central entrance pavilion in a long crescent with glazed arcades, terminating in twin hipped-roofed pavilions. At one end is a patrons' wing; at the other, the main ticketing

View from the north of the serenely sited theater with its landscaped terraces that descend to a manmade lake. In the distance, the ornate brick dam and bridge.





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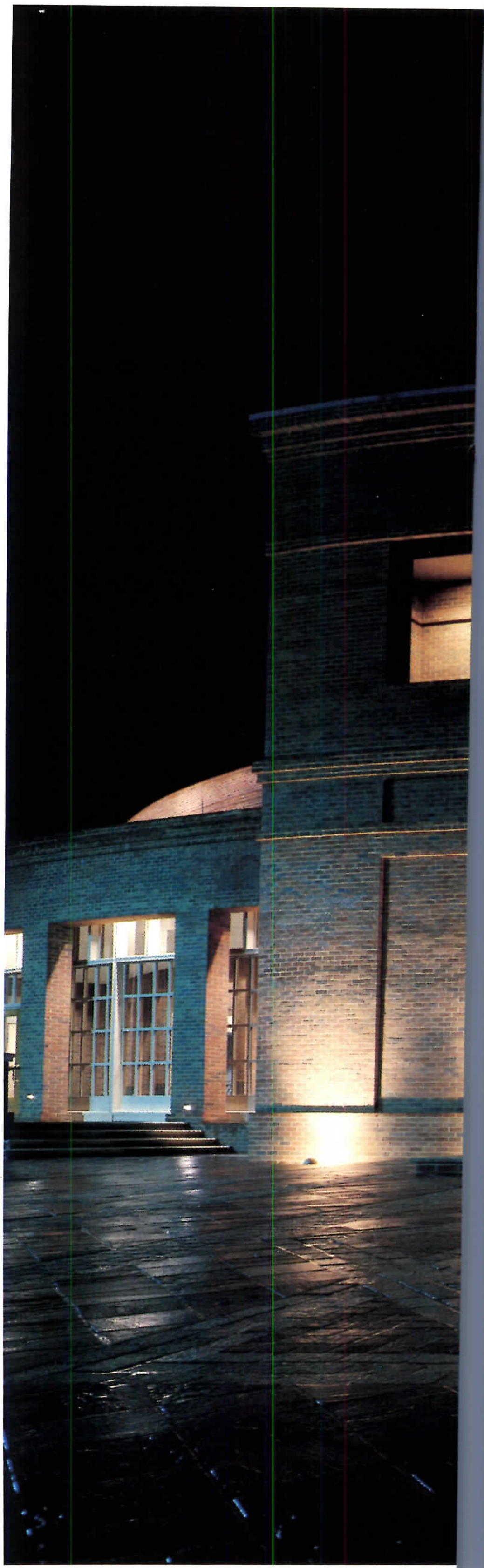

room and administrative center. These pavilions grip the top of the hillside to state "beginning, middle, and end."

The theater has an "up" and a "down" as well. Roughly one-third of the building remains hidden from sight, buried in the hillside. Elaborate facilities for prop production, costume preparation, wig and makeup preparation, as well as dressing rooms for the cast and practice stages are located either under or behind the visible facade.

Seen from a distance, the building makes a non-apologetic, almost austere statement about itself and the place where it sits. The miseenscène is synthetic, almost curious in its singularity, yet is clearly not Stratford in 1600, nor is it Disneyland. Building and park form a unity that is suitable and appropriate.

Above right, the theater's forecourt looking through the open doors of the main entrance to the lobby. Left top, the forecourt retaining wall with the main entrance pavilion beyond. Left above, dam and bridge at the south end of the lake.

Austerity vanishes at night, when the theater's form dissolves and its brick reflection vanishes from the lake. In place of brick mass is a glowing ribbon of light, highlighted by the five bright oculi, round balls juggled at the entrance.

The lake that mirrors the building's mass, as well as the allées of cherry laurel, the Osage orange trees, the rolling parkland, and roadways that curve through the site were conceived by the late English landscape architect Russell Page. Working with the

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architects, Page approved the entrance scheme for the Wynton Blount Cultural Park that would ensure a moment's decompression from the highway and its suburban surroundings and prepare visitors for a mental or spiritual voyage.

The architects have carried out Page's organizing concept, providing consistent flourishes of brick bridges and enigmatic pylons, steps to the water, and paving patterns that accentuate the effect and harmonize with the unified vision.

Theater lies at the heart of this cultural park where "The play's the thing . . . ." If Shakespeare's plays have been staged in every conceivable manner, from the Globe Theater to the starry night, at the Blount theater complex the performing company has the luxury of choice—two excellent stages in a single building provide the company with the flexibility to meet the audience head-on or to produce theater in the round.

The Octagon is the smaller of the two theaters, designed primarily for arena or thrust productions. It is a simple space, intimate in scale, and well proportioned for 250 persons to share an evening with the Bard. It is also well suited for musical recitals and student productions.

By contrast, the larger Festival Stage achieves traditional elegance in form and materials, creating a grand room for experiencing live theater. Like the best of the nation's older playhouses, the Festival Stage brings performers and audience in proximity, thereby provoking interaction of word, gesture, and viewer. Arcs of the 750 seats and boxes rise steeply, creating sightlines

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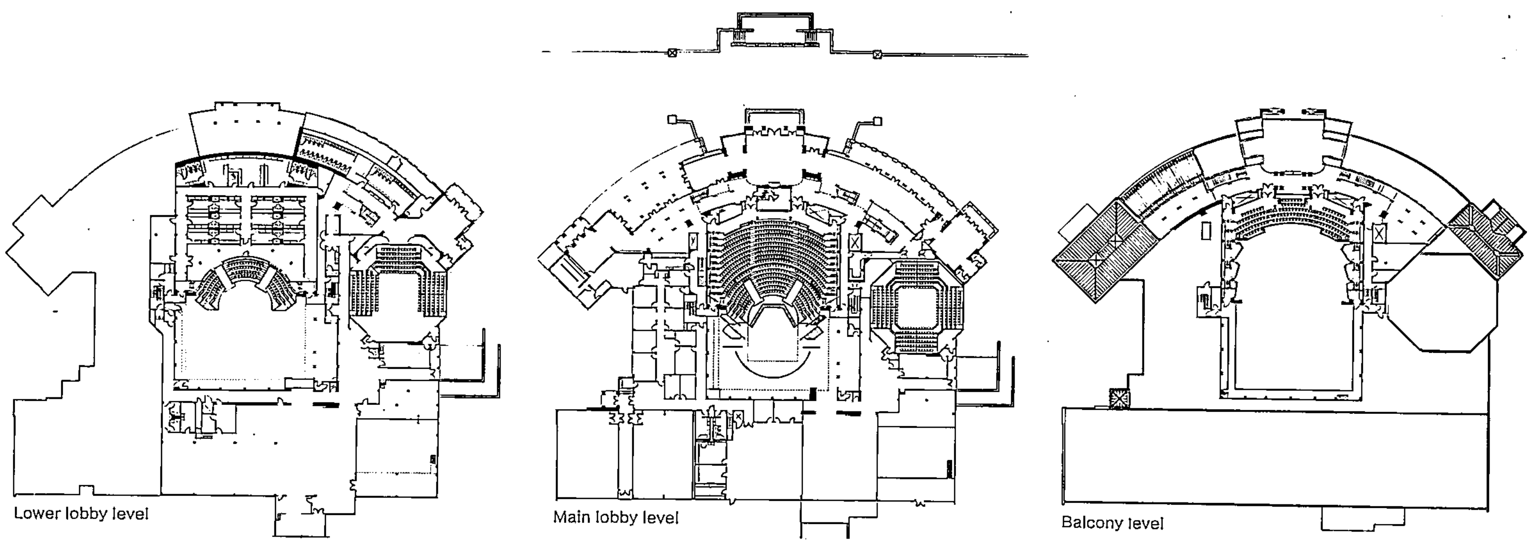

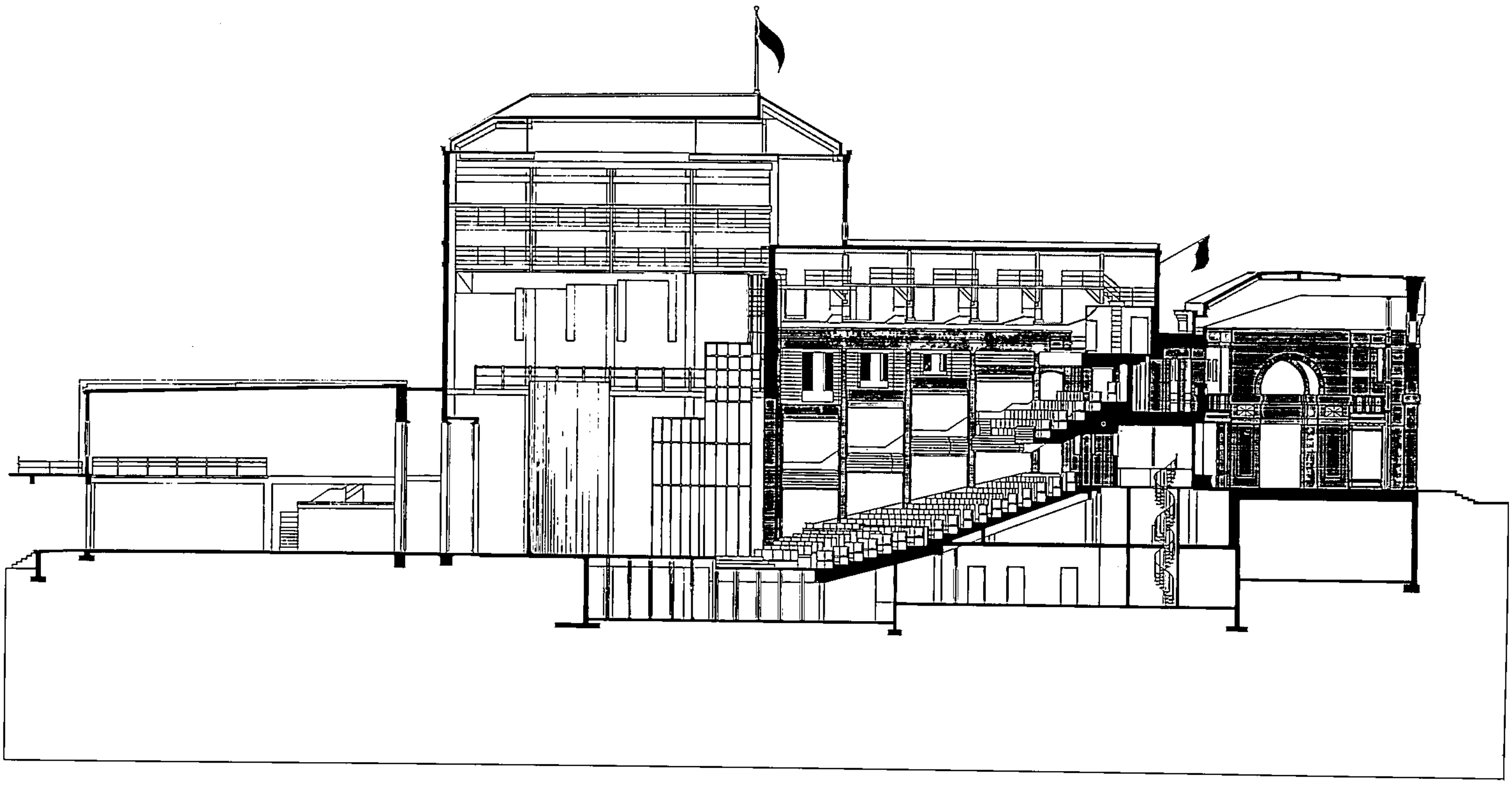

with uninterrupted views of the action below; there is not a bad seat in the house. The room is enriched by materials that range from claret-colored wool seating to white oak trim on the boxes. ARTEC Consultants, Inc., of New York City served as technical consultant for the theater.

For a recent performance of "Richard III," a modified thrust stage had been arranged. No amplification was necessary in the large room, despite the deep stage. When the script read "Exeunt," performers came and went not only through the wings but through twin vomitories located near the front of the seating area.

Audiences spilled into handsome public spaces on the main level after the performance, where a statue of the character Puck danced among the playgoers under a classical pediment. Puck's home, the main lobby, is on axis at the center of the complex. To his left and right are vaulted brick archways leading to tall public galleries. Dark stone flooring forms pathways in these arcades, where oak and glass walls curve to follow the crescent-shaped facade of the building.

The inner wall of the arcade is brick, the dominant building material of the complex. Inner and outer brick walls form a shell of several rings or concentric layers that emerge from the interiors to the building's outer form. These "drab" walls have been enriched with other more elegant materials, such as wrought iron, bronze, brass, and marble, and they are consistently lightened by clerestory glazing.

Left above, the larger and more elaborate of the two theaters, the Festival Stage, with the theatrical set for 'Death of a Salesman.' Left below, simple Octagon theater provides space for experimental and student productions and musical recitals.

Small details marry shell and infill, such as at wall niches for water fountains, where brick coursing lines carry through changes in material. Most detailing is a marriage of neoclassical and contemporary, from Georgian handrail details to the architects' custom designed lighting fixtures.

The feeling of these interior spaces is 18th century without hyperbole, spaces that are appropriate for their function with particular attention given to scale and the orders.

The rough shell of the brick walls lends force and unity to the composition, although some clarity of detail is sacrificed in the pervasive use of brick detailing. Limestone or marble could have brought a crispness to the composition in columns or lintels, for example. Clarity of lobbies and arcades is sacrificed to elegance, as rococco carpets soften and ultimately diminish dramatic spatial effects.

Right, main lobby has a statue of Shakespeare's Puck opposite the main entrance. Above, curving, natural white oak window wall of the lobby bar area looking toward the Founder's Room. Left, lobby from second level with custom designed carpets and light fixtures. □

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Technology & Practice

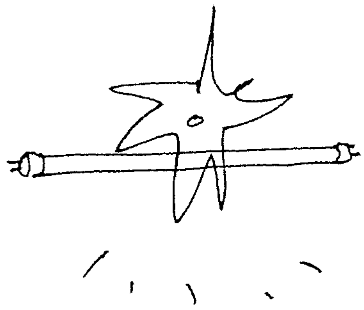
Our affordable CADD evaluation program, which regularly appeared in ARCHITECTURAL TECHNOLOGY, receives an update in this issue and appears in ARCHITECTURE for the first time.

The program began more than three years ago, when Contributing Editor Oliver Witte asked about two dozen architects to try out several brands of CADD software in the real-world environments of their offices and share their experiences with the magazine. The same group has been monitoring developments in CADDware ever since, and while a few new evaluators (and CADD systems) have been added to keep our comments sensitive to CADD novices, it's true that many of the veterans (like much of the profession) are now involved with CADD at a sophisticated, highly productive level.

The full-color presentation in this issue helps show off what the evaluators, and the systems they're using, can do. The article shows off the capabilities of our new format as well. Seven more feature articles related to computers in architecture are planned for 1987. Many will be as graphic as this month's story.

The extensive computer coverage you'll be seeing in ARCHITECTURE supplements the full range of technology and practice material that appears every month. This month, that material focuses on new lighting technologies and proven lighting design strategies.—MITCHELL B. ROUDA

Basics of Daylight Design



Treating natural light as an architectural element.
By Benjamin Evans, FAIA

People *like* daylight. They like their interior spaces to have plenty of daylight. If people *like* something, it stands to reason they will consider it valuable and that when they have it they will be more satisfied and productive than when they don't have it. This is all the justification architects need to introduce daylighting into their building designs.

Architects sometimes are reluctant to try to apply their skills to effectively utilize daylight in building designs. Daylight has been around for a long time, but now it is being talked about as if it were mysterious, to be handled by experts only. But those design skills that effectively employ other elements of esthetics and technology in the creation of exciting and useful spaces are the same ones necessary for the use of daylight. The *analysis* of the daylighting design from an energy conservation or critical seeing perspective does require some acquired skills.

But what is sometimes missing for architects is a memory-stored vocabulary of experiences from observing what buildings do to daylight. What happens to interior lighting when glass is introduced into the space between the ends of a row of concrete T-beams? If such an event has been sensitively observed and stored in the memory, the recalling of the resulting effect will permit use of a similar detail in another building design with reasonably predictable results. If such an event has not been observed and cannot be recalled, a simple scale model under daylight will provide the opportunity for the necessary observation and evaluation.

In the school buildings of the 1950s, daylighting was justified because of its superior contributions to good visual conditions. In buildings of the 1970s, the justification was based on the energy savings possible with daylighting. For energy conservation to be justified from the standpoint of using daylighting, there must be a reduction from the norm in energy use for electric lighting and/or for cooling/heating. Thus, energy conservation is directly related not only to the introduction of daylight but to the proper use and control of electric lighting, which is a subject that will be discussed later.

In both of the above periods, when designers used daylighting effectively, the result generally was an environment that was seen as beautiful and stimulating, as well as productive. The energy crunch was a blessing in that it forced a rediscovery of daylighting as a desirable and esthetically pleasing element in buildings. The introduction of the now-common atrium has shown that spaces are more satisfying to people and will attract them to places of business, thereby resulting in increased sales (which are justifiable results).

While daylighting *can* be effectively employed to conserve energy and *can* enhance the visual environment—both of which are tangible, calculable attributes—daylighting's principal values are in the more intangible areas.

There are many attributes to be associated with the use of daylight in buildings. Among them are: esthetic, e.g. the play of light from windows on surfaces and textures casting beautiful and interesting shadows; the endless variety of moods and appearances due to the movement of the sun; psychological, e.g. the sense of well-being associated with "natural" light rather than "artificial" light and the sense of orientation that comes with being "connected" with the exterior; health related, e.g. improved resistance to infections, skin disorders, and cardiovascular impairment; and energy/cost associated, e.g. reduction in electric lighting use and related airconditioning.

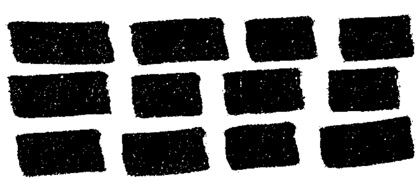
Physiological benefits

Numerous studies have shown that there is a number of desirable physiological benefits derived from lighting to humans, animals, and plants. Some types of growth, orientation, sexual stimulation, migration patterns, egg production, and other attributes are dependent on light content, duration, and intensity.

• *Full Spectrum Lighting.* There has been a strong push in recent years to stimulate the use of so-called "full spectrum" electric lamps in buildings on the assumption that humans evolved in the natural environment and that, therefore, the sun's total spectrum must be useful and valuable. It is difficult to argue against this assumption and easy to comply with it by using daylight whenever possible.

Ultraviolet radiation, for instance, is essential to human health. It prevents rickets, helps keep the skin in a healthy condition, is responsible for the production of vitamin D in the body (thus reducing the incidence of broken bones in the elderly), and it destroys germs. Ultraviolet dilates the capillaries of the skin, reduces blood pressure, quickens the pulse rate and appetite, stimulates energetic activity, produces a feeling of well-being, reduces fatigue, and may even increase work output. Of course, there are also dangers from overexposure to ultraviolet such as skin cancer, wrinkles, and possible eye damage, but most of the benefits and none of the liabilities have been directly associated with the use of daylight in buildings.

• *Stimulus.* The human organism is not adapted to steady stimuli or to the complete lack of stimuli. Uniformity in the



environment produces monotony when humans are exposed to it for long periods. Lack of change is inconsistent with people's natural tendencies. It is here that the constantly changing nature of daylight automatically and naturally responds to the need of the body and mind for a change of stimuli.

Although the body responds to steady state conditions by changing itself, if the monotony is long continued, the body's *ability* to respond to stimuli will gradually deteriorate. People require reasonable stimuli to remain sensitive and alert. On the other hand, overstimulation from lighting (e.g. direct bright light in the eye) can lead to emotional as well as physical fatigue. The trick in lighting design is to avoid excessive stimulation from direct light sources while at the same time providing some visual flexibility and stimuli. The proper introduction of daylight into the interior environment is the most effective way to provide these valuable variations.

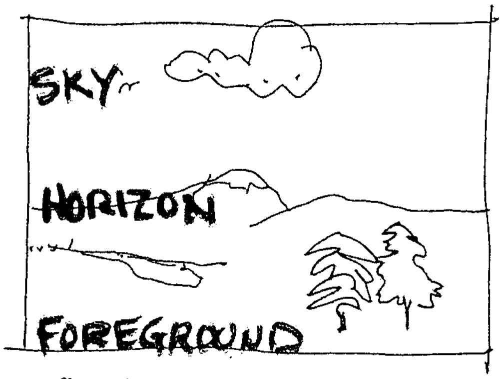
• *Orientation.* The human need for a recognizable relation to the outside environment is well known. Aviators who lose contact with the horizon are subject to vertigo. Passengers on a ship or airplane are much more likely to experience seasickness if they are below decks with no visual contact with the horizon. People inside buildings who lose contact with the exterior may feel insecure about possible escape from fire. Loss of contact with the exterior may also cause "weather disorientation" (Who does not want to know whether it's sunny or rainy outside?) and loss of bodily time rhythms (How does one know when its quitting time if he or she can't see to the outside?) People are frustrated and distracted (perhaps subconsciously) when they are not able to sense what the weather is outside and have little sense of nature's time. Being visually separated from the exterior for long periods can be energy-consuming and counter-productive.

Psychological benefits

There are also psychological benefits that accrue from the use of daylighting in buildings, benefits that are perceived but are difficult to quantify.

• *Sunshine.* The presence of direct sunshine in the interior environment is one of the strongest psychological benefits. The evidence of a desire by most people for some direct sun is strong. Although direct sun on a visual task may produce excessive brightness differences, some direct sun in proper location and quantity is stimulating and desirable. Good building design can often include direct sun without destroying visual acuity.

• *View.* A view to the exterior is another strong psychological benefit to building occupants. While the techniques for admitting daylight are not necessarily directly related to a window with a view, they most often are related. Windows, daylight, and a view go together. Numerous surveys have firmly established that people consider a view out very important. Any lessor of building space will



confirm the fact that tenants usually are willing to pay more for office space with windows than for windowless spaces.

What constitutes a valuable view is generally related to the information content in the view and the distance between occupant and window. The best views (and the most information content) are those that include some sky, horizon, and foreground. More important however, is a view containing a balance of synthetic and natural things with some element of movement, change, and surprise involved. The closer the occupant is to the window (and, hence, a total view) the more the satisfaction will be. Broad horizontal windows are more satisfying than narrow vertical windows, the optimum size being about 20 to 30 percent of the exterior (window) wall.

• *Brightness Gradients and Color Constancy.* Daylight generally produces a gradation and color of light on surfaces and objects that biologically is "natural" for humans. Daylight is the "standard" against which the human mind measures all things seen, probably because of a lifetime association with daylight. A gradation of daylight on a wall surface from a window will seem natural, and the wall will look smooth. Uneven lighting from electric sources will likely make the wall appear uneven. Colors seen with daylight will appear real and appropriate through something called "color constancy" even though the color produced by daylight will vary from dawn to noon to dusk. Changes in the color of electric light will cause things to appear "unnatural" and the mixing of lamps with different color production sometimes is upsetting unless well planned. The shopper purchasing new clothing will be wise to check the apparent color of the material next to the window where daylight is available.

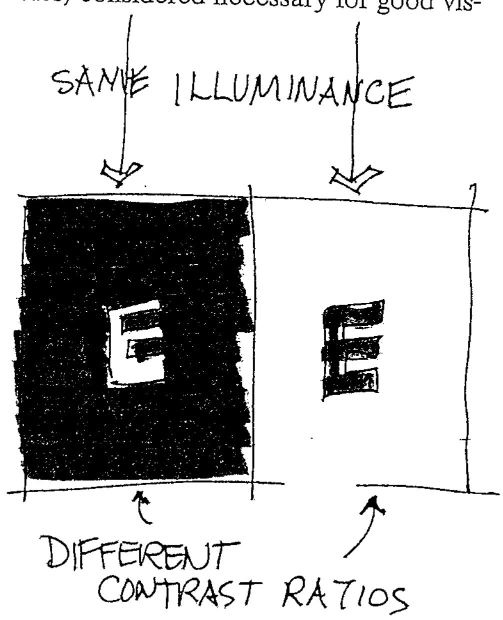
Psychological response of people to the variety of phenomena in the environment is a complex subject and involves much more than lighting and those elements mentioned here. However, all the signs seem to point to the use of daylight in buildings as being less likely to produce uncomfortable results.

There are several ways to consider lighting. Some of them are essentially esthetic and satisfaction with the results of any esthetically-based lighting design will depend on the skills of the designer and the perception of the viewer. But another way to consider lighting is in terms of how well it allows people to see what they want to see. This kind of lighting quality is fairly easy to technically define, if not so easy to apply.

When the ability to see and perceive fine detail in a surface or object is considered necessary or highly desirable (where not seeing the detail will cause undesirable results, such as accounting errors), then the object must be well lighted and the quality of the lighting can be judged through two primary characteristics: contrast and glare.

Contrast is necessary for good visual perception, and is the result of luminous (or brightness) differences that, in turn, are dependent upon the illuminance (footcandles) falling on the task and the reflectivity (ability to reflect light) of the task. The printed words on an illuminated newspaper are of low reflectance, and hence, low luminance, while the white paper itself is of high luminance (or brightness) and the contrast between the two is what allows them to be perceived by the human eye. Naturally, there must first be sufficient light to invoke a visual response. Hence, the need for a certain quantity of illuminance (light).

The quantities of illuminance (footcandles) considered necessary for good vis-

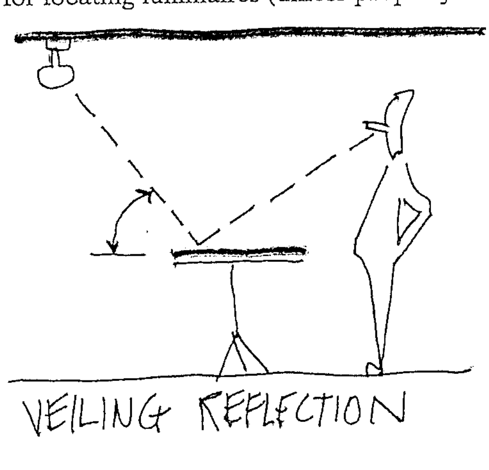


ual conditions for a variety of tasks can be found in almost any recent book on lighting, as well as in the Illuminating Engineering Society (IES) Lighting Handbook.

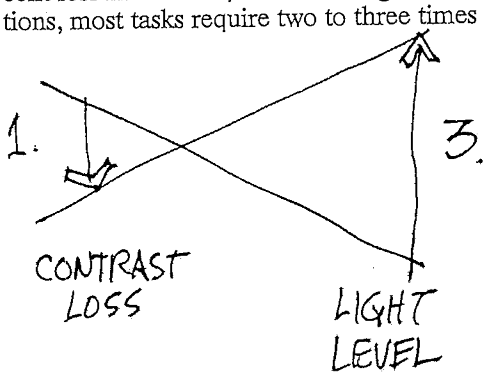
But realize that with a given quantity of illuminance, there can be different contrast ratios in a task that produce different visual conditions. For this reason, illuminance levels are not in themselves a sufficient criteria for judging or specifying the quality of the lighting environment. Luminance differences are more important.

On the other hand, it is possible to produce excessive contrast: contrast that impedes good visual response. A bright light in the field of view will detract from one's ability to see other surrounding objects. An oncoming auto headlight in the dark of night will prevent a view of the dark roadway. A ceiling-mounted luminaire will detract from a person's ability to see a nearby task when both are in the field of view. That is why luminaires need some type of shielding device to prevent a direct view of the lamps. Bright clouds seen through a window will also prevent or detract from the ability to see tasks in the same field of view, such as the interior of an outside wall or a book between clouds and the viewer. Therefore, *competing* luminances should be avoided.

Glare is usually associated with brightness differences (too much light in the field of view) or with reflected light. Light reflecting off a specular task, even one with a low reflectance (e.g., printing), can reduce or eliminate our ability to see the task. This kind of glare is called a "veiling reflection," because it "veils" (reduces or eliminates) our ability to see the task by reducing the contrast. Such glare is the result of a bright light shining off a task at the "mirror angle" (as a light on the ceiling might be reflected in a mirror placed on the task). It is for this reason that the ceiling is generally a poor place for locating luminaires (unless properly located and/or shielded with respect to the occupant's task) and that windows, generally located to the viewer's side, produce good quality task light without veiling reflections.



Veiling reflections cause loss of contrast. Since it takes 10 to 15 percent more illumination to make up for each one percent loss in contrast, due to veiling reflections, most tasks require two to three times as much illumination from overhead sources as from sidewall lighting. Therefore, the required number of footcandles is only one-third as much for daylighting as for the typical electric lighting system to achieve similar quality.



Good quality lighting for visual tasks, then, is a matter of bringing in sufficient light, without producing excessive contrasts or glare. Some guidelines for doing this will be discussed later.

Program for daylight

The decision to include or not to include significant elements of daylighting in a design is generally left to the architect, clients not usually being aware that this issue requires any kind of special attention. And that is as it should be, although there are many instances where clients have been more aware of the potentials of daylighting than their architects. But making extensive use of daylight often calls for some significant trade-offs and it is often important that the client be made aware of the possible choices right from the beginning; that is, in the programming stage.

It is in early programming that some objectives should be set with regard to the visual environment and to the types of lighting that are to be employed. Daylighting cannot be applied to a building design as an afterthought. It is not a simple matter of applying some controls to the windows any more than one can just "stick" some luminaires in the ceiling (as is often done).

How well people wish to be able to see inside a building is a key factor in that building's design, occupants' productivity and satisfaction, operation, energy consumption, and long-term costs. Thus, concerns for an economic, energy-conserving, and productive building must start with the issue of quality of lighting to be provided, then move to the most appropriate techniques for accomplishing that end. Any attempt to establish goals for building systems, components, or materials must consider the relationship of those goals to the overall goals of the design of the *total* building.

In the context of energy, it is the conservation of energy consumed by the total building that is more important than what is consumed or conserved by any subsystem such as lighting. Building energy performance standards have been adopted by almost all states and many municipalities that form the foundation for establishing targeted building energy use for specific types of buildings and site conditions.

Specific goals related to daylighting of buildings may be stated in simple terms: (1) get the daylight into all feasible areas in significant, useful quantities, (2) distribute the daylight reasonably uniformly through all floor areas, with no significant dark spots, (3) avoid allowing direct sunshine into the building interior in such a way that it may cause visual discomfort (excessive brightness differences) or visual disability (glare), and (4) provide controls for the electric lighting so that it will be diminished or eliminated when not needed.

Each of these goals must be evaluated against some standard where such standards exist. For instance, necessary interior quantities of light for various visual tasks as well as criteria for judging other goals related to good visual acuity and quality lighting are put forth in the *Lighting Handbook, Applications Section,* of the Illuminating Engineering Society (IES).

In terms of energy consumption, enough new buildings have been designed and built in recent years to indicate that, with the introduction of daylighting, about two watts per square foot of floor space for electric lighting is sufficient to provide good quality visual conditions with the combination of daylight and electric light.

However, the visual process includes too many other variables to permit footcandle levels to be the ultimate criteria. Brightness patterns and potential uses of direct sunshine need to be thoughtfully considered. The local climatology should be studied to determine the potential for daylighting use, in terms of both visual conditions and energy consumption. Climate will also be a factor for the amount of glass that can be optimally used for thermal as well as daylighting control.

The sculpturing process

The sculpturing of architecture for daylighting, then, begins at the beginning, with site, climate, and the neighborhood. It continues with considerations of building geometry and structure, with surface materials and finish treatments, with apertures and glazing, and may include the more esoteric considerations of piping or reflecting daylight with mirrors. Decisions with regard to daylighting must be considered simultaneously with other concerns such as electric lighting, natural ventilation, view, and energy use, which will only be touched upon here.

Throughout the country, during the principal hours of daylight, there is almost always enough light available from the sun and sky to provide illumination for most human visual tasks: several thousands of footcandles. Because the amount of daylight available tends to change almost momentarily, it is impossible to predict with any precision what will be the interior daylighting conditions in any building at any moment, although excellent data are available on which to base an estimate of typical quantities of exterior available illumination.

However, it is not necessary that conditions be precisely predictable. The designer will establish a set of goals to be achieved within a reasonable range of expected exterior daylight conditions and then will attempt to make the most of that available daylight, while providing a supplemental or alternative electric lighting system to contribute the necessary light when sky conditions are inadequate for daylighting.

There are three types of skies generally associated with the daylighting process:

• The clear blue sky, which provides a relatively steady source of low-intensity light (e.g., 2,000 to 3,000 footcandles on the ground), with direct sun of high intensity (e.g., 6,000 to 8,000 footcandles), or 4,000 to 10,000 footcandles of total light on the ground.

• The overcast sky, which may be a very dark sky providing only a few hundred footcandles, or which may be very bright, producing several thousand footcandles. The overcast sky can be excessively bright when viewed from inside the building, or it may be quite dark.

• The third type of sky is partly cloudy and is characterized by a blue background, with bright, white clouds (oftentimes passing and changing rapidly), with direct sunshine penetrating off and on. Intensities on the ground can change rapidly from 2,000 to 3,000 to 8,000 to 10,000 footcandles. These clouds when viewed from the interior can be exceedingly bright, causing glare and visual discomfort.

Resources are available that provide data on anticipated daylight at particular locations based on the month, day, time of day, and building orientation. (See "Daylight Availability Data for Selected Cities in the United States," Claude L. Robbins and Kerri C. Hunter, Solar Energy Research Institute (SERI), Golden, Colorado, September 1982). These calculated data are reasonably accurate and empirically quantified. However, they do not include allowances for cloud cover and, therefore, must be modified by data on localized cloud cover, which is generally not as predictable as footcandle levels.

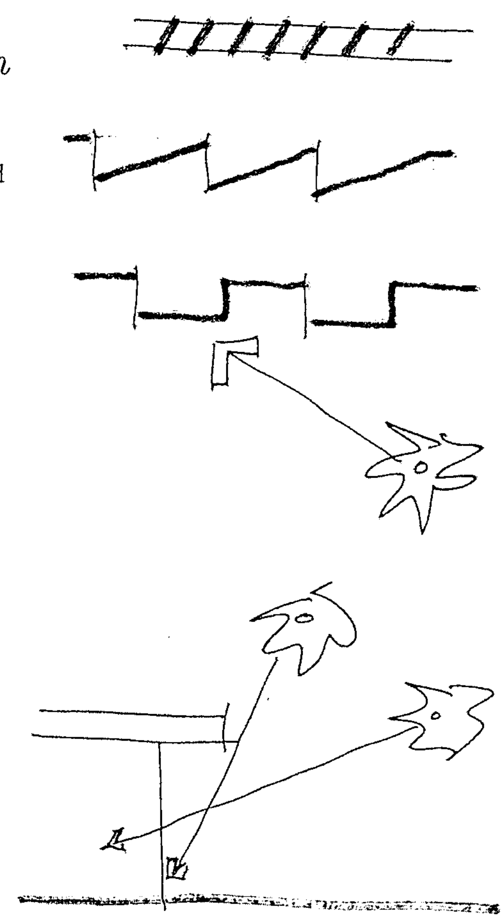
Site and building orientation

The selection of the site might be significantly influenced by daylighting considerations. Several site features that should be considered are: (1) location of the building on the site so that daylight can reach the apertures without significant interference from nearby obstacles (e.g., tall buildings, mountains, or trees); (2) highly reflective surfaces near the site, such as glass-covered buildings that could cause excessive glare; (3) trees and shrubs on the site that might give shade and reduce skyglare from the interior; (4) bright ground surfaces that can be used to reflect daylight into the interior (as much as 40 percent of interior daylight can come reflected from ground surfaces). None of these features, if constraining, need prohibit the use of daylight, but the implications should be considered.

Any building orientation can effectively make use of daylighting, although the amount and type of daylight available will vary with each wall surface. The essential difference in the quantity and quality of daylight received from different orientations has to do with the location of the direct sun. Direct sun may have to be shaded and the intensity of the daylight will vary from south, east, west, and north, in about that order. There is some difference in the brightness and color of the sky in different quadrants, but this difference is of only minor importance to the designer.

Openings to the north will probably require larger glass areas than other orientations to achieve similar results. There can be certain advantages to the north orientation (e.g., no sun control is necessary and illumination tends to be soft and diffuse), but sky glare control may still be necessary and heat losses in the winter can be a concern.

East and west fenestrations must deal with the early morning and late afternoon low-altitude sun, which tends to move up and across the sky in relatively rapid fashion causing excessive brightnesses and potential overheating. Some type of vertical shielding is generally most effective (e.g., vertical louvers or zig-zag walls) on east and west facades. Fixed louvers tend to interface with a view out but can be quite effective in letting daylight in. Automatic controls on movable louvers are more desirable since they don't have to be operated by occupants.

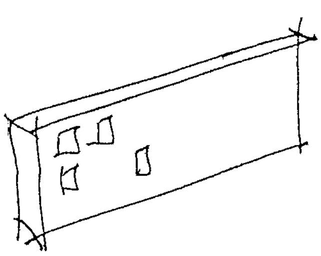


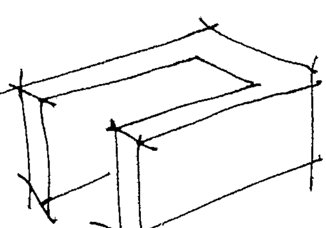
The south-facing facade provides the best opportunity for daylighting since this orientation receives the maximum duration and quantity of daylight. Horizontal controls (e.g., overhangs, louvers, and venetian blinds) will provide control when the sun is in the southern quadrant, keeping the high sun out in the summer but allowing some winter low-altitude sun penetration if desirable. Sky brightness will still be a factor to be dealt with either through interior shades, blinds, or louvers, or with vegetation on the exterior.

Shape guides daylight

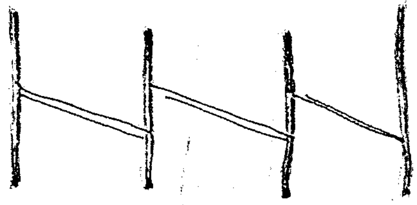
Probably the most significant design determinant in the use of daylight is the geometry of the building—the walls, ceilings, floors, windows, and how they relate to each other. Some very significant buildings have been shaped by considerations for daylight—the early Greek and Egyptian temples, the Gothic cathedrals of the 13th and 14th centuries, school buildings of the early 20th century, and some greatly admired recent buildings by Kahn, Wright, Aalto, and Caudill. An understanding of the effects of various building elements on daylighting provides the basis for manipulating form to achieve beautiful and functional results.

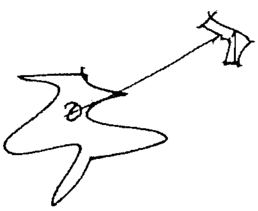
• *Building Configuration.* If daylight is to be a consideration, multi-story buildings will be most effective if they are long and narrow so that daylight can penetrate to the interior from both sides. A rule-of-thumb is that useful daylighting with reasonably sized fenestration openings can be achieved to a depth of about 15 feet inward from the aperture; with windows open to a high ceiling, about 20 feet inward from the aperture. In single-story buildings, skylights or clerestories can be used, thus permitting the building to assume a more square shape.





Often the footprint (or floor plan) of the building can be sculptured to achieve shading from the direct sun and/or to control the view from the interior. Le Corbusier's Carpenter Center for the Visual Arts at Harvard is a good example of breaking up the exterior wall surface to prevent sun penetration while still allowing daylight and view. Atria, light wells, and courtyards can be used to effectively admit





daylight, not only into the well openings, but into adjacent interior spaces as well. While such wells do not provide daylighting as effectively as windows opening to the unobstructed exterior, their effectiveness can be enhanced with the use of high-reflecting finishes (white paint, concrete, light tile), but direct sun on these surfaces may create excessive brightness when viewed from interior spaces.

The Prudential Building in Buffalo, designed by Louis Sullivan, is a classic example of the good use of light well surfaces and openings to achieve a light, daylighted interior. The building was originally U-shaped (the open end was later blocked by another building) and the court walls faced with white ceramic tile. Large windows allowed the entry of daylight into interior spaces with high ceilings. Obstruction of daylight by interior walls was minimized. Even the elevator shaft was enclosed by ornamental iron, which allowed the daylight to pass through to other spaces.

While it is important to understand geometric relationships in terms of lighting function, it is also valuable to grasp some of the quantitative relationships that go with various geometric forms. Designers often ask, "I understand how the walls reflect light, but *how much* light will I get?" A review of measured illumination levels for various types of building designs can be helpful as can simple calculations, but experience is also a good teacher. Designers should manipulate the forms and measure the results before they can understand the quantitative relationships. Such experience can be easily acquired through model studies.

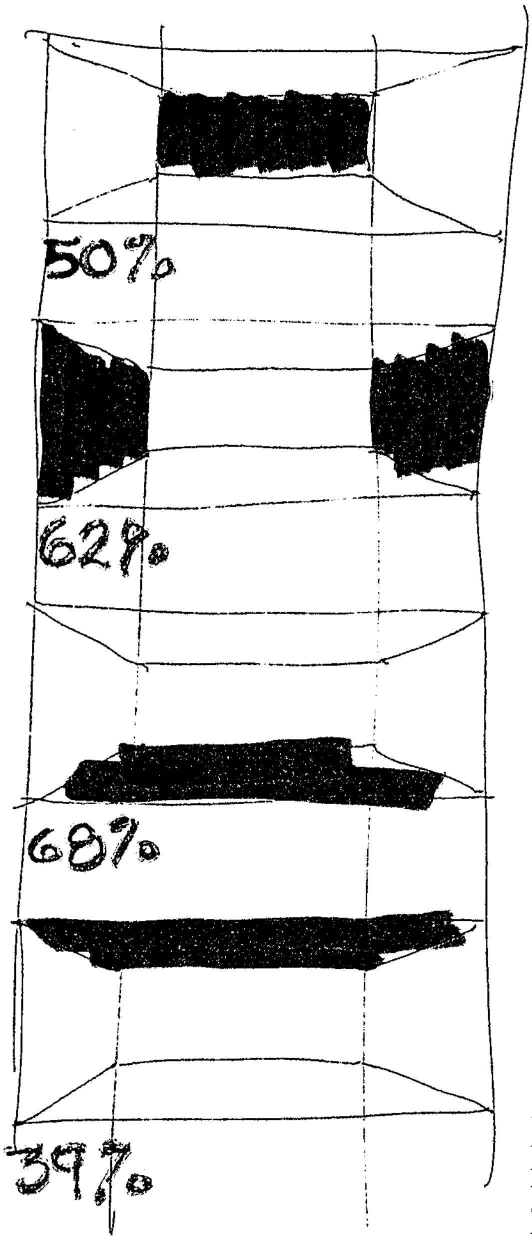
• *Window Height.* The window size and height above the workplane are among the most important geometric factors in daylighting design. Naturally, bigger windows admit more daylight. But the *height* of the windows is the more significant factor in getting the daylight deep into the interior. The higher the window, the deeper the daylight will penetrate. The height of the ceiling above the floor has little effect on the daylight, although, of course, the height of the top of the window is limited by the height of the ceiling.

• *Room Depth.* Tests have shown that as the depth of the room becomes greater, everything else remaining the same, the level of daylight intensity throughout becomes less—a simple matter of spreading the same quantity of incoming light over a larger area. A 28-foot-deep room has 18 percent less light at a point near the back wall than at the same relative position in a 24-foot room; a 32-foot room, 28 percent less.

The old rule-of-thumb (in some cases a state code stipulation) that says that the depth of the room should not be more than two and one-half times the height of the window is not a bad one, but that is assuming that the window is continuous from one side wall to the other.

• *Surface Reflectances.* The effects of various wall surfaces can be seen from this hypothetical example. In a simple rectangular room with windows on one end, all the room surfaces are painted white. The measured illumination on a fixed desk is considered to be 100 percent. When the back wall (away from the window) is painted flat black, the illumination on the desk is reduced to 50 percent of the original intensity; with the side walls only painted black the intensity is reduced to 62 percent; with the floor only painted black the illumination is reduced to 68 percent; and with the ceiling painted black, to 39 percent.

These figures, the results of actual tests, show that the *ceiling* is the most important surface in reflecting daylight coming into the room and reaching the task. Next in importance is the *back wall,* then the *side walls,* and finally, the *floor.* This indicates at least two things to the designer: keep the ceiling as light in color as possi-



ble and use the floor surface for deep colors. Dark colors on the floor will have the least negative effect on the daylighting of tasks.

• *Overhangs.* Building overhangs can be very useful for sun and rain control and, although they do reduce the level of daylight within the building, particularly next to the window wall, they are especially effective in collecting light reflected from the ground and further reflecting it back into the interior of the building. The result is a more even distribution of light in the space.

Test results indicate a 39 percent drop in illumination near the window of a unilaterally lighted room with the addition of a six-foot overhang, but only a 22 percent drop near the interior wall. Overhangs are also helpful in reducing the area of bright sky that can be seen from within the interior, although the effect is usually minimal.

Apertures are critical

The amount of daylight that enters any opening (aperture) is directly proportional to the size of the opening, the transmissivity of the glazing, and, of course, the daylight available to enter. The amount of daylight that reaches any point in the interior is related to the area and brightness of both the exterior sources of daylight and interior daylighted surfaces that are "seen" from that particular point. Thus, a point close to the aperture "sees" a larger portion of the sky and has a higher footcandle level than a point farther away from the aperture. Interior surfaces also contribute daylight to the task and are influenced by light reflected from other surfaces.

• *Light Shelves.* Much ado has been made about the effectiveness of the so-called light shelf—a horizontal plane inserted into the fenestration glazing, usually just above door height and just below the ceiling level. These shelves may be located entirely on the exterior of the fenestration, they may be located on the inside, or both. Sometimes window sills may be extended as with a thick wall section or with a bay-window configuration to act as a light shelf. Generally speaking, their effect on interior daylighting is not significant. When compared to a fenestration of the same dimension without the light shelf, the interior illumination with a light shelf will be less, because the light shelf, being opaque, blocks out some of the light that would otherwise pass through.

The exception to this is when the top of the light shelf is exposed to direct sun, reflecting daylight up against the interior ceiling and down to task level. Even here, the contribution to interior daylighting may be small. But if the shelf can be justified as a sun shade, the extra daylight contribution, along with the shading, may be cost effective.

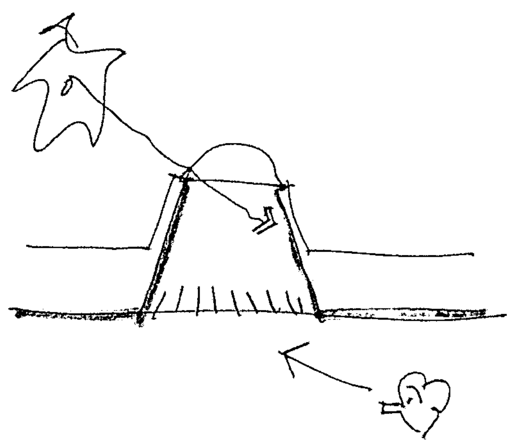
The light shelf may be white or highly reflective (as with polished metal) to increase the daylight reflectance. However, if the surface is mirror-like, it may create an unattractive strip of high brightness on the interior ceiling.

Light shelves are virtually ineffective when they are exposed to diffuse skylight only, because of the low light levels (2,000 to 3,000 footcandles versus 8,000 to 10,000 footcandles for the direct sun and sky) and, therefore, their use anywhere but on a south-facing fenestration will not be productive. (For a more detailed description of the effects of light shelves, see *Concepts and Practice of Architectural Daylighting,* by Fuller Moore, Van Nostrand Reinhold Company Inc., 1985.)

• *Skylights.* Skylights are excellent devices for allowing large quantities of daylight with minimum sized openings. The illumination falling on the horizontal plane of the roof may be many times that which strikes the vertical plane of a window wall even under an overcast sky.

The largest use of skylights is probably in the roofs of warehouses and light industrial buildings where the major objective is a minimum quantity of light for the least cost.

In environments where visual conditions are more demanding, such as classrooms and offices, the diffuse skylight, if directly viewable from below, is very likely to produce excessive brightness and to cause disabling veiling reflections on tasks below, just as electric luminaires can. However, daylight from skylights can be controlled through the use of deep wells,



splayed wells, and louvers, eliminating any view of the skylight from below and minimizing the veiling reflection problem. Diffuse plastic or glass in skylights tends to diminish the biological benefits of daylight by modifying visual contact with the weather. There seems little logic in using diffuse glazing.

Double glazing is recommended for colder climates as a means of reducing conductive heat losses in winter. Some building codes require double glazing for climates with more than 2,500 heating degree-days. The value of double glazing in warm climates is doubtful where radiant heat gains are more significant than conductive losses.

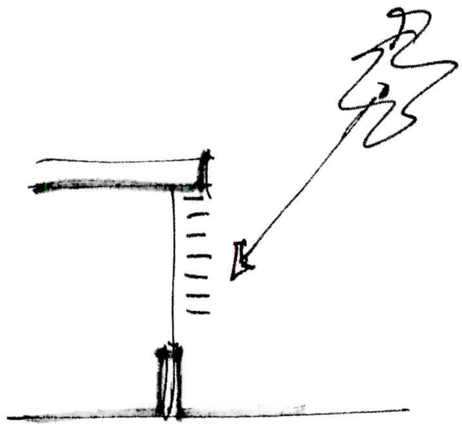
On the plus side, skylights reduce energy consumption by reducing the need for electric lighting, and they admit heat from the sun in the winter, reducing the need for other internal heating, which can be significant. On the negative side, skylights lose some interior heat and electric light to the cooler outside air and they admit heat from the outside during the air-conditioning season. The determination of whether or not skylights will be economically viable in a particular situation must include a year-round analysis of both positive and negative aspects based on local climatic conditions. A properly designed and used skylight system with daylight and heat transfer controls for both day and night operation will prove viable on a year-round basis in almost all localities.

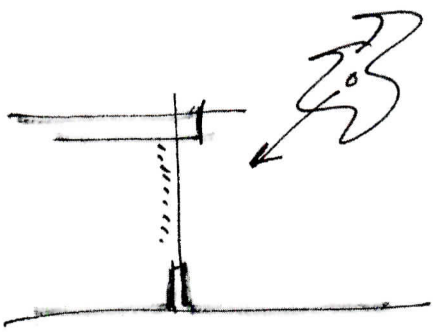
• *Clerestories.* Clerestories have most of the attributes of skylights except that they occur in the vertical rather than the horizontal plane and, therefore, are exposed to less quantity of daylight than are skylights and can be oriented to prevent penetration of direct sun. When built in combination with an interior reflector or light shelf, a clerestory can bounce great quantities of direct sun against the ceiling providing significant levels of illumination on the tasks below, and at the same time blocking the view from below of the bright sky. The penetration of direct sun through clerestories can be eliminated with proper orientation or with the addition of overhangs and/or horizontal louvers, on the interior or exterior. Light colored roof surfaces (such as white rock) adjacent to the clerestories can increase the reflection of daylight to the interior.

Some devices control daylight

A variety of daylight controlling devices can be used which may be helpful in getting the daylight to where it is needed and for eliminating excessively bright areas from view. Some of these controls are dynamic (they can be moved) and some are static (they remain in place permanently). Dynamic controls have the advantage of allowing for change in response to changing sky conditions, thereby improving the efficiency of the design, but they have the disadvantage of requiring either an operator (usually the occupants, an unreliable source in general) or an expensive automatic device, which can be difficult to maintain. Static controls are less troublesome but also less responsive and efficient.

• *Louvers.* There are a variety of types of louvers for daylight control. They may be small, movable, and on the interior





(such as venetian blinds), or they may be large and fixed on the exterior as were commonly found on buildings of the 1940s. Regardless of type, they perform basically the same way. One of the most effective is the venetian blind. Venetian blinds can be adjusted to exclude direct sun but reflect its light to the ceiling where it will bounce into the interior areas, while still allowing a view to the exterior, or they can be tilted to the closed position to block light and view. They can be raised or lowered. They have great versatility and tend to increase the ratio of interior light from the ground. But they also have some disadvantages. For them to respond appropriately to changing sky conditions, they must be operated by people who have the time and incentive.

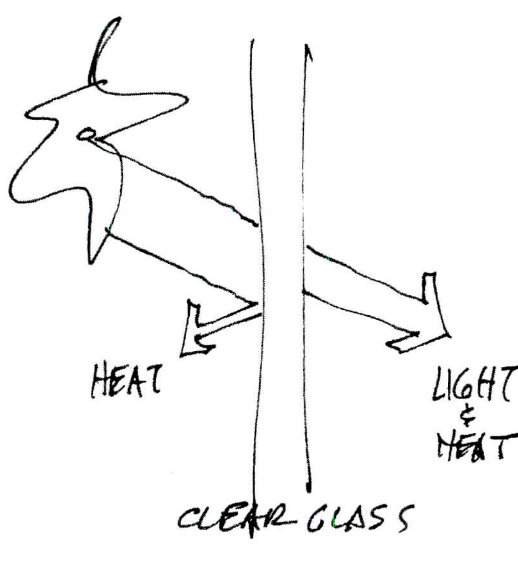
Horizontal louvers and overhangs are most effective for high altitude sun such as on the south fenestration. Vertical louvers are most effective for low altitude sun such as on the east and west facades. For situations where both high and low sun must be considered (southwest facade), "egg crate" louvers are often the most effective control.

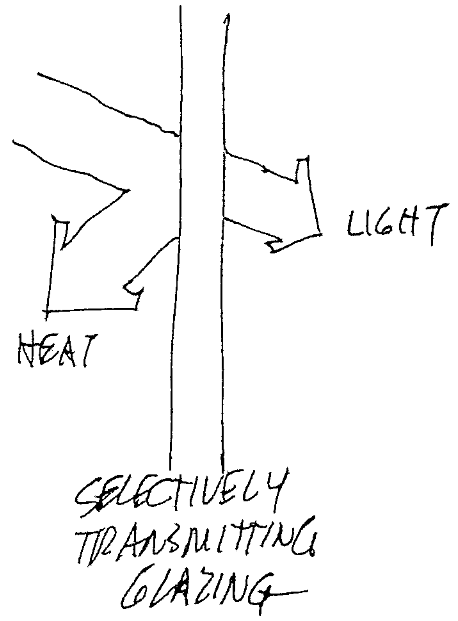
• *Glazing.* The most popular types of glazing materials include clear glass, tinted glass, and other glasses referred to as "selectively transmitting" glasses. Actually, all glazing materials are somewhat selectively transmitting, that is, they permit the passage of some parts of the radiant energy spectrum (light), while reflecting or absorbing other parts (heat producing). For instance, ⅛-inch clean, clear glass transmits about 90 percent of the visible energy which strikes it, while allowing only about 79 percent of the infrared (heat producing) radiant energy to pass through.

The tinted, transparent glasses (and plastics) have long been popular because of their ability to reduce the apparent brightness of exterior surfaces when seen from the interior. These glasses are produced principally in gray or bronze, or variations thereof. The use of tinted glasses that change the color of the daylight being transmitted should be avoided because of the color distortion which results. Transmittances of these tinted materials range from the very dark (10-15 percent), to the very light (70-80 percent) and their transmittance of the infrared spectrum (heat) is only slightly more restricted—usually 10-15 percent below that of the visible transmittance.

While tinted glazing can be a useful tool in creating a lighting environment, its use in a building to be daylighted is self defeating since it prevents the penetration of the useful daylight. Tinted glazing is recommended for use only when the primary source of interior light is from other locations (e.g., skylights or electric lights) and the tinted glazing is used only for viewing out.

If the transmission of tinted glass is around 60 percent or above, most occupants of a building will not be aware of the situation when they are inside, unless they can also see to the exterior through some clear glass or an opening at the same time. Once people become aware of the tinted glass, they tend to find it a





little frustrating because of its unnaturalness. Tinted glass below about 50 percent transmissivity may be noticeable and invoke a feeling of impending rain.

Manufacturers of glass have begun refining old glasses and developing new ones that are more selective in transmitting beneficial light than the old ones. Some glazing materials, for instance, reflect (rather than transmit or absorb) a higher percent of the sun's heat-producing energy while allowing a greater percent of visible light transmission. Such glasses offer some advantage in the light-heat tradeoff process, but manufacturers' literature can sometimes be very misleading through the uses of verbal claims that are not substantiated by their own technical data. Caution should be exercised in the selection of the most cost effective glazing materials.

Systems can transport light

A relatively new line of thinking in the daylighting field is that of transporting daylight, usually direct sunlight, relatively long distances through buildings to illuminate areas not accessible through normal apertures. This is done via various devices such as mirrors, heliostats, lenses, light plenums, light pipes, and other reflecting and transporting devices. One system is referred to as active solar optics, which includes devices such as powered heliostats which track the sun and reflect direct sunlight into a building. Those systems that use only fixed equipment such as roof-mounted mirrors are referred to as passive solar optics. Passive systems include the more esoteric methods of reflecting sunlight into buildings via mirrors and light wells, sometimes with lenses, as well as the more mundane methods which employ reflective louvers or light shelves in the fenestration. The success of transporting direct sunlight effectively and economically is still dependent on refinement and/or development of more efficient and cheaper heliostats, mirrors, lenses, and other equipment, all of which are currently under study and/or development.

One of the most promising developments is the "light pipe" which employs the concept of Total Internal Reflection. With the light pipe, or even a water-filled plastic tube, it is possible to configure the pipe so that sunlight is transported through the tube and around bends and corners with very little absorption and loss of light. At least one company already has a commercial version of the light pipe on the market for use with either sunlight or electric light, or both.

Energy and cost issues

Cost-effective design for daylighting is generally linked to the reduction in energy use for electric lighting and for airconditioning. If the consumption of energy from electric lights can be reduced, the energy needed for dumping the heat from those lights to the outside can also be reduced. These savings must be balanced against the heat gains and losses associated with the daylighting system through windows and skylights.

Numerous studies in recent years have shown that such energy savings are possible with daylight. But cost effectiveness must be linked to total *benefits* derived and some of the benefits from daylighting are more difficult to quantify than savings from electric lighting.

Often the assumption is made that good daylighting design will increase the capital cost in a building. If the design concept is confined to a rectangular space with windows on one wall, there is little that can be done to make daylighting effective without adding to the building's first cost. However, if daylighting is a prime consideration in the total design—allowed to influence spatial relationships, form, and detail from the very beginning of the design process—the first-cost investments specifically attributable to daylight may be small or nonexistent.

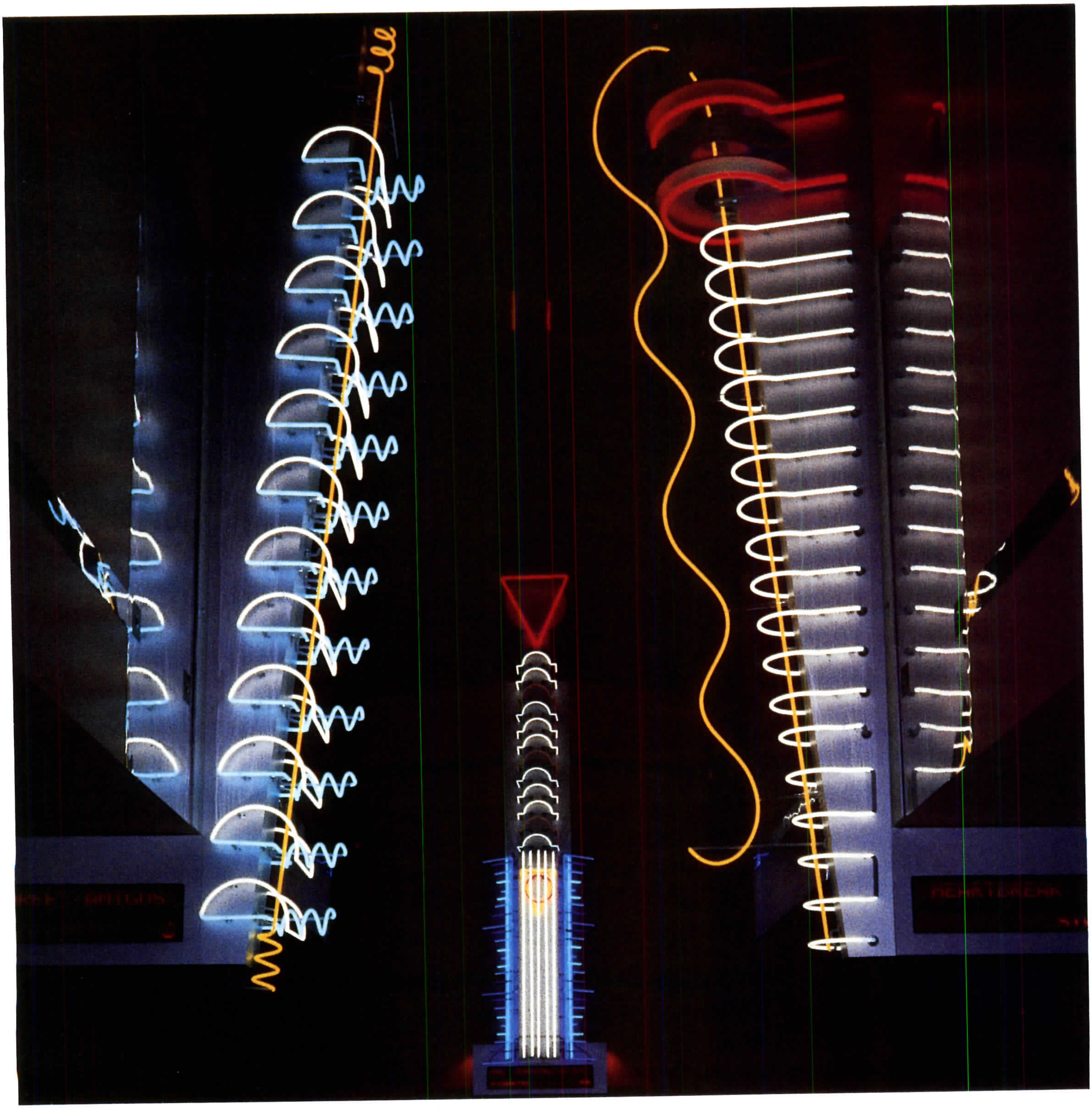
Daylighting is part of the total building cost-benefit picture and should not be treated as an "add-on." The cost benefit of design for daylighting must be considered in conjunction with other lighting costs and benefits, with solar heat gains and losses, with energy uses and savings, and so forth. There is no simple conclusion about the cost of daylighting that can be applied to all building designs. Presently available daylighting analysis methods range from the use of simple graphic tools to sophisticated mainframe computers and physical scale-model studies. All analysis methods, whether they be graphic, mathematical, or physical, are attempts to simulate a full-scale condition. The difference in the various analytical tools available is in the parameters that can be included and the accuracy of the results. A simple graphic overlay can be used to size a window under overcast sky conditions, but the result will be far from a reproduction of reality. A small programmable calculator can provide a comparison of two design alternatives under certain very limited conditions. Personal computer programs allow a somewhat more complex analysis, but are still limited to parameters that must be understood for useful results. A mainframe computer can provide fairly accurate results, within certain important limits, but it can also couple daylighting concerns with the thermal, energy, and cost concerns involved. A physical scale model can produce quite accurate results if constructed and tested under appropriate conditions.

Perhaps the most useful daylighting analysis for the designer can come from the use of scale models. They have the advantage of being familiar to most architectural/engineering firms. Scale models can (1) provide an indication of approximate footcandles to be expected under various types of skies, (2) allow a comparison of various design alternatives (e.g., windows with and without louvers), and (3) allow observation and photography that provide a sense of the esthetic as well as help define brightness differences and potential glare problems.

Designing for good daylighting while taking into consideration all of the concerns expressed here is a complex process. It requires some experience, study, and thought that will not be accomplished overnight. Nevertheless, it offers considerable richness for bringing together the manmade and the natural environment to produce a much more beautiful, inspiring, and humanistic architecture. □

A Rich New Palette Of Light Sources

They create a wide range of special effects. By Michael Z. Cahana



Gideon Bosker

In any architectural setting, light can have a multitude of uses, from the mundane to the ethereal. Light and shadow are the ultimate form-givers to a three-dimensional surface. Perception and color are dependent on the type of light present. If the lighting designer is an artist, light sources and fixtures are the palette and brush.

In recent years, the range of sources available to the designer has increased dramatically. Incandescent lamps have become smaller and are now available with tiny, precise, and powerful beams. Compact fluorescent lamps can fit into spaces once reserved for incandescent sources, and can give a similar warm glow. Even high-intensity discharge sources, once relegated to roadway lighting, are coming indoors in small packages with excellent color rendition. Then there are the exotic sources.

• *Miniature incandescent.* The increased use of low voltage power supplies has created a plethora of new, miniature incandescent sources. Most of these use a tiny tungsten filament encased in a clear quartz envelope. This envelope is filled with a halogen gas that reacts with free tungsten molecules and redeposits them on the filament. This tungsten-halogen cycle keeps the bulb wall free of the "blackening" characteristic of most incandescent lamps, and can greatly increase the life of the lamp, making it more cost effective.

Since the T-H cycle is very heat dependent, the use of low voltage quartz lamps, which can create a great deal of light and heat in a tiny space, has become very popular. Line voltage quartz lamps certainly exist, especially in high wattages, but lack the precision of the miniature lamps.

When the tiny quartz lamp is coupled with an integral reflector, a miniature projection system is created that barely needs a fixture to contain it. This has given rise to the PAR-36, the popular MR-16, and the ultra-miniature MR-11. In situations where a precise beam is needed from a tiny package, these lamps can't be beat.

Incandescent lamps are not the only source getting smaller and more efficient. The standard four-foot fluorescent tube, often criticized for its poor color rendition, cool color temperature, and sometimes awkward size, is being reworked on all fronts.

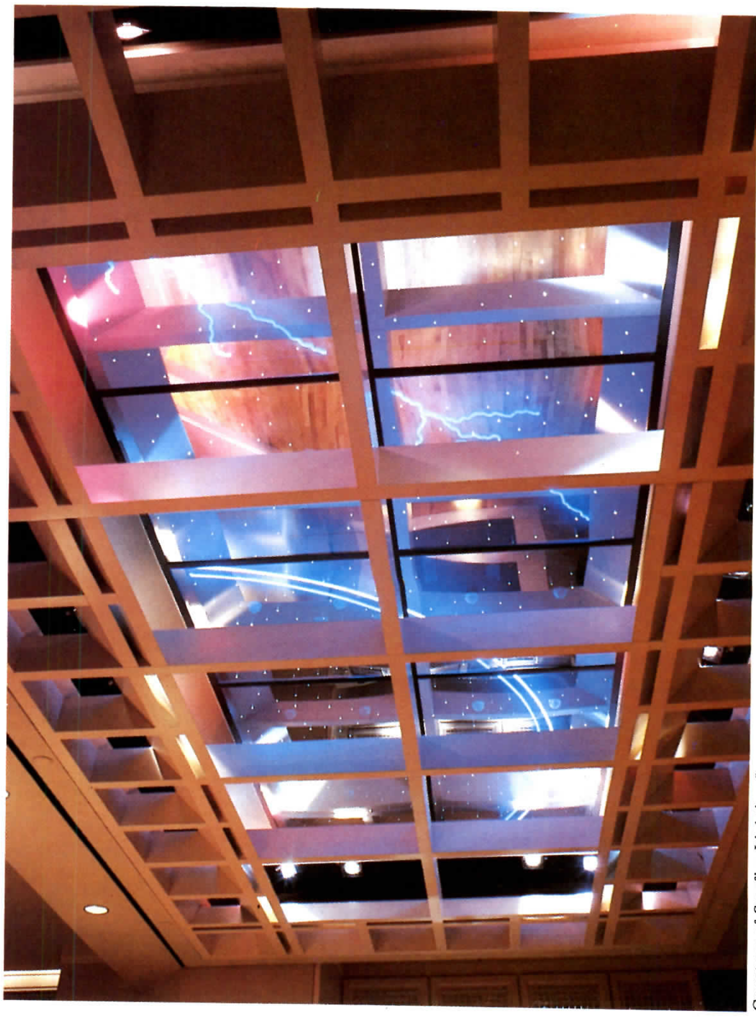
• *Prime colored fluorescent.* Several years ago, a new theory of vision was advanced. It stated that the human eye actually "sees" only three colors: an extreme violet, an imaginary green, and an extreme yellow. The mind then "interprets" all others. This is the theory behind prime colored fluorescent lamps. Using combinations of rare earth phosphors, these lamps give off light in discrete bands of color which the eye interprets as "white." Various mixtures of these phosphors can affect the apparent color temperature as well as the ability of the lamps to render color accurately. Prime colored or tri-phosphor lamps tend to make colors appear more vibrant because all the colors are compressed into the blue, green, and red-orange bands.

• *Compact fluorescent.* Another major advance in the versatility of fluorescent lamps came with the introduction of the compact fluorescent. Also known as the PL or single-ended fluorescent lamps, these units pack a great deal of light into a small package. The standard version consists of a ½-inch diameter T4 tube bent into a hairpin "U." The base contains the starter; the tiny ballast is contained outside the lamp. Wattages range from 5 to 13. The higher-wattage lamps put out an amount of light similar to a 60-watt incandescent for about ¼-inch of the electrical energy. In addition, these lamps last about 10,000 hours compared to the 1,000 hours of a standard A-19. As with all new fluorescent packages, compact fluorescent lamps are prime colored and are available in warm or cool color temperatures.

Over the past two years, the compact fluorescent has been undergoing more changes. One direction has been to pack more surface area into the same overall package size. This is done by placing two "U" shaped tubes together on the same base in a folded "W" configuration. These two tubes are joined into one via a bridge at the base. The end result is a lamp with about

Mr. Cahana is a lighting designer with Wheel Gersztoff Friedman Associates in New York City.

Neon is making a big comeback. At the Lloyd Center Cinema (left) in Portland, Ore., by Broome, Oringdulph, O'Toole, Rudolf, Boles & Associates, neon marquees (designed by the Robert Bailey Design Group) define the interior and announce the 10 theaters in a way reminiscent of movie palaces of the past. Below, an architectural wooden framework covered with two-way mirrors acts as a concealing device for the lighting and sound system over the dance floor of the 'Encounters' club, in the Doubletree Hotel, Tulsa, Okla. In daylight the ceiling appears to be a decorative trellis; at night neon fiber optics, quartz pin-spots, and down lights combine to create an active, exciting ceiling. Interior design by Frank Nicholson & Associates, Boston. Lighting design by Starfire Lighting Inc., Jersey City, N.J.



Courtesy of Starfire Lighting Inc.

twice the output of the standard single-ended fluorescent. These "D" lamps (for double) are available in 10 to 26 watts, with the 26-watt version designed to replace a 100 A lamp. A second version of this lamp is designed to be used with electronic ballasts and dimmers. As of this writing, no dimmer has been marketed for these lamps. It is, however, only a matter of time.

An alternative to compressing compact fluorescent lamps has been the move to extend their length. Recently introduced by General Electric and Osram are the "Biax" and "Long Compact" lamps. These are available in 18, 24, 36, 39, and (as of January 1987) 40 watts. The longer lamps are about half the length of a standard F40 fluorescent and have a tube about ⅝-inch in diameter. The new 40-watt version is designed to be used in a 2x2-foot troffer, replacing the older U-lamp with longer-lived (about 20,000 hours) and better-colored lamps. Currently these lamps are available in 2,700, 3,000 3,500 and 4,100 degrees Kelvin, depending on the manufacturer. And they have a color rendering index of 86.

• *Compact metal halide.* Osram has been an innovative lamp manufacturer in the high intensity discharge field as well. Its HQI metal halide lamps are beginning to bring this genre of light source out of the cold, as well as redefining its use out of doors. One of the reasons for this is the very compact size of the double-ended HQI. With an overall length of under six inches and about a ¾-inch diameter tube, this package can fit into a very small housing. Even more important is the small size of the arc, which allows for a more precise reflector than was previously possible. In addition, the wattages have been brought down to a manageable level. The double-ended HQI is available in 70 or 150 watts. The 70-watt version gives off about the same amount of light as a 300-watt incandescent and lasts about 15,000 hours.

• *Neon.* Some of the exciting new light sources are not new at all, but are simply making a comeback. Neon is a prime example. Once the emblem of sleazy roadside inns, neon and cold cathode sources are being revitalized as elegant, attractive architectural statements. The ability to "draw" a thin line of light in a large variety of colors can be very appealing to the architect lighting designer. Neon can be used to create the definition of a space, to develop focus, or to draw the eye along a particular plane. Many visual artists are now using neon as their medium, both as gallery and urban art. Neon is a flexible, versatile, and long-lived source that should not be overlooked.

• *Electroluminescent.* Another source just beginning to experience a resurgence of interest is electroluminescence. Research in the late 1950s into EL lamps held the promise of luminous walls and flat TV screens. After several years of exuberance and development, the realities fell short of expectations, and electroluminescent lamps all but disappeared. Today's EL lamps are produced primarily for the government and the aircraft industries, where a thin, light, low energy consumption source is necessary for indicators and instrument readouts. However, the world of architecture is beginning to re-evaluate the usefulness of this versatile lamp.

Electroluminescent lamps can be produced in just about any size, shape, and color. They are extremely thin (about 1/3500th of an inch), immune to weather, produce very little heat, and have uniform illuminance over the body of the lamp. They have a low surface brightness (on the order of 20 foot-lamberts at 115 volts) but can be ideal for backlighting graphics and outdoor signs or for low brightness decorative lighting.

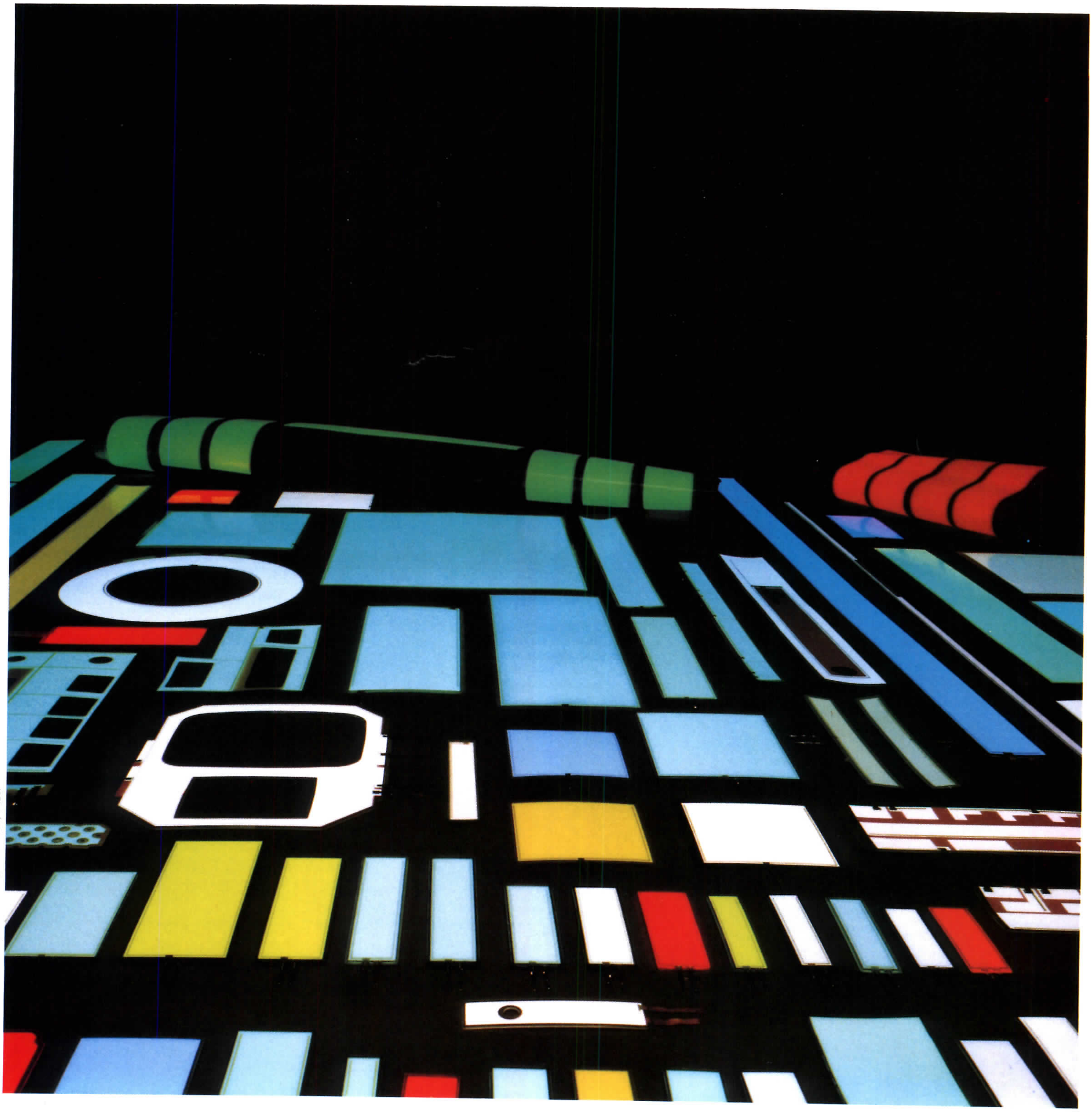
According to David Emmett, founder and president of Panel Light Corp., a manufacturer of a metal-ceramic (as opposed to a plastic) electroluminescent product, EL lamps are being seriously investigated for use in casinos such as the Trump Castle in Atlantic City. One such project under consideration is a giant display of coins, all back-lit by an EL panel. Also under consideration is a decorative light base for use around the casino's slot machines.

• *The future.* Predicting the future of any industry or technology is tricky at best. Certainly the development of other industries will affect lighting products. As lasers become more common and less expensive, we may begin to see wider applications in architectural lighting. Holograms, although not strictly lighting products, are another form that may become more common decorative elements. Radio and microwave powered lamps are already a reality, although not yet in production (with the exception of ultraviolet lamps.) These lamps will be similar to high-intensity discharge sources, but with a purer spectrum and no blackening of the lamp. This will be possible because the lamp will not have electrodes, but will induce the arc with controlled radio or microwave transmissions. The promise is, according to one developer, for a "clean, cool, controllable, stable, flexible, reliable, safe, and long-lived" light source. □

Courtesy of Starfire Lighting Inc.

Courtesy of Starfire Lighting Inc.

Tiny quartz MR-11 flood lamps in an adjustable 2x2 housing (at left, top), are tilted slightly to create a scalloped effect on the walls. The Prime Design Group, Fairfield, N.J., used halogen sconces to provide the fill light. A chandelier of low-voltage sources in long, clear tubes (at left, bottom) provides sparkle and a visual center for Choung's Restaurant in Garden City, N.Y. Today's electroluminescent sources can be produced in a wide variety of shapes, sizes, and yes, colors (below).



Courtesy of Luminescent Systems Inc., Lebanon, N.H.

Low-Voltage Lighting—It's Everywhere

Linear systems give architects a new option.
By H. L. Lee

In the electrical trade, "low voltage" has historically referred to 120-V circuitry, as opposed to 220 and higher voltages. But in the past decade or so, a new concept of "low voltage" has gained rapid recognition and widely increased use in public buildings, private homes, commercial establishments, the theater—in fact, everywhere that lighting is used. The "new" low voltage—12-V and 24-V circuitry—uses miniature light sources as opposed to larger heat-producing line-voltage lamps, and is operated by transformers plugged into standard voltage lines. Energy efficiency is a major advantage to low-voltage lighting, especially in today's conservation-minded economy. Twelve-V incandescent lamps can provide up to 40 percent more light output per watt consumed than do conventional 120-V incandescent lamps, and quartz low-voltage lamps are even more energy-efficient. This results in less lamp energy being converted into heat within a building, and less energy expended by a cooling system to remove that heat—a double saving in energy during warm weather.

The safety factor is another important consideration. Low-voltage transformers reduce 120-V line-voltage to a safe, shock-free 12 V, making the miniature fixtures safe to use even in wet locations, indoors or out.

Low-voltage lamps provide a whiter light than their 120-V counterparts, and because the 12-V lamp filaments are substantially stronger than those in 120-V lamps, they are more resistant to shock or vibration and usually have a significantly longer operating life. Moreover, the miniature size of low-voltage fixtures and systems enables them to be used in areas where conventional fixtures simply won't fit.

A history of low-voltage applications

The first practical applications for low-voltage lighting were in automobiles, since the miniature lamps can be operated from automotive engine current. Then, as the popularity of recreational vehicles increased, low-voltage lighting found new applications in trailers, boats, and motor homes. Soon, landscape lighting also became a viable and growing market for low-voltage fixtures because of their weather resistance and relative safety even in such wet locations as swimming pools.

The selection of fixtures grew as the range of applications expanded into home security and landscape lighting. The original plastic-spotlight type of low-voltage lighting yielded to attractive, sturdy, and natural-appearing fixtures in redwood, cedar, or earth-tone aluminum. Spotlights, always popular, now offer a selection of controlled-beam patterns, and are supplemented by area lighting, stake-mounted garden lights, post lights at a variety of heights, wall-mounted fixtures, hanging fixtures, tree lights, wall-wash and direct-beam lighting—all in a wide selection of styles.

Where glaring outdoor lights once discouraged trespassers—and blinded guests—now soft, inconspicuous low-voltage lighting defines walkways and steps, illuminates entryways, emphasizes special landscape features, and performs area light-

This article was adapted with permission from Lighting Design + Application. *Mr. Lee is vice president of marketing with Sylvan Designs, Inc., Northridge, Calif., and has been studying low-voltage lighting applications for 30 years.*

ing around swimming pools and in gardens. Landscapes can now be as eye-appealing after dark as they are in the daylight.

Bringing low-voltage lighting indoors was the next logical step. Because of their small size and easy, conventional installation techniques, low-voltage fixtures are ideally suited for areas where conduit can't be run, where limited power is available, or where access is severely limited. Many low-voltage architectural lights can fit within normal 2x4 framing space in areas too confined for the larger line-voltage fixtures.

Once again, availability of unusual low-voltage fixtures broadened to meet an increasing market. Miniature 12-V fixtures with lamps sized from six to 50 W can now be acquired in surface-mounted, semi-recessed, or recessed styles; fixed or adjustable; and with a variety of light patterns minutely controlled by specially designed reflectors and baffles.

Low-voltage lighting types

Low-voltage lighting is being used today for task lighting, for special effects, for ambient or background illumination, for decorative designs, and for displays and signs. It washes walls, creates softly lighted and low-key environments, pinpoints dramatic decor, selectively lights small areas, defines traffic areas, provides reading nooks, draws the eye to paintings and objets d'art, illuminates cabinets and display counters, and even recreates a night sky on indoor ceilings. In short, miniature low-voltage fixtures, which require no bulky shades, filters, or masks to control light, have widened the creative horizons of lighting designers.

A departure from the individual fixture approach to low-voltage lighting is the flexible ribbon lighting system: a series of .4-W subminiature bare-bulb lamps mounted on a clear plastic-covered conductor ribbon. Offered in 12-V and 24-V versions, the ribbon lights can be ordered with two- or four-channel construction, and, for most reliable operation, should be wired in parallel.

The outstanding feature of the ribbon lighting system is its flexibility. The ribbons of light can be draped, twisted, bent, angled, hung, or used in any manner the imagination can devise. Installation is equally versatile—the low-voltage ribbons with their "buds" of light can be pressed in place with their adhesive backing, stapled, taped, glued, intertwined, or suspended. Individual bulbs are spaced on the ribbon to customer specification and can be removed or replaced or relocated within seconds.

Ribbon lighting can be used to outline windows, picture frames, or displays; to create sparkling patterns or messages; to cascade from planters, provide a graphic, or direct traffic flow. They bring glitter to restaurants, home bars, discos, and showrooms; twinkle in trees or on ceilings; and can be used with light pattern controllers to give an effect of motion. The limitless range of imaginative ribbon-lighting applications is demonstrated by their current use for decorating theatrical costumes, outlining bird cages and parasols, and overlaying ribbons for light concentration.

Linear low-voltage lighting is a ribbon-lighting system modification, where the flexible light ribbon is placed within a semi-rigid aluminum channel, backed by a light-diffusing reflector and protected by a curved acrylic lens. The combination of non-metallic reflector and snap-in lens provides maximum light dispersion, so there is no individual light "bloom." The three-sided aluminum channel permits the linear ribbon of light to be mounted on any of three planes, to direct light up, down, inward, or outward. And since two of the planes are at a 90-degree angle to the other, the design permits smooth mounting in corners.

The newly introduced low-voltage linear lighting channel is especially popular for coffer lighting, in cabinets, around shelves, for illuminating displays and stairways, for framing areas of special interest, in recessed or cove lighting, and other imaginative task-lighting applications, both interior and exterior. It is presently being used in showrooms and advertising displays as well as in private homes and commercial and public buildings.

Using tiny .84-W lamps, tubular lighting systems allow unusual lighting applications, since the streams of lights are inherently protected from environmental damage, shock, or vibration. Subminiature lamps on O/C spacing from two inches to 12 inches are enclosed in transparent tubing of either flexible vinyl or semi-rigid polycarbonate. The tubing is evacuated and filled with nitrogen gas to eliminate moisture condensation and oxidation. Parallel wiring is preferable for tubular lighting systems so that current can bypass burned-out lamps and keep the rest of the lights in the series operating.

Tube lighting is often used in corners and around arches, and because of the protective tube, can be used for pool lighting and in advertising displays where the light system may be vulnerable to vandalism. In some more unusual applications, the tubular lights have been set into channels in floors, along stairways, under bannisters, and beneath stepping stones in decorative reflection ponds. Like most of the new low-voltage lighting systems, the use of tube lights is no more limited than the lighting designer's imagination.

Adding a new dimension to light

One of the great advantages of four-channel low-voltage ribbon, linear, or tubular lighting systems is the potential for adding the illusion of movement to light arrays. Micro-processor-operated light controllers can program lights to create distinct or random patterns at varying speeds. By using several controllers as "slaves," several different patterns can be operated at the same time. This facility has been popular in commercial and public buildings, where lights appear to cascade like water, dart backward and forward, or indicate directions. Some controllers are small and light enough to be hand held, and are easy to install and program, making light with movement a practical option for almost any low-voltage lighting design.

What was, in the past, a system for lighting trailers or sidewalks, has today become an imaginative, valuable resource for the lighting designer. Today's new low-voltage lighting fixtures and systems are not intended to be a wholesale replacement for line-voltage lighting. Instead, they offer an inventive solution to space- and energy-saving problems, a practical and attractive technique for area or task lighting, and a new medium for decorative lighting design. The potential for innovation and originality is virtually unlimited, and designers across the country are proving it daily as they create sparkling new effects with low-voltage lighting. □

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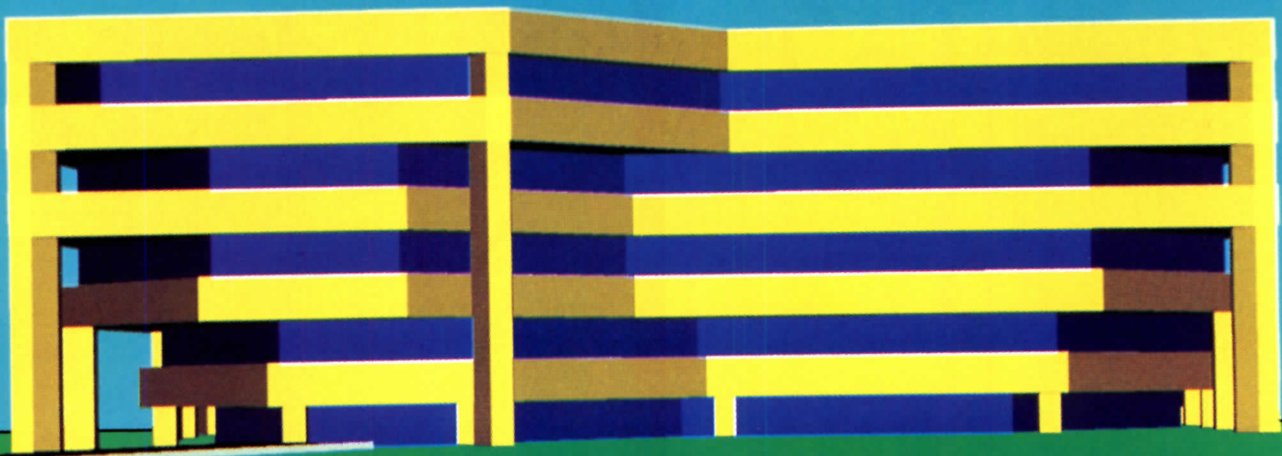

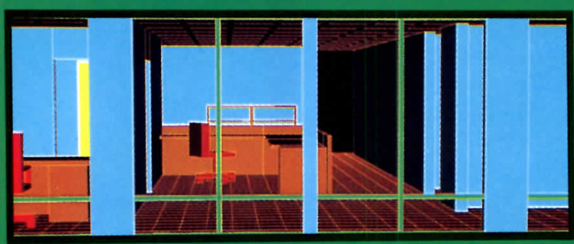

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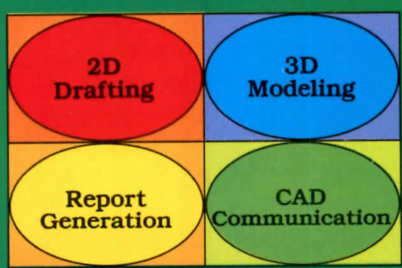

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Affordable CADD: 1987 Update

This year the key word is integration.
By Oliver R. Witte

ARCHITECTURE magazine's continuing evaluation of affordable alternatives in computer-aided design is now three years old, and the teams of evaluators assembled to sort through the confusing combinations of software and hardware are no closer to consensus on which system is best than when they started. Indeed, they may be further apart.

Each day, it seems, brings the announcement of a stunning new product or improvement to an existing product. The range of choice is widening, not narrowing, and the preferences of the evaluators have grown correspondingly diverse.

Fueling this proliferation of products has been a sales explosion as designers begin to discover the value of CADD. For example, Autodesk—the sales leader—has sold 75,000 programs in the past five years. Half of those sales were made last year. Cadvance sold 2,500 programs last year, two and a half times more than the previous year. Point Line tripled its sales last year, compared to 1985.

In this hotly competitive environment, the best CADD software or hardware may be the one most recently released, and it probably will be leapfrogged by the next release of its competitor. In some areas, such as graphic boards, the technology is moving so quickly that distribution and software support cannot react fast enough.

Despite the lack of agreement, one conclusion remains reassuring for architects who have been waiting in vain for one system to emerge triumphant before they take the plunge into CADD: The evaluators tend to prefer the programs that they have. Given the opportunity to switch, they'd rather not. This means that architects who choose any of the leading programs probably won't go too far wrong.

CADD programs included in this evaluation are Autocad, Cadvance, Datacad, Drafix, Megacadd, Personal Architect, Point Line, and Versacad. Details on them and the evaluators currently participating in the program appear on page 98.

Our method for comparative evaluation of CADD software and hardware has been in place since February 1984. Each program is placed in the hands of one to three firms, clustered in the Chicago area for reasons of synergy. The firms agree to use the program professionally and to report as a team on their experience. Their charge is to act as surrogates for the profession, not as advocates of any product.

The evaluators met for what has come to be called Round I of Affordable CADD in May 1984. Each team took turns showing the other teams the strengths and weaknesses of the system they used. The results were reported in the fall 1984 issue of ARCHITECTURAL TECHNOLOGY. An update followed in the winter 1985 issue. Round II took place in October 1985, with publication of the results in the January/February 1986 issue of ARCHITECTURAL TECHNOLOGY.

This article, an update to Round II, is based in part on a Dec. 3, 1986, meeting of the 14 current evaluators. For the first time, CADD software vendors were invited to demonstrate the enhancements they had made to their programs during the previous year.

The most significant conclusion reached by the evaluators was that CADD vendors have increased the speed and power of their products while maintaining or reducing prices. For example, a year ago Version 1.0 of Personal Architect cost $10,800; today, a much improved Version 2.0 lists for $7,900.

Drafix, generally acclaimed as the "best buy" in CADD software at $295, now runs on a $1,200 Atari 1040-ST color computer that is more powerful than the IBM-XT that was used to run the programs in Round I. Both Autocad and Versacad have introduced low cost versions that compete with Drafix, but most other programs priced at less than $1,000 have not found favor with the evaluators.

The results of the current update bring into question the value of a small architectural firm spending more than $9,000 (list price, plus plotter, training, and installation) on CADD. Even evaluators who have been using their CADD systems for more than a year confess that they still are tapping only a fraction of their systems' capabilities.

So why spend more? The answers may be irresistible: a "brand name" computer, speed, true 3D, solids modeling, more RAM and permanent storage, a modem to transfer files by phone, a laser printer for sharper presentations, upgraded equipment, convenience, and the little software utilities that computer users buy one at a time and then can't figure out how they got along without.

Although it's possible to upgrade as you go, looking ahead will save money by avoiding unnecessary redundancy. For example, why buy a small internal hard disk and tape backup for the computer when a Bernoulli Box offers the storage, flexibil-

This article, and the product-specific comments it contains, are based on an evaluation process initiated by ARCHITECTURE *magazine that places computer software in the hands of registered architects for review.*

ARCHITECTURE *does not endorse any product, nor, for that matter, does the American Institute of Architects. AIA, as a matter of record, acts as a distributor for one of the products evaluated. That relationship has never and will never influence the editorial contents of this magazine.*

For their significant help with this year's evaluation program, the magazine thanks the Chicago Chapter/AIA and vendor representatives Sam Stellato and Jim Bliss.—M.B.R.

ity, safety, and security that you're going to need soon? And why buy a 16-color graphics display when you know you're going to need 256 colors to do solids modeling?

The key word this year is integration. Evaluators are losing interest in long charts comparing which programs have this feature or that. The point, they say, is how productively the features have been integrated with each other. Analysis based on which program has the most features may be misleading, they say.

The integration that interests the evaluators most is 2D and 3D. Most of the top programs now appear generally comparable in their 2D capabilities, so the issue turns to which program offers the smoothest two-way movement between 2D and 3D.

Getting full value from both functions requires the ability to take a set of plans and generate a model, study the spatial relationships, make changes in the plan, and reconsider the new effect.

"I always thought I was good at thinking in 3D, but as I walk through a computerized model I see interferences and details I don't like," said evaluator Robert Babbin. "These new programs present the possibility of doing much better architecture. We're at the threshold of an entirely new technique for designing buildings."

Walter Hainsfurther, AIA, was similarly enthusiastic. "Architecture is a 3D art," he said. "You must be able to see that way. Even clients relate better to perspectives. But the ability to see opportunities in 3D and make changes immediately in the plans is exciting."

Edward W. Wenzler, AIA, believes that the real productivity gains with computers are to be found in 3D functions, not 2D. Generating a perspective by hand, either for study or for presentations, can take him a day or more and yields only a single drawing, he said. With a computer, he can get all the perspectives he wants in a couple of hours.

Because of the limitations of wire frame models, CADD vendors have been giving more attention to showing surfaces in 3D. But realistic representations and acceptable speeds require another step up in hardware and software costs.

The color graphics adapter (CGA) card and monitor used for the Round I presentations listed at $925 from IBM. It displayed four colors with a screen resolution of 320x200 pixels.

By the time of Round II, most evaluators were using an enhanced graphics adapter (EGA) card and monitor from IBM. It presents four times more colors at twice the resolution for almost the same price. An EGA-compatible card from Quadram and a monitor list for less than $1,300. Deep discounts are readily available, and the QuadEGA+ card offers users a choice of three other functions (high and low resolution monochrome plus CGA emulation).

But even 16 colors no longer suffice for applications that involve surfaces and shading. Satisfactory rendering and acceptable speeds require a professional graphics adapter (PGA) card and monitor, capable of presenting 256 colors at a resolution of 640x480 pixels.

Today the list price of a good PGA compatible display (graphics card and monitor) like the VMI 640 is $2,090. The reason why this price is a good value has to do with the difference between "dithering" and "polygon fill."

Versacad prefers to show its solids modeling capability on a 256 color display primarily because it refreshes the screen a dozen times faster than on a 16 color display. A drawing that would appear in three and a half minutes on an EGA takes 17 seconds on a PGA. To represent shading with fewer colors, the software must specify which pixels are to be lighted on the monitor. To represent shading on a 256 color display, the software merely specifies the colors. Lighting pixels, which is dithering, takes much longer than specifying colors, which is called polygon fill.

The VMI 640 also is fast enough to keep up with the new 80386 microchip. VMI's older 8820 graphics board, which used to cost $3,990 plus monitor, now is available for $1,000. Also PGA compatible, it works at speeds up to 10 mHz, which is all most IBM-ATs can manage.

Every office big enough to have a director of design soon will insist on a monitor that measures 19 inches diagonally and has a resolution of at least 1,024x768 pixels. Design directors will argue that they need the larger screen and higher resolution to be able to review large drawings quickly. Smaller screens or lower resolutions waste a lot of time zooming in and out because it is difficult to see an entire drawing clearly. One of the leaders in large screen technology is Vectrix Corp. of Greensboro, N.C. Its PePe is one of the fastest and highest resolution graphics boards for large monitors.

The computer itself packs much more power today at lower cost. The IBM-XT that was used to run the programs in Round I was priced at $4,900 with 640K RAM memory, a 10 megabyte fixed disk drive, and a 360K floppy disk drive. The IBM-AT of today uses an 80286 microchip, runs 40 percent faster, and has triple the storage capacity. Its list price is $5,500, but most CADD users speed it up still further with faster processors and co-processors from Ariel Corp., Flemington, N.J.; Megahertz Corp., Salt Lake City; or Microway, Kingston, Mass.

Megahertz charges $125 for its AT Turboswitch II. It permits operators to select the fastest speed at which their computers will operate, up to 12.5 mHz. The AT normally runs at 6 or 8 mHz, depending on when it was purchased. The speed of the co-processor also is of interest to architects because it performs the mathematical calculations required to display a CADD drawing on the screen. The 10 mHz 80287 co-processor by Megahertz Corp. typically improves drawing speed by about 20 percent. It costs $500.

Of course, many architects are buying computers that are compatible with the IBM AT for $3,000 or less. Charles R. Newman, AIA, favors the PC Limited 286 for its 12 mHz speed (50 percent faster than the current IBM-AT) and its ability to run all IBM software and peripherals.

Caution is needed in buying brands advertised as IBM compatible. Some prospective evaluators who own so-called compatibles discovered that they would not run the desired CADD software.

The next generation of computer, based on the 80386 chip, has arrived in the form of the Compaq 386. John C. Voosen, AIA, never the last to try anything that offers more speed, praises the machine, even though software vendors probably will not convert their programs to take full advantage of its power until an IBM version is announced.

Compaq compatibles like the TA/386 from TA CADD Systems, Worthington, Ohio, already are on the market. The TA/386 sells for $5,995 with 640K, one parallel and two serial ports, a 72 megabyte hard disk drive, and a 1.2 megabyte floppy disk drive. To display Autocad's drawing of St. Paul's Cathedral took 24 seconds on a souped up IBM-AT and 15 seconds on the TA/386.

Extra RAM has become so useful that many architects are buying memory expansion boards. The IBM-AT permits only 512K on the mother board, and this is not enough to run most CADD programs and essential utilities like Sidekick comfortably.

The Rampage board, by AST Research, Irvine, Calif., permits up to two megabytes of memory, a parallel port, and two serial ports for $1,895. Intel's Above Board PS/AT, with up to 1.5 megabytes of RAM, a parallel port, and one serial port, costs $1,095. The effective price of a memory board is narrowed by the need to bring up the available RAM to 640K in any case and by the requirement for serial and parallel ports to serve the digitizer, plotter, and printer.

With the extra memory, the CADD user has access to the speed of a RAM disk or the super-quick pans and zooms controlled by software through display list technology. Of all the vendors who made presentations at the Dec. 3 meeting, only Versacad came prepared to demonstrate both.

A RAM disk is especially helpful to users of programs like Autocad, which keeps parts of the program and drawings on the hard disk. If all the information is loaded into extended RAM memory it can be retrieved faster than by going back to the hard disk. Other programs, like Megacadd, contain the entire program and drawing in basic RAM, so there is a big advantage to having 640K of RAM, but no advantage to having more.

The ever growing appetite for memory also affects hard disk storage. The original XT had a 10 megabyte fixed disk, and Iomega's Bernoulli Box of just a year ago had removable 10 megabyte cartridges. So it was with some amazement that the evaluators noted that Personal Architect and Versacad no longer are able to get the program and drawing files they needed for their presentations on a single 10MB cartridge. Iomega has responded to the growing need for storage by introducing a Bernoulli Box with dual 20 MB cartridges and, more recently, another version with an 80 MB Winchester drive and dual 20 MB cartridges. The price is $2,695 for the 10+10, $3,495 for the 20+20, and $5,495 for the triple drive, plus in each case $280 for an adapter.

Sidekick, the bundle of utilities mentioned earlier, demands a brief explanation because it is almost universally perceived as a lifesaver. With two keystrokes, it provides an architect immersed in a drawing a notepad on which to write instructions, memos, reminders, etc. Two more keystrokes bring up a

Comparing Apples and Oranges

All of the programs under evaluation are for use with IBM or like hardware. But a growing number of architects are taking a look at Apple's Macintosh as an alternative.

With the addition of the 20SC hard disk (the so-called "scuzzy drive"), the Macintosh now operates fast enough to do serious CADD, word processing, spread sheets, and financial management. And with more and more software developers writing for the machine, the variety and quality of applications is sufficient to satisfy the needs of most offices.

For presentations, the Macintosh is the only computer system that permits CADD graphics, business graphics, typeset-quality text, and headlines to be merged on the screen as they will look on the printed page. On the Macintosh, the weak link is CADD. On the IBM, any integration is difficult, and the result of anything less than extraordinary effort is unsatisfactory.

The graphic concept of the Macintosh has always held a unique appeal to architects. The system's design is distinctly visual and appeals immediately to any right-brain oriented user. And Apple is simple.

However, Macintosh CADD software is probably 18 months behind IBM CADD software. Macintosh CADD software is buggy, slow, generic, and all black on white. No specifically architectural CADD programs are available yet.

Nevertheless, the Macintosh world is worth watching because Apple is getting close. The company's new management has made two decisions that should affect architects soon: (1) Apple will co-exist in the IBM world, and (2) Apple will make a major effort in the area of desktop engineering (which includes architecture). Co-existence means the introduction of networks to tie together the two machines, a concept that must have struck the company's founders as like mixing apples and oranges.

Two Macintosh CADD programs were invited to make presentations at AIA's Dec. 3 Affordable CADD meeting. They were EZ-Draft by Bridgeport Machines and Mac3D by Challenger Software. The evaluators, mostly born and raised on IBMs, were not impressed. They thought the software was more than a little green. But they were delighted to see an alternative to IBM.

Only a few CADD programs so far show the promise of developing into architectural tools. They are:

- EZ-Draft by Bridgeport Machines, 2500 Office Center, Maryland Road, Willow Grove, Pa. 19090, phone (215) 659-5055. At $2,500, EZ-Draft is the most expensive CADD program for the Macintosh.
- Mac3D by Challenger Software, 18350 Kedzie Avenue, Homewood, Ill. 60430, phone (800) 858-9565. In Illinois, call (312) 957-3475. $195. Evaluator John C. Voosen, AIA, tried several programs and described Mac3D as having "a lot more meat and potatoes to it" than some others.
- MiniCAD by Deihl Graphsoft Inc., 3246-K Normandy Woods Drive, Ellicott City, Md. 21043, phone (301) 461-9488. $395. Rapidly maturing, it now supports parallel line walls, layers, and an internal symbol library.
- Pro3D by Enabling Technologies, 600 S. Dearborn Street, Chicago 60605, phone (312) 427-0408. $349.
- MacDraft by Innovative Data Design, Suite 8, 1975 Willow Pass Road, Concord, Calif. 94520, phone (415) 680-6818. $269. Similar to Apple's MacDraw program. The company said it has sold 28,000 copies, 65 percent to architects.
- MacCAD from CompServ Co., 800 Freedom Lane, Slidell, La. 70458, phone (504) 649-0484. Libraries of templates that work with MacDraw, MacDraft, and MiniCAD. The prices are $139 each for the commercial and layout templates, $119 for the residential templates and $49 for a toolkit. This helpful company also makes MacPlot, a group of 50 plotter drivers, for $325.

calculator. Not being able to use Sidekick with Drafix is a serious handicap.

Networks that allow multiple users in the office to share files electronically remain controversial among the evaluators. Voosen and Newman disagree about almost everything, and networks are no exception. Voosen prefers the simplicity of sharing files by simply handing a disk to a colleague. Newman worries about having several different versions of a design in existence simultaneously. A network provides better control and offers everyone access to the same data, libraries, etc., he contends.

Sharing files between offices is getting easier. Drawings can be transmitted over telephone lines through devices called modems. Autocad's DXF format has been adopted by most CADD vendors and provides a more or less satisfactory common language for different programs. Modems have declined in price and gained in speed. Because CADD files can be quite large, modems that transmit at 300 baud are unacceptably slow. A better choice would be 2,400 baud.

Most evaluators prefer external to internal modems. Offices with more than one computer don't want to be limited, and an external modem is easier to move from computer to computer than an internal model. Further, an internal model can confuse the computer about its port configuration. Only two serial ports are permitted, and most architects already have them committed to the digitizer (or mouse) and plotter. An external modem, like the digitizer and plotter, comes with a cable that can be attached or detached easily, depending on which device is in use. To use an external model simply means unplugging the mouse and plugging in the model. Switching boxes also are available.

With a modem, an architect also can make use of bulletin board services specializing in Cadvance, Autocad, Iomega, and others.

A modem is perhaps more likely than any other piece of external computer gear to require technical support to make it work. Of the three kinds of modems in use by the evaluators, Ven-Tel, Santa Clara, Calif., won the highest praise because of the quality of its technical support. The firm even provides a toll-free number to call for help: (800) 538-5121. Ven-Tel's 2,400 baud model is priced at $600 including software or $475 without software.

Newman and his teammate, Charles Grant Pedersen, AIA, have experimented with transferring Versacad files between their offices using Hayes 1,200 baud modems and PC-Talk III software. The drawings were exchanged successfully the first time they tried it.

A new and costly piece of equipment that is beginning to make itself indispensable is the laser printer. The price range is $2,000 to $6,000.

The fastest model is produced by LaserMaster, Minnetonka, Minn. It will generate a 300x300 dot per inch print of Autocad's "nozzle" drawing in less than 30 seconds. Equally impressive is its superior ability to produce blocks of dense black, a tribute to the Ricoh technology on which the LaserMaster is based. Black blocks produced by most other lasers, which are based on Cannon technology, tend to look streaky.

The LaserMaster seems to have been designed specifically to print CADD drawings. It reads DXF files and has direct drivers for Autocad and Versacad. It also accepts input in such well-known formats as Hewlett Packard plotter and printer and Diablo 630 language. The price is $5,135, including controller card, drivers, and utilities.

In addition to producing quick prints of CADD drawings, LaserMaster can merge text and graphics with more than a dozen type styles and sizes. Its value as a marketing tool for producing eye-catching presentations and transparencies makes it worth the price.

A hybrid printer/plotter by JDL also has caught the eye of the evaluators, especially in its earlier, Model 750 version. It produces 180x180 dot per inch drawings in 14 colors on 17x22 inch paper. Versacad and Autocad have drivers for it. The current, 850 version is compatible with the Hewlett Packard plotter format. As a printer, it does high quality word and graphics processing.

Babbin snapped up the earlier model as a bargain at $1,850, but he's less certain about the current model, which costs up to $3,895. It's getting rather close in price to the new Hewlett Packard 7570A plotter, which holds eight pens and produces D size drawings (24x36 inches) for $5,400.

Meanwhile, Houston Instrument has been moving to larger plotters. Its new DMP-56 produces E size drawings (36x48 inches) and sells for $5,995.

Nevertheless, the plotter remains the major price and performance bottleneck in most offices. A professional model costs more than any other component of the CADD system and takes the most time. Some evaluators dedicate a small computer just to running the plotter to free other computers for more productive work.

Software developers are trying to ease the time problem by incorporating routines for off-line plotting. They enable the computer to plot "in the background" while the operator works on another drawing. Versacad is among the leaders in this technology.

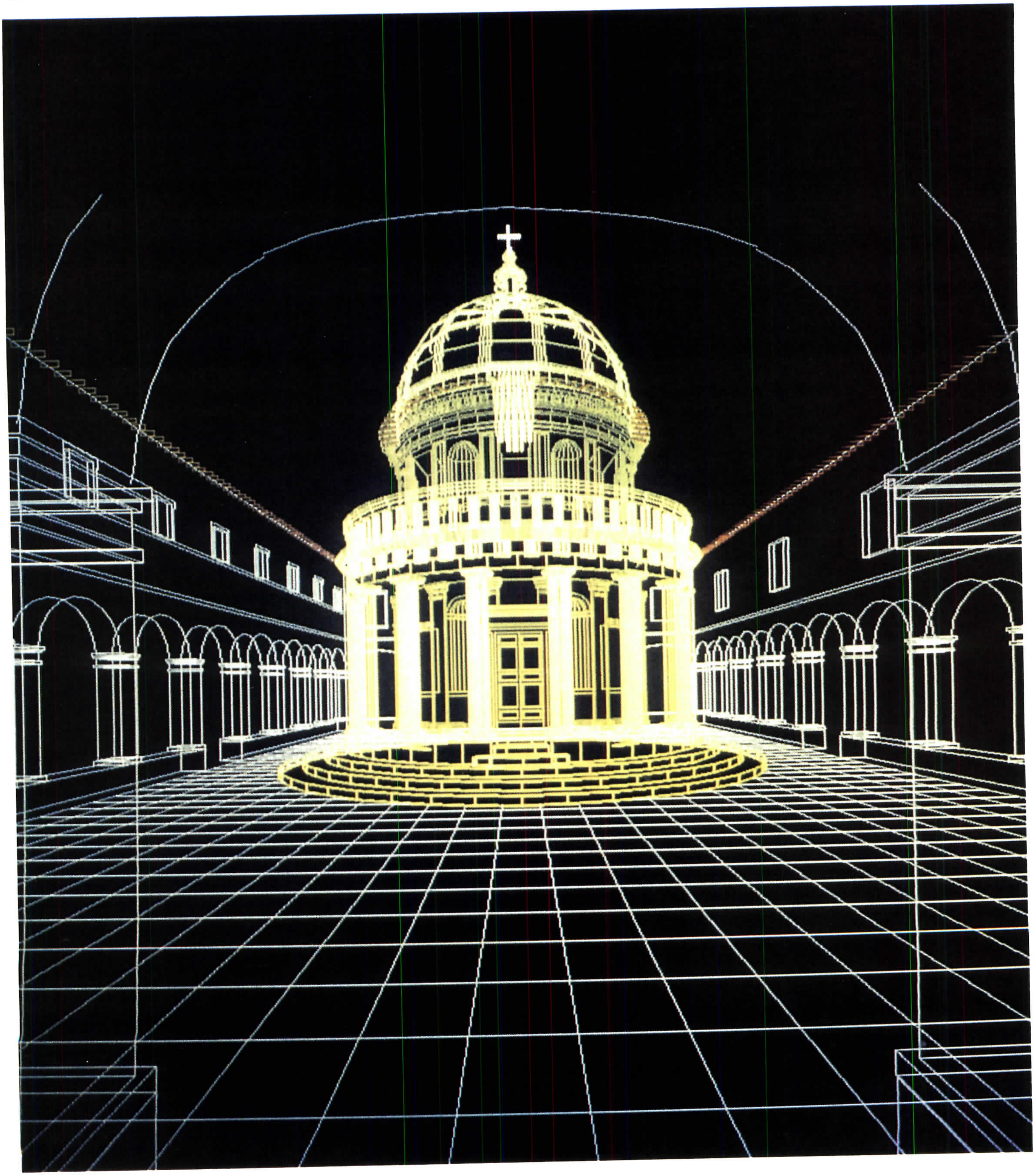
Numerous vendors offer peripheral equipment that attaches to or replaces standard IBM computer components. One of the most useful replacements is the Keytronic KB 5153 keyboard. Built into the keyboard, just to the right of the numeric keypad, is a touch pad that can do triple duty as a mouse, digitizer, or macro template. It permits even a finger to be used to select macros or control the cursor.

Because architects are starting to use computers in their presentations, an attempt was made to run CADD on laptop models, which are much more convenient than the so-called portables. The result reminded us of the proverbial dancing dog: The surprise was not that the dog dances well, but that it dances at all. Datacad Version 2.5 actually loaded into the new IBM convertible, and it actually ran. But the speed is painfully slow, and the squashed screen distorts the drawings.

Technical support, which used to be free (if you could get it), gradually is becoming a commodity with a price. Some software vendors, like Megacadd and Cadvance, are exceptionally friendly, providing even a toll-free number. Others, like Autodesk, prefer that technical support come from the dealer, who may or may not know the program. And a few provide excellent technical support but have started to charge a fee. Versacad, for example, charges $295 for use of its toll-free line after the warranty has expired but continues to answer questions without charge on its regular number.

The point is that prospective buyers should shop as diligently for value in technical support as in hardware and software. A survey of how users whose names were supplied by the vendors rate their technical support was published on page 52 of the January/February 1986 issue of ARCHITECTURAL TECHNOLOGY.

CADD Software Evaluations



Autocad—industry standard

The Autocad bandwagon keeps gathering momentum. It's the biggest success story in the CADD business and its awesome lead keeps growing.

Autocad has become the standard against which other micro-based CADD software is measured. Dozens of CADD programs are making sales simply by claiming they are "just as good as Autocad." Few of them can support that claim.

The drawing exchange format (DXF) of Autocad is becoming an industry standard because other vendors realize that if their files can't be read by Autocad they risk being orphans. Work remains to be done to assure full compatibility.

"I'm leery of DXF transfer files," said Jankowski. "I've gotten abstract art a couple of times. I don't have a lot of hope for taking details from one program and using it in another."

LaserMaster, which has a built-in routine to plot DXF files quickly, has balked initially. But when the file was first copied into Autocad, it printed normally.

In fact, Autocad has become a "passport" program. It supports and is supported by all reasonable computers and peripherals; an Autocad drawing can go virtually anywhere.

Autocad has reached the point that it is making sales not just because it is an excellent program but because it has become the standard. Clients and consultants buy it because their architects have it. And architects buy it because their clients and consultants have it.

More architects in the AIA evaluation have tried Autocad than any other program. They confirm its excellence, if not its superiority in all aspects.

Frank Abatangelo, an evaluator of a program that withdrew after Round II, selected Autocad in preference to any other. Heitzman and Engelke, both evaluators of 3D programs, chose Autocad for their 2D work. Babbin, temporarily frustrated with the limitations of Drafix, selected Autocad.

But even Autodesk, the vendor of Autocad, proved it is capable of self-inflicted foot wounds. In a widely forecast move, Autodesk imposed a use-limiting device on its new Version 2.5. The expectation was that all the pirates who had made illegal copies of the program now would have to buy the new version to keep up.

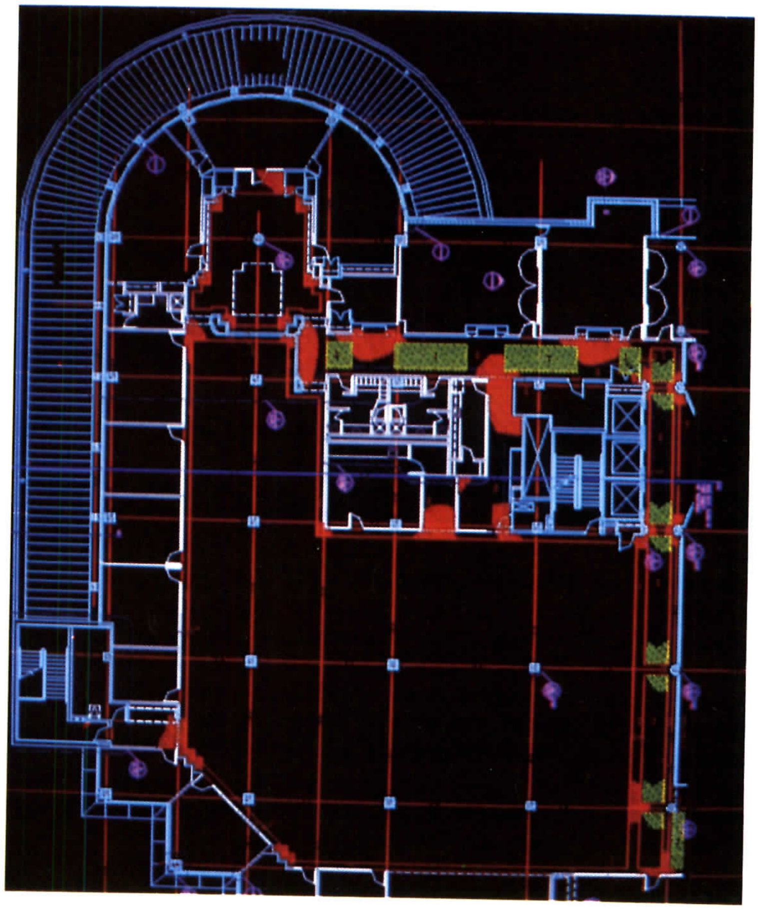
It might have worked if Version 2.5 had been a bigger leap forward. Although sales continued to improve, they did not skyrocket and the use-limiting device was withdrawn.

Version 2.52 provides 70 enhancements over Version 2.18. The most significant is to the architectural template, now called Autocad AEC. The previous version was faulted by most evaluators as slow, awkward, and incompatible with Autocad's flexible philosophy. The new version is getting high marks from the evaluators.

The AEC template takes full advantage of AutoLisp, the programming language built into Autocad. The menu structure has been opened up, making it fully customizable. Architects can now control attributes, scale factors, layer assignments, and shapes.

Response time has been greatly enhanced. Although Autodesk

Datacad's 3D detail is shown in this rendition of Bramante's Tempieto di San Pietro. (The command screen is deleted here.)



This floor plan of an office building was prepared by Potter Lawson Pawlowsky, of Madison, Wis., with an Autocad program.

said its new version supported both expanded and extended memory, neither was demonstrated. Significant increases in speed could be expected to result from either.

The ability to draw parallel line walls and insert doors and windows has been improved significantly, although it still lags behind programs like, say, Cadvance. Walls attributes can now be saved for repeated use without having to respecify them. Autocad AEC also will convert a single line schematic drawing into a double line working drawing by permitting the user to define interior and exterior wall widths.

Users can define spaces by attributes such as square footage and other parameters. Then the plan can be extruded to achieve an axonometric representation.

The AEC template will interface with a forthcoming series of templates for the architect's consultants. The new template to be released will be for HVAC engineers. Along with layer conventions, Autocad anticipates the development of industry standards for the use of Autocad.

Other important new features include undo and redo commands, extended memory support, the ability to mix colors and line types on a layer, and the ability to rescale an object or drawing. New commands include polygon, divide, measure, explode, rotate, stretch, and trim.

Autocad's competitors should study its New Features book-let that explains Version 2.5. The explanations are clear and the graphic examples very helpful.

Although more evaluators are more familiar with Autocad than any other program, familiarity doesn't always produce complete approval.

Babbin found the program "inherently complex, slow, and cumbersome." Responding to a question about how he liked Version 2.5, Hainsfurther said he still hadn't figured out Version 2.18.

Robicsek disagreed, noting that Autocad has sold more programs than all competitors combined in its price class. The universality of Autocad, which makes it easy to pass drawings electronically to both clients and consultants, and the extent of third party support make Autocad the only reasonable choice in CADD software today, he said.

"If IBM is 'Big Blue,' then Autodesk is 'Big Black,'" Robicsek said, referring to the companies' colors.

Voosen, who had rejected Audodesk's previous architectural template in favor of the Cadillac template, called the new Autocad AEC "by far the greatest improvement I have seen in templates." He added, "I like to go to client meetings with both Autocad and Megacadd. When a client asks if he can see the altar from a certain seat, boom, I can put him right there and he can see for himself."

Wenzler, a previous critic of Autocad, said Autodesk had come a long way to make the program work for architects. He had high praise for the way the new AEC template speeds drawing walls and inserting doors and windows. And he called the ability to do quick area bubbles a real plus.

Autocad Version 2.52 is priced at $2,750 plus $1,000 for the AEC template. Installations as of December total 75,000, excluding products like AutoSketch that are not called Autocad.
Autocad, Version 2.52, by Autodesk Inc., 2320 Marinship Way, Sausalito, Calif. 94965, phone (415) 332-2344. Evaluators: John C. Voosen, AIA, and Robert C. Robicsek, AIA, both of Chicago.

Cadvance—still the fastest

The biggest advantages of Cadvance are its speed, ease of learning, ease of use, and architectural heritage. All of those advantages have been strengthened by the three revisions since Round II. No other program is faster at most normal architectural functions. Most evaluators praised it warmly.

Cadvance functions include the ability to slide a door along a parallel wall. Many programs can insert a door more (Datacad) or less (Autocad) well, but in Cadvance the user can slide the door back and forth along the wall, the intersections being cleaned up as it goes, until the operator has the door exactly in the right place.

Lee Schwerin, AIA, said his firm, Holabird & Root, has been running both Autocad and Cadvance. The firm's clear preference is Cadvance because it requires much less training time. Schwerin blamed the difference in part on the manual. The Cadvance manual is succinct, whereas the Autocad manual can be difficult to use, he said.

Version 1.3 of Cadvance is priced at $2,500, including 2D, 3D projections, database extraction, open architecture, and a macro language. An IGES drawing file transfer utility costs $1,600 and a DXF file utility costs $195.

The vaunted speed of Cadvance comes from its integer form of calculation. Theoretically, it is a bit less accurate than the floating point system used by other affordable CADD programs. Thus a rectangle rotated several times will deform slightly. The integer system also requires that the smallest unit be identified in advance, and the number of those units then cannot exceed 65,000, thus limiting either the size of drawing or the tolerance. If quarter-inch units were selected, the maximum size of building that could be entered is 65,000 quarter inches or about 1,350 feet long.

Newman contends that Cadvance's integer system disqualifies it. But James C. Jankowski, AIA, scoffs.

"I've never spun anything more than twice, and on a 6,000 foot site an increment of one inch is close enough," Jankowski said. "What is important is speed and operator productivity. Cadvance is making money for us."

Recent enhancements have strengthened Cadvance's architectural building grids, construction aids, and parallel offsets. The program now offers full digitizer menu support, including macros and symbols. A command to draw a tablet menu also has been added.

Cadvance's ability to compile macros, which it shares with Datacad, increases the operator's productivity.

Macro power and speed of execution have both been improved.

User-defined area textures are now possible. Textures may be made up on any shape, including lines, circles, and text users can edit. Version 1.3 allows five text fonts per drawing.

Use of the program is limited by a device between the input device and the communications port.
Cadvance, Version 2.3, by CalComp, 200 Hacienda Ave., Campbell, Calif. 95008, phone (800) 225-2667. Evaluators: Lee Schwerin, AIA, and James C. Jankowski, AIA, both of Chicago.

Datacad—architectural and intuitive

Architects love Datacad, perhaps because it was written by architects. Its popularity can be summed up briefly: It's intuitive. The program always seems to be a step ahead of the operator. If you're the type of person who expects to sit down and start drawing, Datacad may be for you.

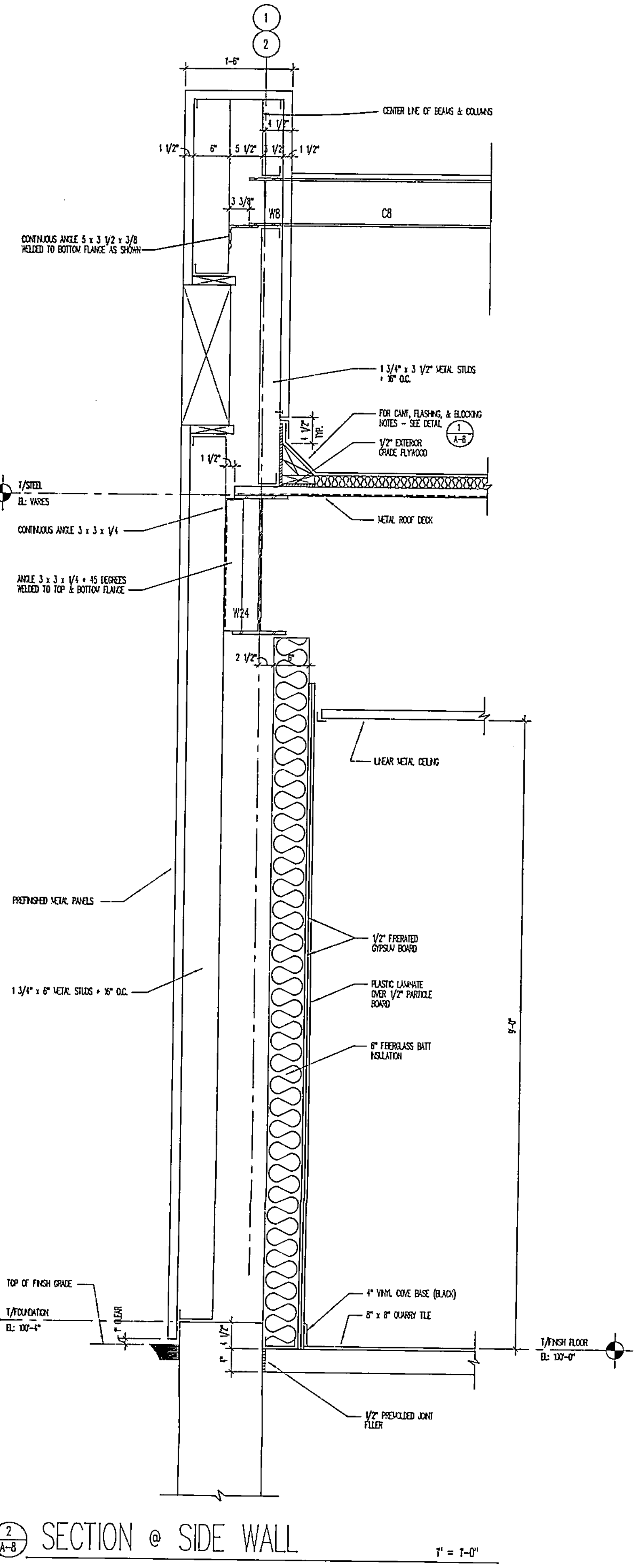
"I loaded it and it ran immediately," said Voosen. "Loading the new version of Autocad took me three hours."

Nevertheless, the enthusiasm that the evaluators expressed for the program at Round II has waned because it was not as aggressively updated last year as others. Once head and shoulders ahead in some respects, Datacad now is seen as one of several excellent programs.

One of the most significant improvements was the addition of a stretch command, Wenzler said. Coupled with associative and automatic dimensioning, it enables the architect to tinker with the sizes of rooms without having to keep changing the dimension lines. The program does it automatically, thereby avoiding a common cause of embarrassment.

Many of the changes corrected annoying glitches in routine 2D drawing functions, Wenzler said. The size of the drawing file, which was too small, has been increased to four megabytes. Symbols made into a group, such as an apartment, can now be searched and replaced. Hatching and text entry, which were buggy, now work well.

The manual, which was average or worse, has been upgraded to good, Wenzler said, although Voosen protested its cheap-looking typesetting and paper. But occasional users can now find answers quickly in it.



The program's 3D-like functions have been improved somewhat, but not enough to make it a leader in this area, and hidden line removal is clumsy, Wenzler said.

For a mainline CADD vendor, Microtecture supports rather few peripherals.

Architects considering Datacad will have to decide if they accept the vendor's dedication to "heads-up" drawing. Although the program does support three digitizers and it does accept keyboard entries, it really is intended to work with a mouse. Symbols and commands appear on the screen to be selected. The effect is to restrict the size of the drawing area on the screen.

The version of Datacad shown to the evaluators was 3.0. It is priced at $2,995 including an architectural library. Users pay $95 each for additional symbol libraries of doors and windows, construction, HVAC, electrical, and plumbing. A DXF file transfer utility costs $495.

Microtecture reports 1,200 sales as of December, 70 percent of them last year.

Datacad, Version 3.0, by Microtecture, 218 W. Main St., Charlottesville, Va. 22901, phone (804) 295-2600. Evaluator: Edward W. Wenzler, AIA, Milwaukee.

Drafix—ultra low cost

Drafix continues to delight the evaluators with its high performance and $295 price. Running on an Atari computer priced at $1,000, it was the hit of the Dec. 3 meeting. Add a mouse and a plotter, and an architect is ready to do serious CADD.

Babbin described it as a "tremendous buy." Hainsfurther called it "truly affordable CADD." The learning curve for the program was "practically nothing," he said. James Lyman, AIA, called the program "incredible" and "just amazing" for the power it could provide at such a low cost. It was the only program he chose to comment on except the one he is evaluating.

Both Babbin and Hainsfurther use Drafix as their CADD program of choice. Nevertheless, after a year, they are beginning to wonder if they have outgrown it. But since many of their needs may have been answered by the latest release (Drafix 1+, Version 1.5), they are suspending judgment until they try the new enhancements.

Their chief need was for a library of architectural symbols. It was just received at deadline for this article, so the evaluators were unable to comment on it. The library has 700 symbols and is offered at $150. Hainsfurther did not see the lack of symbols as a detriment. Drawing symbols, he said, was a good way to get beginners to learn the program.

Drafix 1+, still priced at $295, includes a macro capability that enables the user to assign a series of commands to a function key. Other enhancements include curve fitting, splines, and bezier curves through a series of points or lines. Freehand sketching and smoothing of sketched objects also is provided. Notes now can be added to a drawing with a utility that operates more like a word processor.

Foresight Resources sold 4,000 copies of Drafix last year.

Drafix +1, Version 1.5, by Foresight Resources Corp., 932 Massachusetts St., Lawrence, Kan. 66044, phone (800) 231-8574. In Kansas, call (913) 841-1121. Evaluators: Walter Hainsfurther, AIA, Des Plaines, Ill., and Robert Babbin, Chicago.

Drafix-drawn wall section from Orville I. Kurtz & Associates.

Megacadd—unique 3D niche

That Megacadd has been able to carve out and maintain a unique niche in a crowded CADD market is a tribute to the elegance of this splendid program. It has earned its reputation as the only good, inexpensive 3D program. Easy to learn and easy to use, it was courted by the big 2D CADD vendors who wanted to establish links to it.

But now that the 2D vendors are tying in 3D versions of their own and good solids modeling programs are becoming accessible, evaluators are questioning the future of surface technology and wire frame display.

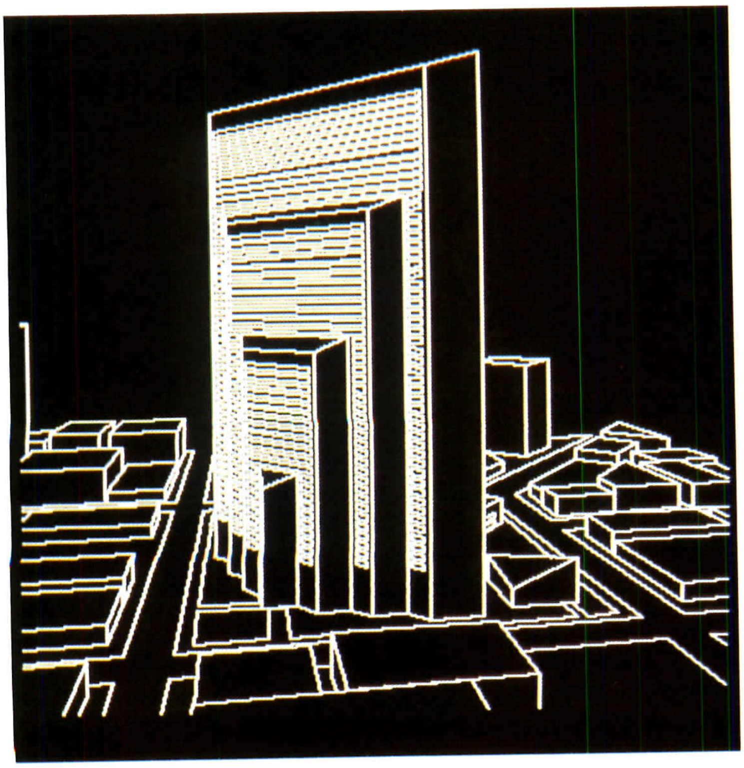
Megacadd disagrees. Until printers or plotters are able to represent color shading more effectively, surface technology will not be obsolete, Megacadd said.

"Some see the phasing out of Megacadd, but I see it as the only affordable CADD program that is 4D," Voosen said. "The fourth dimension, of course, is time. I can set up a fly-through path through a building and pull out up to 1,000 slides. The effect on our understanding of space is fantastic. When clients find they can back up or go forward through the slides they really get excited." The views can be displayed with hidden lines having been removed automatically.

The price of Megacadd's Design Board Professional, Version 3V2.09, is $2,150 for the 640K version. An option, Version 4V1.01 of Illustrator for $395, offers the slide show capability and a paint routine to add color, texture, shading, and text. Version 2V2.09 of Link for $295 enables a Megacadd drawing to be read by the major 2D programs.

"Megacadd is priced so low it's going to be hard to displace," said Hainsfurther. "It's not necessary for 2D and 3D programs to come from the same package, as long as they integrate."

Megacadd allows three-dimensional views with unmatched ability to remove hidden lines automatically, according to reviewers.



Meanwhile, the program keeps getting better. The latest revisions added color, layers, and the ability to work with arcs and fillets. Some more expensive programs still have not matched Megacadd's ability to remove hidden lines automatically, to display the entire model in four active simultaneous on-screen views, and to transfer files to most major 2D programs.

Megacadd's major limitation, still shared by most other programs in this evaluation, is the inability to move from 2D to 3D. Files can be transferred only from 3D to 2D.

Off-line plotting is not available.

Sales (end-user installations) as of December totaled 1,200.

Design Board Professional, Version 3V2.09, by MegaCadd Inc., 401 Second Ave. South, Seattle, Wash. 98104, phone (800) 223-3175. Evaluators: David J. Engelke, AIA, Madison, and Frank E. Heitzman, AIA, Chicago.

Personal Architect—ahead of its time?

Computervision has taken major strides to improve the documentation, ease of use, protection, and price of Personal Architect. Evaluators think they still have a ways to go. Sales total 300, most since April 1986. The price for the drafting and design modules has been reduced to $7,900. An optional surfaces module costs an extra $2,800.

Moving the menu choices from the digitizer template to icons on the screen—a move intended to make the program easier—is controversial among the evaluators. Some liked it; others preferred the digitizer method, arguing that the icons took up too much of the screen.

The protection device now attaches to the parallel port.

The major problem in the minds of some evaluators, though, is more conceptual. Personal Architect intends that basic information about the building, such as wall widths and heights, be specified in advance in a technology file.

Robert C. Robicsek, AIA, contends that this is backward.

"A lot of us don't know that much about a building when we start it," he said.

Babbin saw the specifications as more related to the program's European heritage, which is more design/build than in the United States.

Carol M. Schmidt disagreed with their arguments. "I like the concept, although it may be ahead of its time," she said. "Personal Architect deals with volumes as entities, whereas most of the other programs are more like drafting in 3D, using lines to create walls and roofs. For example, a symbol in Personal Architect is a volume; the others deal with it as group of lines. The drafting module works just fine, but the design module is hard to learn and hard to teach."

Jankowski supported Schmidt: "Personal Architect is a space bubble—a building within a machine. It uses information quickly, but not easily."

The evaluators agreed that the program's complexity was both its strength and weakness. Personal Architect is probably not for the architect who expects to fire it up and run it intuitively, like Datacad or Cadvance. The user must study the manual or call for technical support, and both need help, evaluators said. Use of the program is limited by a device that attaches to the parallel port on the back of the computer.

Personal Architect, Version 2.0, by Computervision Corp., Building 16-2, 2 Crosby Dr., Bedford, Mass. 01730, phone (617) 275-1800. Evaluator: Carol M. Schmidt, Chicago.

Point Line—wonderful but costly

Point Line is the most controversial program in the evaluation. Everyone who sees a demonstration is impressed. Of the eight survivors of Round II, Point Line may be the best, most evaluators believe.

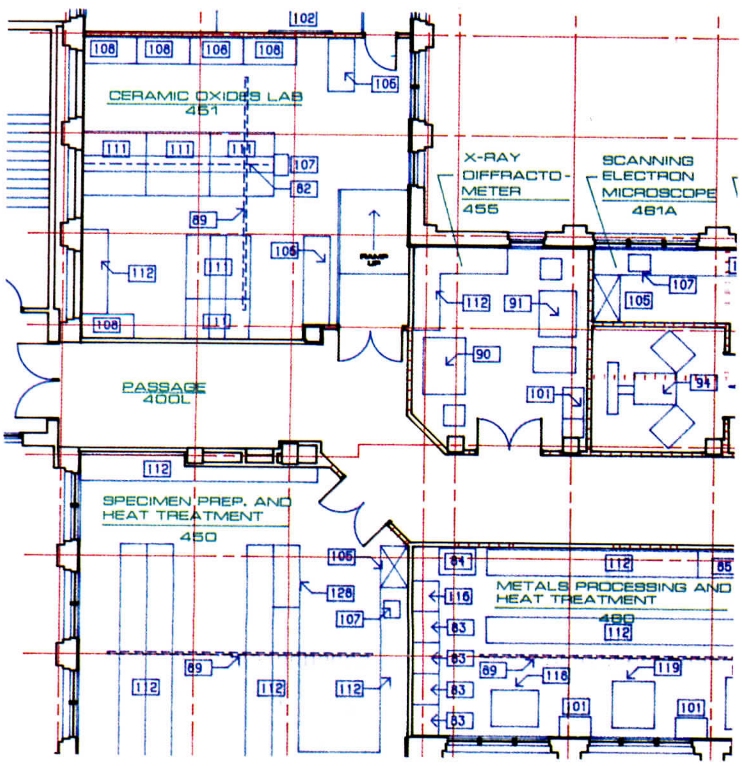
Only Point Line offers instantaneous pans. Even with Versacad, using paged memory, panning is fast but not instantaneous. Animation routines generated from an IBM-AT are eye-popping. Solids modeling is done with geometry not shading, so doors, windows, and pipes can be inserted in walls and removed.

Yet Point Line was the only program in Round II that was unable to attract two volunteers to evaluate it. When that round was over, John H. Hanson, AIA, who evaluated a program that withdrew, was offered an opportunity to switch to any CADD program he wanted. He picked Point Line. A year later, he is so pleased with his choice that he has expanded to two systems.

The major reasons for the controversy are price and the way Point Line handles the hardware that runs it. In its basic configuration, Point Line is not the most expensive program. The 2D module costs $2,995 (a $305 reduction from last year), the wire frame 3D costs $2,000, and the bill of materials costs $1,000. But that's not the end. The program requires an Artist 1 graphics board configured to Point Line specifications, raising questions about its ability to run other programs.

Two monitors also are required, one in color for the drawing and the other in monochrome for the data. This, too, is controversial. The second monitor multiplies the cost and divides the attention. Point Line replies that it makes no sense to fill up an expensive color monitor with data that could be displayed on an inexpensive monochrome monitor. Versacad avoids the controversy by allowing users their choice.

Four-color floor plan of the Engineering Building, Marquette University, drawn on Point Line by Plunkett Keymar Reginato.



To run Point Line as demonstrated to the evaluators calls for another level of investment. The solids modeling program costs $5,000 and requires a Weitek 7100 mathematics processor for $5,500 and a second Artist 1 card for $1,995. The color rendering module adds another $1,500.

The tab comes to more than $20,000 and still does not include a computer, plotter, monitors, and incidentals.

Hanson has the works, but his team member, David J. Rajsich, AIA, does not. He'd like to have it all, but he can't justify the hardware investment.

Sample comments by other evaluators:

"Even more wonderful than at Round II but even more unaffordable."—Frank E. Heitzman, AIA, recalling Point Line's Round II presentation a year ago.

"You might as well buy a mini-computer for that price." —Robicsek.

"Too expensive for this evaluation, even without solids modeling."—Hainsfurther.

Not everyone agreed. "The real cost of CADD is not in hardware and software but in training and effort," Jankowski said. "It's a question of controlling variables. If I have to spend 20 minutes setting up something, it's a problem."

Rajsich praised Point Line's 3D module. He said he has used it for presentations, interviews, and competitions. He credited the program with helping him win jobs. His wish list includes automatic hidden line removal.

The 2D program, on the other hand, lags, he said. It has trouble accessing more than one layer at a time.

Hanson, who purchased all the equipment required to get the most from the software, said he was "totally amazed" at the power of the system. He described it as "fast, fast, fast," with no glitches. Even so, he too has a wish list. On the top of it is being able to move back and forth more seamlessly between 2D and 3D.

As of the end of last year, Point Line had 450 installations. The current version was 2.1.

The way Point Line limits use of its program is through the least favorable technique— a device that occupies one of the precious few slots inside the computer.

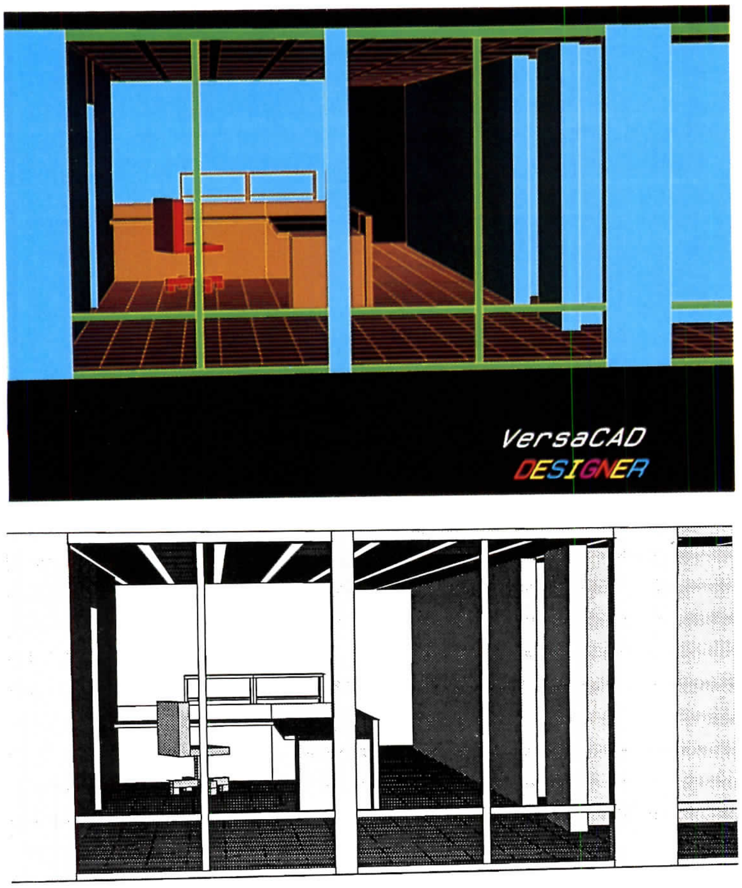
Point Line, Version 2.1, by Point Line Co., 2280 Powell St., San Francisco, Calif. 94133, phone (415) 989-0444. Evaluators: John H. Hanson, AIA, Chicago, and David J. Rajsich, AIA, Milwaukee.

Versacad—most improved

Versacad is the most improved of the affordable CADD programs. If a new ranking were established as of Dec. 3, Versacad would be highly favored. The evaluators felt that Versacad had done the best job to date of integrating 2D and true 3D functions.

More evaluators said they would like to try the new Versacad Designer than any other program. They all took note that Versacad has made a serious and successful effort to develop as an architectural program.

The program was the only one in the middle price arena to take advantage of paged (expanded) memory to support software pans and zooms. This feature enables the designer of a large building quickly to zoom in on one corner of a building, start a line or dimension, pan over to the opposite corner to attach the line, and zoom out to see the whole building and place the dimension line.



The full-color, 3D interior view at top was produced with Versacad. It translates into toned hard copy (at bottom) or color (contents page) when laser printed or four-color plotted.

Version 5.1 is priced at $2,995 and includes a bill of materials, IGES and DXF file transfer, and an off-line plotting utility. A specifically architectural overlay (template) that fits on a digitizer costs another $500. It includes a library of 750 architectural symbols.

"Versacad has fixed virtually everything I objected to in previous versions," said Voosen. "It really intrigues me."

Babbin echoed his enthusiasm.

Beginners can work through screen menu prompts, or experienced users can select functions directly from the template.

Babbin praised the apparently "seamless integration" between 2D and 3D. He also liked the ability to customize the program and build his own menus. Third party vendors have picked up on this ability and Versacad now has enough add-ons to fill a catalog.

Architects with inexpensive equipment will appreciate Versacad's ability to display shaded drawings in 3D on virtually any supported monitor.

Pedersen paid special tribute to Versacad's technical support. "I've tried several CADD programs now," he said. "In each case, I've had to call for help and Versacad is the only company where I've never failed to reach someone who could answer my questions."

Versacad Designer, Version 5.1, by Versacad Corp., Suite 106, 7372 Prince Dr., Huntington Beach, Calif., 94133, phone (714) 847-9960. Evaluators: Charles Grant Pedersen, AIA, Hillside, Ill., and Charles R. Newman, AIA, Naperville, Ill.

New Programs

Is there room for more micro-based CADD programs? The answer, apparently, is yes.

Dozens of vendors have announced or are about to announce new CADD programs intended to compete with the eight discussed in the adjoining article. Four programs that run on IBM-AT and compatible computers have caught the attention of the evaluators. Six others that run on an Apple Macintosh are discussed separately.

None of the new CADD programs has been examined in sufficient detail to enable any of the evaluators to say more than they appear to have potential. The four that will be getting a more careful look in preparation for Round III of Affordable CADD are:

• CAD Solutions, by Sigma Design Inc., 61 Inverness Dr. East, Englewood, Colo. 80112, phone (303) 790-9080. The basic program is priced at $3,000, plus $2,000 for the architectural module, $1,500 for the 3-D modeling, $1,000 for the database management system and $1,000 for the macro and programming language.

• Drawbase, by SKOK Sytems Inc., 222 Third St., Cambridge, Mass. 02142, phone (617) 868-6003. The program is priced at $4,995, including drafting, data management, templates, DXF file transfer utility, macros, and symbol library. The current version is 102. The first installation was May 1986. Sales as of the end of 1986 were 200.

• FastCAD, by Evolution Computing, Suite 106, 437 S. 48th St., Tempe, Ariz. 85281, phone (602) 967-8633. This 2D program, still in beta test, had not reached Version 1.0 at press time although it is being sold for $2,295.

• Solid Vision, purchased last fall by CalComp from an Israeli company, Architecture and Computer Aids. It does true solids modeling in 3D and includes a DXF file transfer utility. Version 2.5 is priced at $3,500 or, if purchased with Cadvance, $4,995. Copy protected.

Cad Solutions—minicomputer heritage

Sigma Design is one of the Blue Chip firms in multiuser CADD systems. Its Sigma II, Sigma III, and Sigma 20 systems set quality standards for powerful design software and hardware. Last fall, the firm released its microcomputer version capable of running on the IBM-AT, Compaq 386, and compatibles.

One of Sigma's first customers for both its mini and micro products was Lester B. Knight & Associates, Chicago.

"While some firms seem to be moving up from micros to minis, we're going in the reverse direction," said James Lyman, AIA, managing associate for Knight. The firm was one of the first to get a look at the newly released micro version last fall.

After watching the presentations on all eight CADD programs that survived Round II, Lyman said, "I didn't see a whole lot that isn't available now in CADD Solutions, especially in 2D/3D integration. The Sigma data base always has been 3D."

Lyman said his firm knew Autocad well. It bought the program because a client asked for the drawings to be produced with it. But in a speed comparison, Cad Solutions is 10 times faster, he said. Lyman also liked the smooth integration that Sigma provides from micros through multiuser computers.

The major stumbling block is likely to be the program's operating system—Xenix, a version of Unix for the personal computer. In order to run both Xenix and DOS on the same hard disk, it must be partitioned. A better alternative would be to dedicate a Bernoulli Box cartridge for Xenix and use the other for DOS. Those who have tried both usually report that Xenix is more difficult to learn than DOS.

Drawbase—database capabilities

A powerful database is this program's strongest point. For example, Otis Associates, the evaluator of Drawbase, adds information about the light properties of windows and asks the program for a total to compare against building code requirements. Similar techniques facilitate the specification of doors, vents, and the like.

Drawbase produces 2D drawings efficiently, although Otis would prefer more flexible text handling. When a room is flipped to produce its mirror image, text that was left-justified becomes right-justified.

The program does not have a 3D capability.

Fastcad—exceptional speed

Finding an architect willing to invest the time and effort to evaluate a new CADD program can be difficult. When volunteers discover that they can't all be Autocad evaluators, enthusiasm sometimes wanes. But not with Fastcad.

Harry Weese & Associates, Chicago, is exploring the use of CADD. One of the firm's project architects, Paul J. Zinni, AIA, was offered his choice of a wide range of CADD opportunities. He took one look at the exceptional speed of Fastcad and chose it. This 2D program owes its speed to the assembly language in which it was written. Assembly is the lowest practical language and addresses the computer directly.

Although it runs well on the IBM-AT, Fastcad is one of the first programs written to take advantage of the more powerful features of the new generation of microchip, the 80386.

Fastcad's screen bears more than a passing resemblance to the Apple Macintosh. Commands are pulled down from a menu at the top of the screen, functions are selected from tiny, almost illegible icons at the right of the screen, and dialogue boxes offer additional choices. A digitizer template is not provided.

Up to four views of the drawing can be displayed in separate windows on the screen at one time. The operator can draw in any of them and update the others simultaneously. As a room or wall is stretched, the dimension line associated with it is automatically changed.

Voosen described Fastcad as rethinking of CADD for a powerful microcomputer. Neither is it weighted down with mainframe baggage nor has it been successively overlaid with addenda for new PCs.

"The icons could be better but what I like about it is that everything is right there," Voosen said. "And the whole thing is programmable so you can change it to suit yourself."

Zinni said he wished Fastcad had more architectural features. Although it has a good trim command, it does not yet draw parallel lines and clean up the intersections, insert doors and windows automatically, or insert dimension strings easily. But he called it a "very good beginning."

Solid Vision—true solids geometry

Solid Vision is causing the most excitement of any new program currently, despite its really nasty copy protection, which can cause data to be lost if handled improperly. The program still has bugs, the manual is hopeless, and the price is a bit high. But except for that, oh boy!

Evaluator David J. Engelke, AIA, had a commission that made it helpful to show central Madison, Wis., around Capitol Square. He chose Solid Vision, with impressive results.

Because the program does true solid geometry, it is possible to create and manipulate real computerized models with Solid Vision, not just paint surfaces as with Personal Architect. Doors, windows, and pipes can be inserted in walls and removed. True architectural sections can be taken along any plane. The viewer can walk through a door or peek through a window. The cursor will snap to points in space.

Although the program will remove hidden lines automatically, the feature often isn't necessary because the shading covers them. And it does all this with remarkable speed and on conventional computers and graphics boards, although it works best with the VMI 8825 Image Manager.

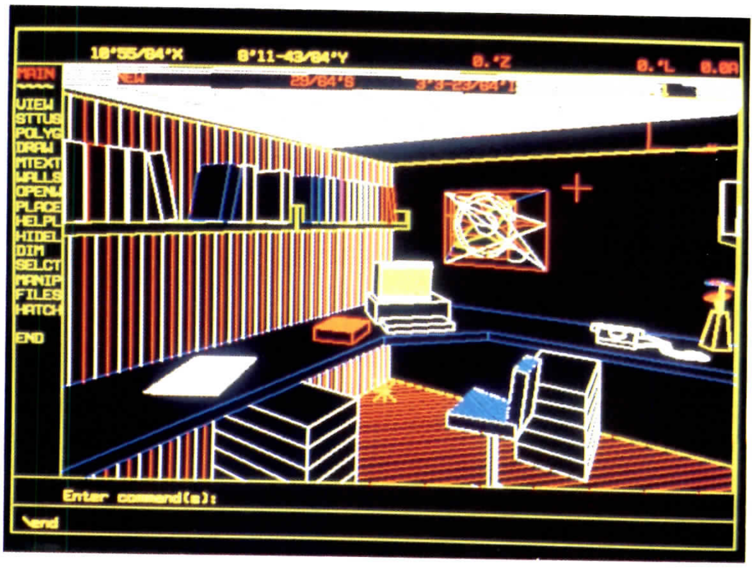
Engelke calls Solid Vision a major advance in CADD capabilities, although much work remains to minimize the frustrations of learning and using the program.

Evaluator John C. Voosen, AIA, faulted the program for being too hard to learn, but he did put in a good word for part of the manual that gave an overview of the program and explained what it was trying to do.

Voosen said Solid Vision contains a respectable 2D capability but he questioned whether it would be developed or promoted because CalComp already has a good 2D program in Cadvance.

Evaluator Charles R. Newman, AIA, conceded the glitches, but added, "The bottom line is that the program is quick and appears to contain all the capabilities we're looking for. It's the direction CADD vendors should be going." □

With the true solid geometry of Solid Vision, sections may be taken along any plane, allowing the viewer to 'walk into' this office. Moreover, elements are inserted into three-dimensional space, rather than merely drawn onto planar surfaces.



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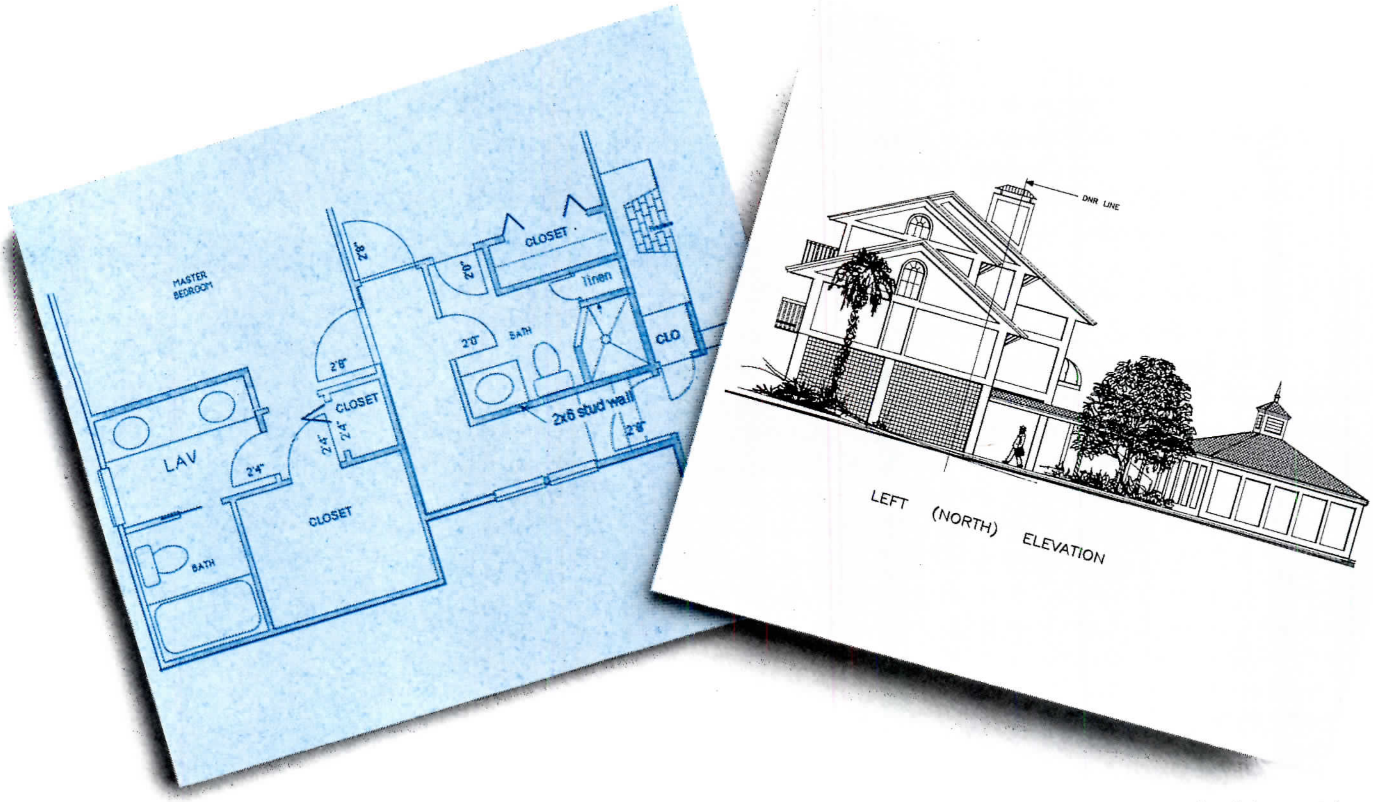

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Skylights Need Not Leak Water or Energy

You never forget your first skylight. Marvin surely won't. Marvin came to our firm fresh out of school and, as his supervisor, I assigned him to design and detail a skylight over an existing courtyard to create an atrium. It wasn't a very tough problem, I thought. But after two days of Marvin not even glancing up from his board, I decided to investigate. Marvin had created a monster. He had designed a series of small chair supports welded to the steel beams. Nuts were to be welded to the chairs, in order to support threaded rods stepping up progressively in height to achieve the proper drainage slope. Other details showed he had worked out flashing connections and construction sequencing, all theoretically correct, but equally custom and cumbersome. "Marvin, that's great," I said, leading him over to the bookshelves. "But let me introduce you to Sweet's Catalog, Section 7.8."

Sweet's Catalog gives the architect a wide range of skylight options, most requiring little more work on the part of the architect than writing specifications. The few choices that remain for the architect can usually be made simple with a quick phone call to the manufacturer; most manufacturers freely help architects determine structural loading and heating and cooling loads, which are the major considerations for skylight design. Determining these loading conditions will in turn make selection of glazing type, framing, flashing, and sealants a manageable decision process, rather than Marvin's time-consuming architectural re-invention of the wheel.

"Unfortunately, many architects still design skylights that are impossible to build, though it is happening less often," says Chris Molenaur of IBG, a large manufacturer of commercial skylights. That's why Molenaur's company, like others, can't stop stressing one fundamental rule for skylight design: Contact the manufacturer early in the design process.

Deflection criteria and design loading form the two most important structural design criteria for skylights and influence all subsequently chosen component parts. Excessive deflection can cause air and water leakage if structural members shift or rotate, and mechanical joints fail. Glazing breakage often occurs when differential deflection allows the metal frame to come in contact with the glazing material and fracture it.

As a rule of thumb, deflection is usually limited to a percentage of span with an absolute maximum, as stated in the Super Sky manual, which recommends that deflection not exceed 1/240 of the span, or 3/4 inches maximum. Super Sky's manual adds, however, that when dealing with complex skylight shapes it's often unclear exactly what "span" means. With large free-span structures the standard criterion can lead to overly conservative and expensive designs.

This would enforce the suggestion that architects faced with large or complex shapes get the manufacturer involved in the early stages of the design.

The model building codes offer further guidance for structural requirements. For example, when a skylight is considered part of the roof system, the codes require that it meet the same structural requirements as the roof. Other skylight design loads are outlined by the model codes, but check for inconsistencies in local codes, especially with regard to multi-faceted geometric skylights.

Local wind dynamics around buildings—especially in large cities—may create unusually high and unexpected speeds that must be considered as part of the structural calculations. This phenomenon, along with the height at which the skylight is to be installed, may make wind tunnel testing prior to installation a good idea in high-rise or urban situations. Other potential dynamic loads, such as high winds, snow loading, and periodic loads caused by objects placed on the frame during periodic maintenance must not be overlooked.

Taking the load off systems

The heating, cooling, and lighting requirements of a building will probably be drastically altered by the use of skylights, and in fact may be the reason for their use. The orientation of the skylight and the types of glazing and shading devices chosen have major influences on the heat gain. Close coordination among the architect, skylight manufacturer, and mechanical and electrical engineers will help make the skylight work for the building, rather than adding unnecessary loads on the mechanical or electrical systems. Heating, cooling, and lighting calculations are essential for retrofit projects to determine if the existing mechanical system can handle the increased heating and cooling loads.

Properly designed skylights will help reduce the need for electrical lighting and, during the winter months, pro-

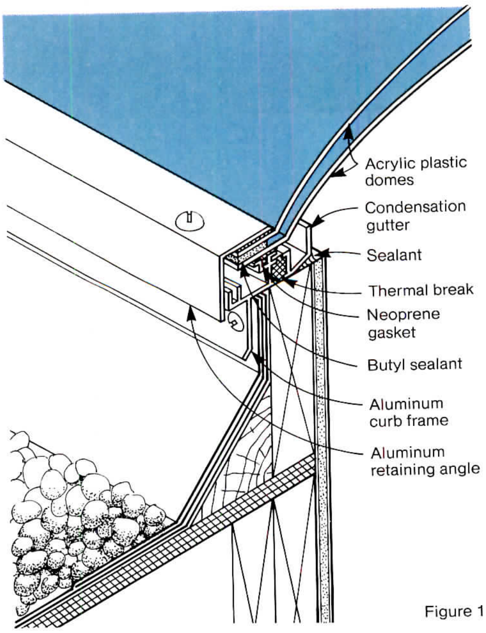

Figure 1

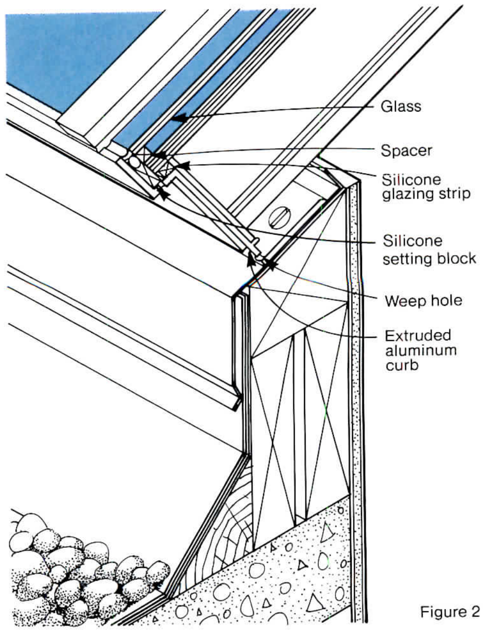

Figure 2

vide more heat gain from radiation than heat loss from conduction. But shading, either through the use of tinted lights and reflective metallic coatings or some type of mechanical device, may be needed during summer months, depending on geographic location, orientation, skylight size, and placement of the skylights within the building. Shading techniques must be selected on a project-by-project basis.

Glass vs. plastic

The two common materials used for skylight glazing can be divided into glass and plastics. Again, the choice tends to be project-specific. In general, glass is more expensive, more fragile, heavier, and is less flexible in shape, but it has a higher transparency and lasts longer than plastic.

The common plastics used for glazing are acrylic and polycarbonate, which can be translucent or transparent. Polycarbonate is stronger and has a greater resistance to heat than acrylic. Plastic skylights, Figure 1, come single-, double-, or triple-glazed. Since plastic can be vacuum-formed with relative ease into a variety of complex shapes, such as vaults, pyramids, polygons, and circular domes, there is no need for internal frames. The vacuum-formed skylight relies on the acrylic or polycarbonate glazing for its strength, though this in turn limits its size. Vacuum-formed domes rarely exceed eight feet across. Domes using internal frames and plastic glazing regularly reach spans of 150 feet or more.

Bill Cintani, president of Mapes Industries, Inc., which manufactures acrylic skylights, says, "A curved design can be expensive in glass and cheap in acrylic. And plastics can withstand impact, making them safer and more cost-effective in areas where breakage presents a temptation, such as around schools. You also have a greater choice of colors with acrylic glazing, and the ability to color-match the frame."

Despite the advances made in plastic glazing over the last decade, some manufacturers specify only glass for their skylights—especially if they are targeting the commercial market. Super Sky believes glass is the more reliable product because it isn't subject to the expansion and contraction range of plastic, as shown in Figure 2. Glass breakage can't be discounted, and by selecting the appropriate glazing to meet safety factors determined by code, this risk can be greatly reduced.

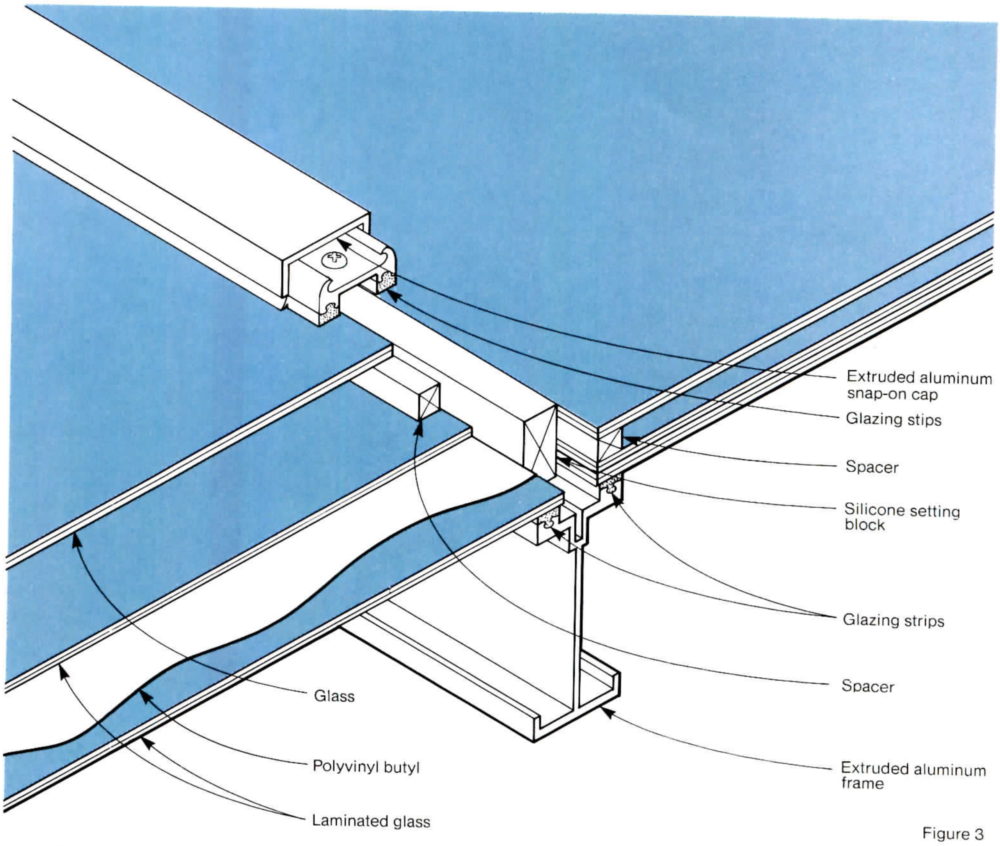

Figure 3

For this reason, fully tempered and annealed glass are popular choices for skylights.

Fully tempered glass is four to five times as strong as annealed glass, while heat-strengthened glass is twice as strong. This extra strength is most important for the outboard light in a multiple-layer glazing assembly. While annealed glass may be adequate for vertical glazing, sloped areas on which there's greater risk of thermal stress may require a heat-strengthened or a tempered, laminated assembly.

Many skylight manufacturers feel that the extra cost of heat strengthening or tempering is offset by the lower maintenance and replacement costs. The model codes require that annealed and heat-strengthened glass be further protected by continuous screens, often on both sides.

The outboard screen protects the glass from falling objects, and the inboard screen will protect the building's occupants from flying glass should breakage occur.

When safety is a priority, an assembly containing a combination of glass and plastics, such as laminated glass, may prove to be the best choice. Laminated glass is made up of a polyvinyl butyl (PVB) bonded between two lights of glass, as shown in Figure 3. If breakage occurs, the fragmented glass will adhere to the PVB layer, reducing the risk of injury to the building occupants.

All three model building codes require laminated safety glass on single-glazed applications; in multiple layer applications, they require that the inner light be laminated safety glass. According to the Uniform Building Code, the PVB interlayer must be a minimum of 30 mils thick. However, because small ripples can occur in the glass during the laminating process, some manufacturers recommend a thicker layer of PVB to guarantee better adhesion.

In addition to structural and mechanical loads, glass chosen for skylights must accommodate handling stresses. Skylight glass is an expensive product that requires a long lead time when ordering, so breakage from handling can cause long delays in construction. Architects often don't take into consideration that skylights have to be installed from the outside, and this usually means lifting the glass by crane and man-handling it into place. For this reason, Greg Huffman, vice president of sales for Super Sky, recommends that lights be kept small—40 square feet of glass maximum. He also advises specifying heat-treated glass, which is less prone to breakage.

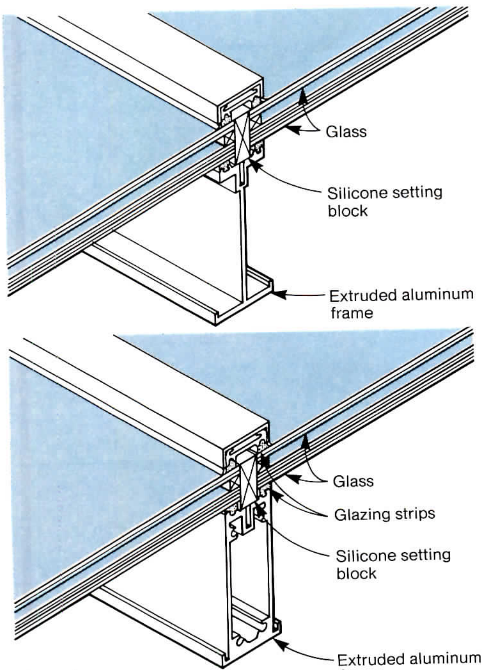

Figure 4

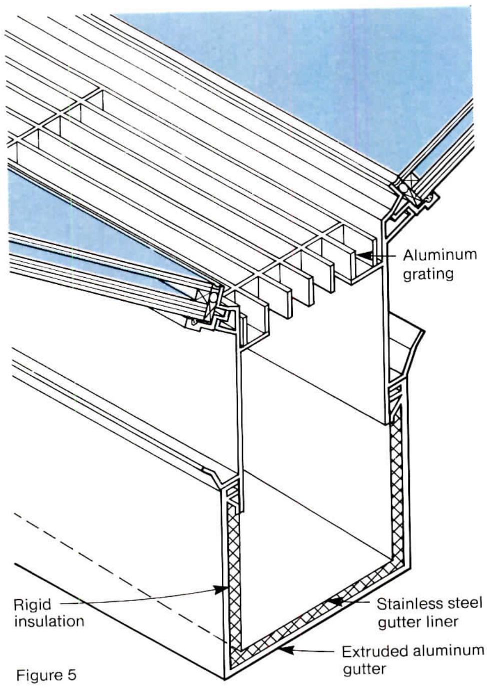

Figure 5

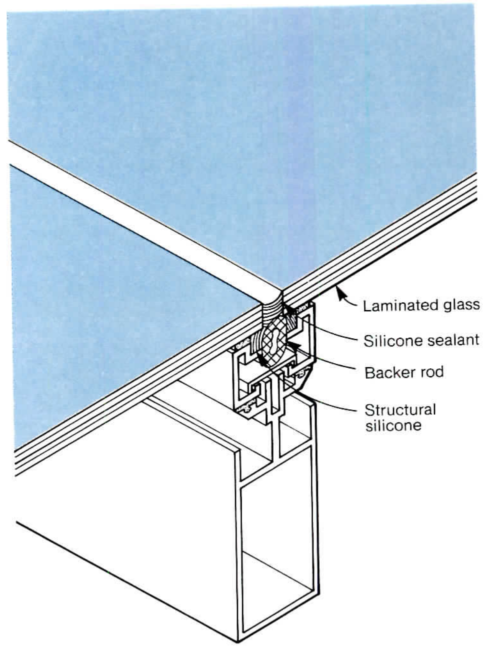

Figure 6

For all types of glass, tinting may be desirable to reduce heat gain and visible daylight transmission. Only the outboard light should be tinted; tinted inboard lights are not recommended due to the increased risk of thermal stress. Thin reflective metallic coatings on the outboard light will also improve the shading coefficient, but local codes should be checked for restrictions on their use.

The frame keeps out the rain

Aluminum is the metal of choice for most manufacturers of skylights. Relatively lightweight and inexpensive, aluminum can be extruded into complex shapes easily. Unfortunately, aluminum is hardly a perfect material: It carries a high potential for galvanic corrosion when in contact with a dissimilar material, and has a rate of thermal expansion twice that of steel. The two standard aluminum shapes most manufacturers advertise are tubular (square or rectangular) or I shapes, as shown in Figure 4. Nevertheless, most manufacturers carry a wide variety of shapes and sizes, and many are willing to produce custom shapes. One leading skylight manufacturer, O'Keefe, advertises over 500 aluminum extrusions available.

Because skylights take the place of the roof in many cases, it's important that proper drainage be taken into account. Fortunately, most of the commercial manufacturers design their skylight frames with integral sloped gutters, as shown in Figure 5.

The places where the building comes in contact with the skylight are always points for concern, because it's there that trouble in the form of air and water leaks often occurs. There is no consistent solution; particular flashing requirements depend on how the skylight meets the building, which building material is in contact with the frame, the type of frame or subframe, and overall exposure and slope. This is especially true with larger commercial skylights, and close coordination between the manufacturer, architect, and installer is a must. Manufacturers of the smaller, residential variety of skylight have developed a number of standard details designed according to the type of roof and its degree of slope.

How the skylight edges are detailed and sealed can make a great difference in battling the perennial foe of skylights, condensation. Some skylights incorporate a continuous condensation gutter to collect the excess moisture. Alternatively, thermal break frames and double glazing condensation can help eliminate condensation before it requires channeling. Thermal breaks are usually made where the glazing is attached to the framing member by the use of a nonheat-conductive material. Neoprene and silicone most often form setting blocks and thermal breaks between the glazing and frame, while silicone sealants with backer rods are used to seal the joints. Structural silicone glazing systems, Figure 6, are gaining in popularity as skylights, but because they are relatively new, manufacturers recommend care in selecting an installer.

Spec it out!

Commenting as a member of The American Architectural Manufacturers Association's skylight and space enclosure division, Huffman says the AAMA group has recently developed a skylight specification performance standard applicable mainly to residential skylights. AAMA 1600-86, Voluntary Specification for Skylights, indicates performance standards, which include the American Society for Testing and Materials tests for water and air infiltration. Manufacturers may test their products, and if they meet the standards, receive a certification label from the AAMA. The procedures for testing and evaluation are expected to be in place by early 1987. The specification covers component materials such as aluminum, vinyl, wood, and plastic glazing, but not glass.

AAMA plans to produce a glass design manual and a manual for structural design of skylights in early 1987. Huffman says these manuals will be geared toward the larger commercial skylights.

—Timothy B. McDonald

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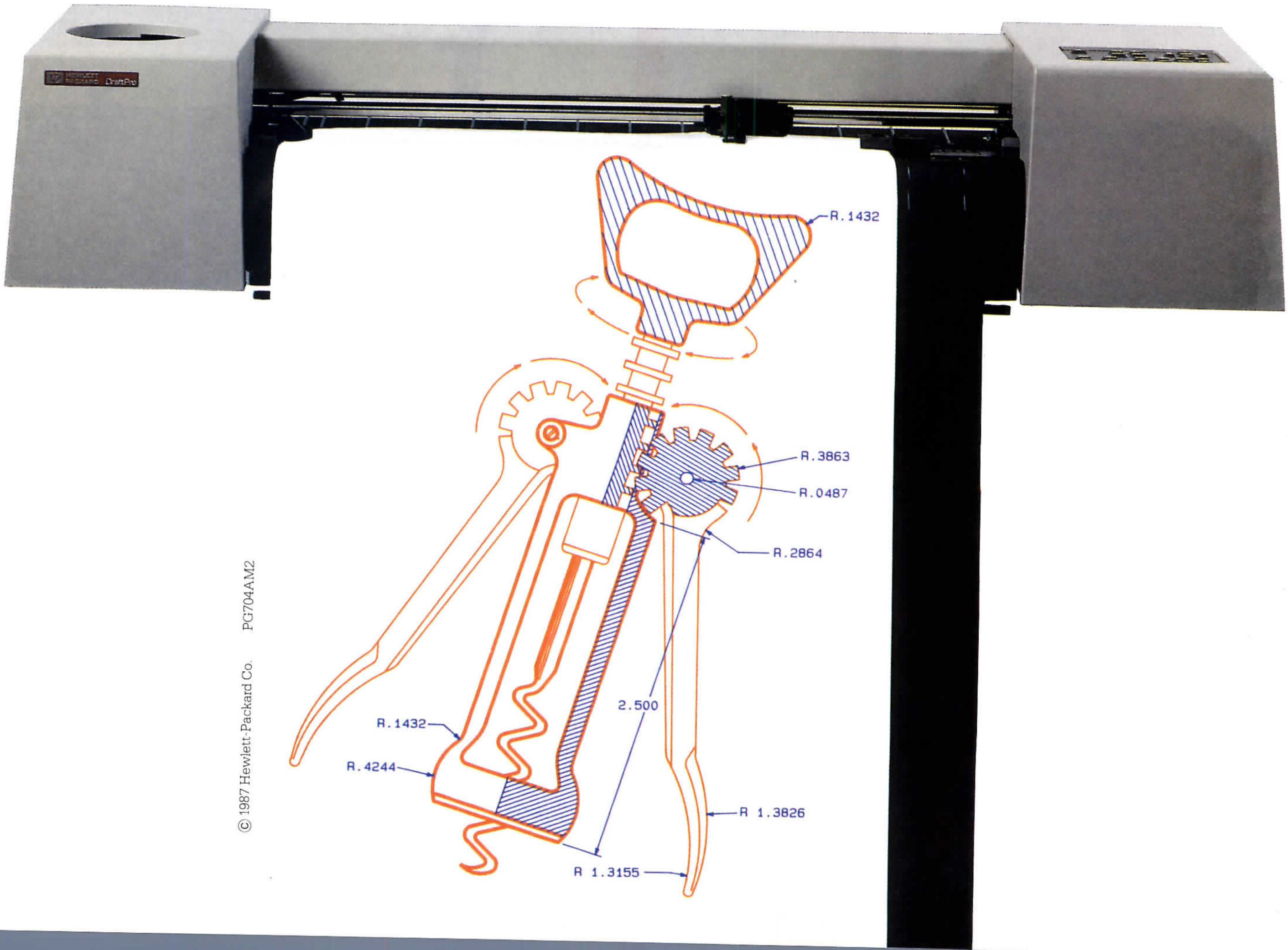

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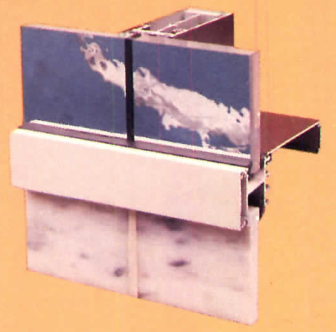

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Contrasting Pair of Lofts

There's nothing remarkable about 1872 North Clybourn. On the outside it's just another industrial building converted to residential use on the fringe of up-and-coming Lincoln Park in Chicago. With its heavy timber mill construction and industrial sash windows, its 58 condominiums carved out of the 117,000-square-foot, six-story building are also typical, characterized by the minimal approach: raw space with European style kitchens, sand-blasted brick, tile baths, and vast but blank drywall dividing one unit from another. Those purchasing the units were expected to add the finesse to this no thrill approach.

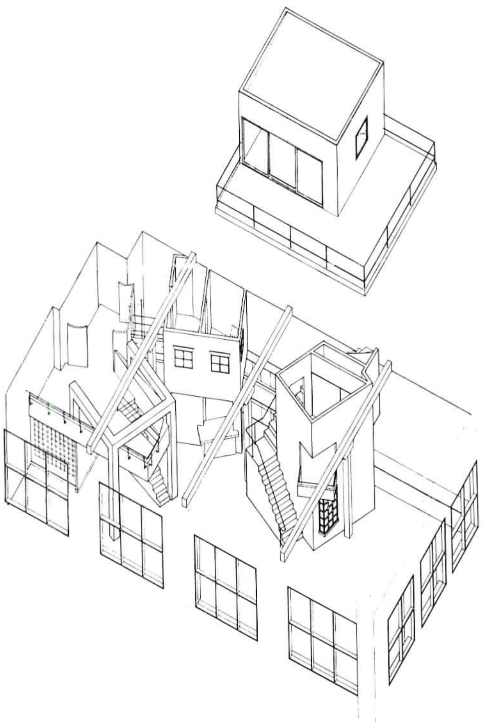
And add they did. When architects David Haymes and George Pappageorge, AIA, went to work on the project for developers Horwitz/Matthews, they not only laid out the interiors but also oversaw construction and became designers for 18 of the condominiums' purchasers. Each of the partners also purchased his own space in part to give his own architectural ideas some exposure and in part as a speculative venture on a mini-scale. They eventually sold both units, but not before their talents were ably demonstrated.

Although the ceiling heights throughout the building were taller than normal residential construction, Haymes was fortunate to buy a top floor unit with roof rights. The ceilings stretch to 15 feet and views take in all of the Chicago skyline. As if to emphasize the vastness of the volume as well as to help define it, Haymes inserted three pavilions into the space

Pavilions divide and define loft.

positioned in such a way as to create vistas through it. At the far end is a guest bath with a study/guest bedroom on the mezzanine; in the center a kitchen with sauna above. The third is a master suite with bathroom on the lower level, dressing room above, and finally the penthouse bedroom with a deck that punches through the roof. What remains of the space surrounding these pavilions (and it is no small amount) is given over to living and dining that take advantage of the corner views toward the city.

Of all the clients who came to the firm to design their spaces, one best exemplified the dilemma that so many loft purchasers confront: Coming from traditional spaces, how do you marry all the possessions of a conventional past with the newly acquired unconventional space? This client



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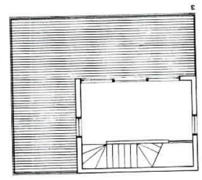
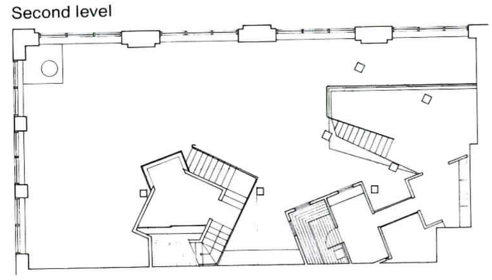
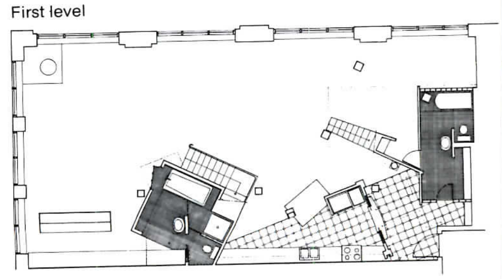


Third level

Second level



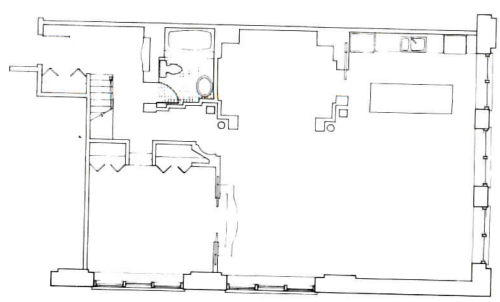
First level



Across page, the three pavilions were positioned in rectangular loft to create interior vistas. The pavilions house the more private spaces—bedrooms and baths and a sauna. Living spaces are scattered throughout the leftover space. Right, in a more formal loft, oversized cornices delineate the private spaces.

is a single woman in her 30s who purchased the condominium and then hired the architects to design an interior that could accommodate all of her antiques. Their solution was to wrap the space in a two-and-a-half foot cornice, which they felt not only bridged the scale between the large space and the single pieces of furniture but also provided an element of visual detail that could join the two disparate elements. As a device, the overscaled cornice succeeds simultaneously at dividing the space and unifying it, at inserting a backdrop against which the period furniture works while remaining a clearly modern element. This oversized molding divides the space in half, defining a dining area where a drop ceiling adds a mezzanine storage level above and the bedroom raised one step, both of which open off the main living space. A stair, placed at the entry for access to the mezzanine, gives the impression of a two-story house, while wall details include niches and columns lending a more formal, classical air.

Both apartments are elegant lessons in the deft use of drywall construction to create illusions that transcend the minimal four walls that came with the mortgage. Throughout all the spaces, airconditioning and heating ducts are exposed, which, like the wooden columns of the old factory, serve to continually remind the viewer of the industrial origins of the building.—Sharon Lee Ryder



'Secular Chapel Of Learning'

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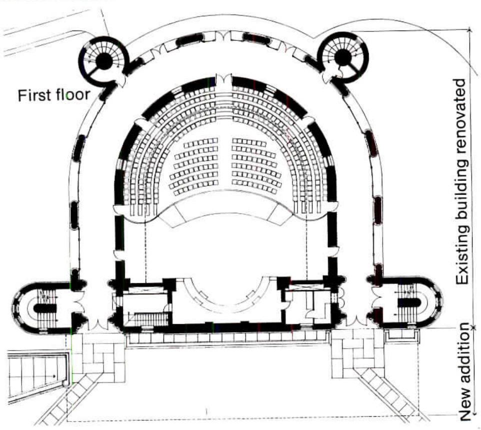
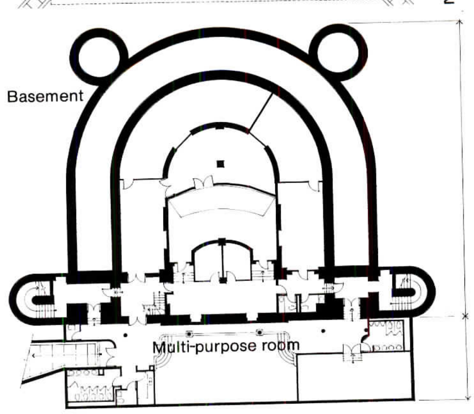




Top left, stage before renovation; below right, underground multi-purpose room.

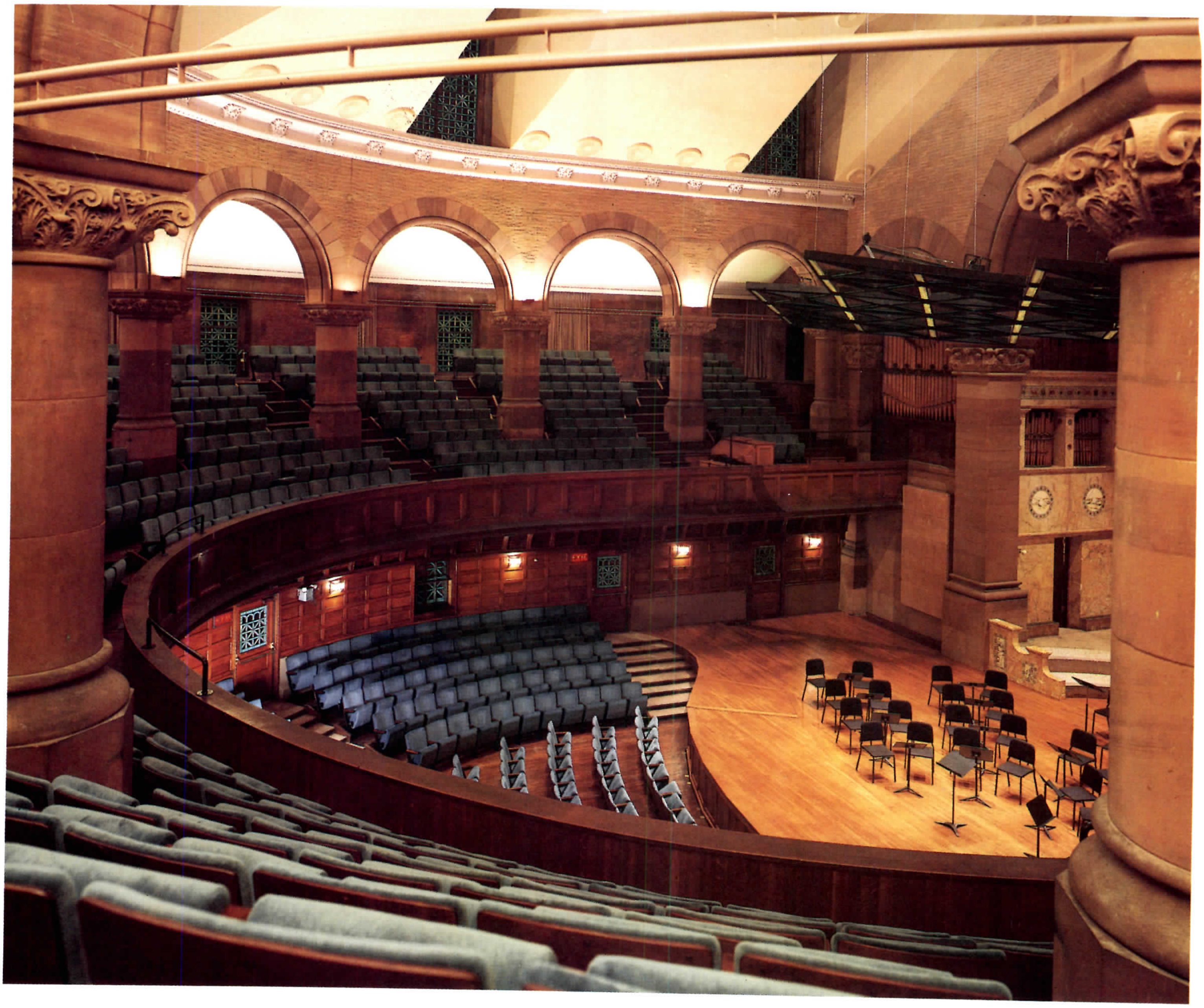
If Alexander Hall had been out to win a popularity contest, it lost. It was voted the least popular building on the Princeton campus in 1950, due not so much to its architectural qualities as to the fact that semester grades were posted in its ambulatory, giving many students less than fond memories of their visits there.

Alexander Hall survived that test as it did previous ones. Built in 1892 by William Potters, it was conceived as a commencement and lecture hall. But within two years the student body outgrew the facility and the university abandoned it for commencement exercises, using it instead for lectures, theater, music, and dance performances. In typical makeshift fashion, the university replaced the original pews with wooden seats and rigged up a stage at one end. Otherwise little was done to alter the building.

Typical of many academic structures built during the late 19th century, Alexander Hall is an eclectic mix of styles based on the Norman and Romanesque models that H.H. Richardson made popular. In its use, it is also a mix of metaphors—its architect terming it a "secular chapel of learning" and blurring the distinctions between academic functions and religious images so often found in this type of architecture. For almost 100 years, the building served its new purposes well and remained in its semi-state of conversion.

Its most recent renovation was completed in April 1985, when the university decided to bring the facility into the 20th century by improving the acoustics and upgrading the long outmoded technical, mechanical, and electrical systems. As both the interior and exterior of the building had remained relatively untouched during the intervening years, virtually no restoration work was needed.

Much of what architect James Grieves did goes largely unnoticed. The marble surfaces, mosaics, and stained glass windows designed by Tiffany were cleaned. With the installation of a wooden stage, a portion of which is on a lift, an orchestra pit can now be created for performances of opera and theater. Airconditioning and heating ducts, so often the bane of sensi-



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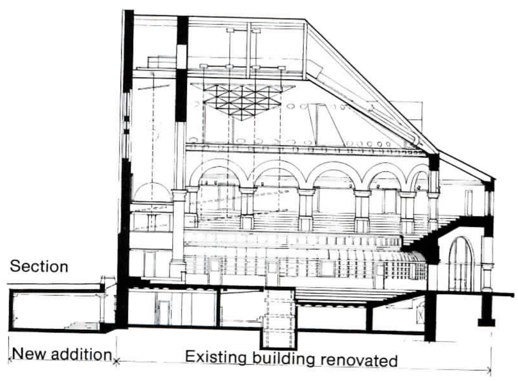
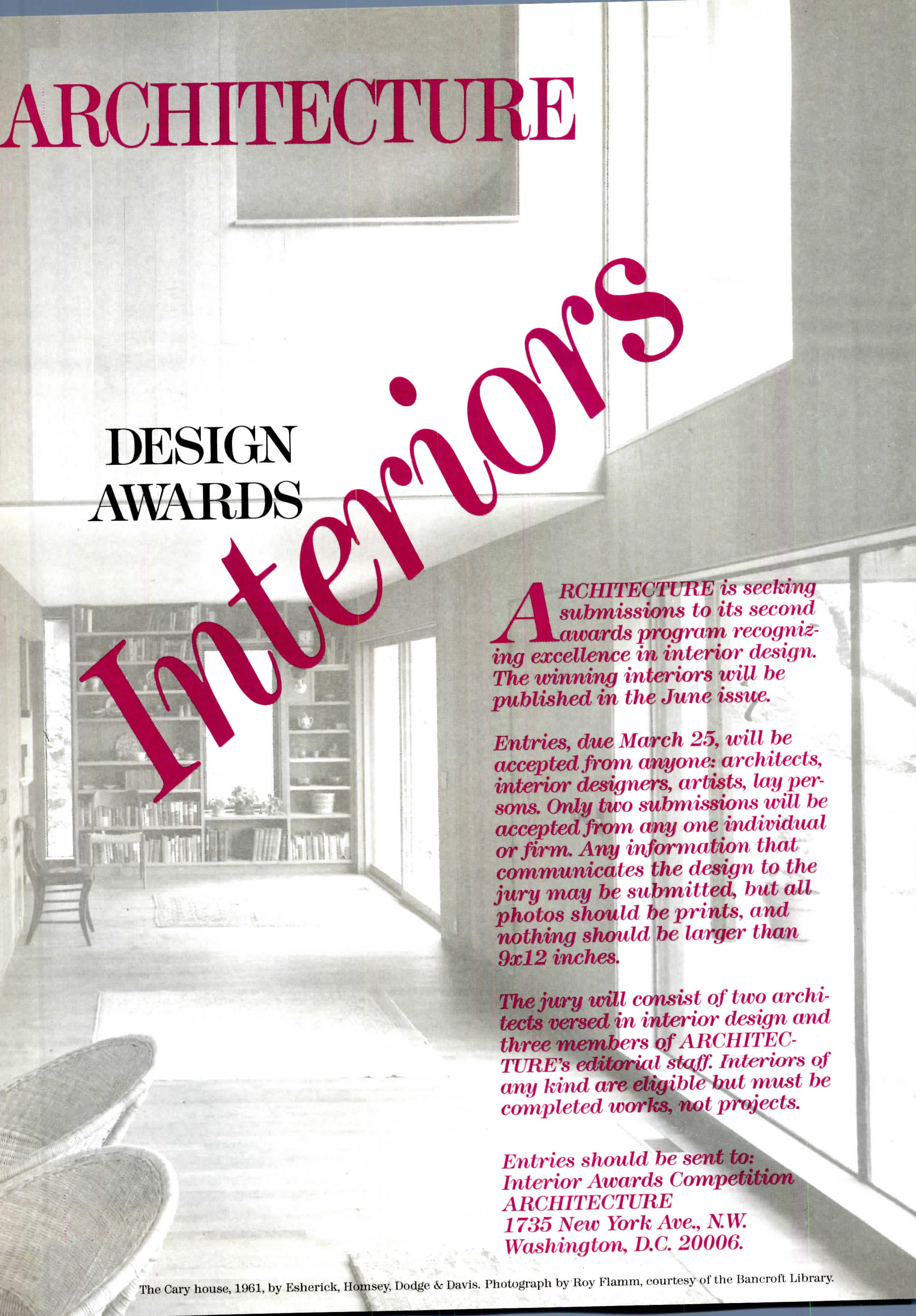
tive historical renovations, have been threaded in the space between the ceiling and the roof. The hard wooden seats, a remnant of Victorian sternness, were replaced with upholstered ones.

Least noticeable is a new addition, some 3,300 square feet of space that has mechanical and rehearsal rooms. With no desire to alter the exterior and no room in the basement, the solution to the problem of additional space became apparent when the university began a program of tunnels to connect many of its buildings. With the trench dug, an underground addition adjacent to the building seemed the most feasible and, with careful grading of the entrances and placement of skylights, the interior would not feel like it was in the basement.

The more visible interior changes are those that improve the functioning of the hall as a performance space, the most obvious being an acoustical panel that reflects and scatters sound among members of the orchestra and audience. Rigged like a theatrical set, the panel can be raised and lowered as needed, leaving a clear view of Tiffany's rose window when not in use. Light fixtures were incorporated into the panel. New lighting was also installed: downlight in the ceiling, a wash of uplight from fixtures set just above the column capitals at the balcony fronts, and wall sconces on the wooden paneling at the orchestra level.



Although Alexander Hall had found its proper niche long before the current renovation, its interior now glows. With its facilities brought up to date, it has, at long last, become one of the more popular places on campus.—SHARON LEE RYDER



ARCHITECTURE

DESIGN AWARDS

Interiors

ARCHITECTURE is seeking submissions to its second awards program recognizing excellence in interior design. The winning interiors will be published in the June issue.

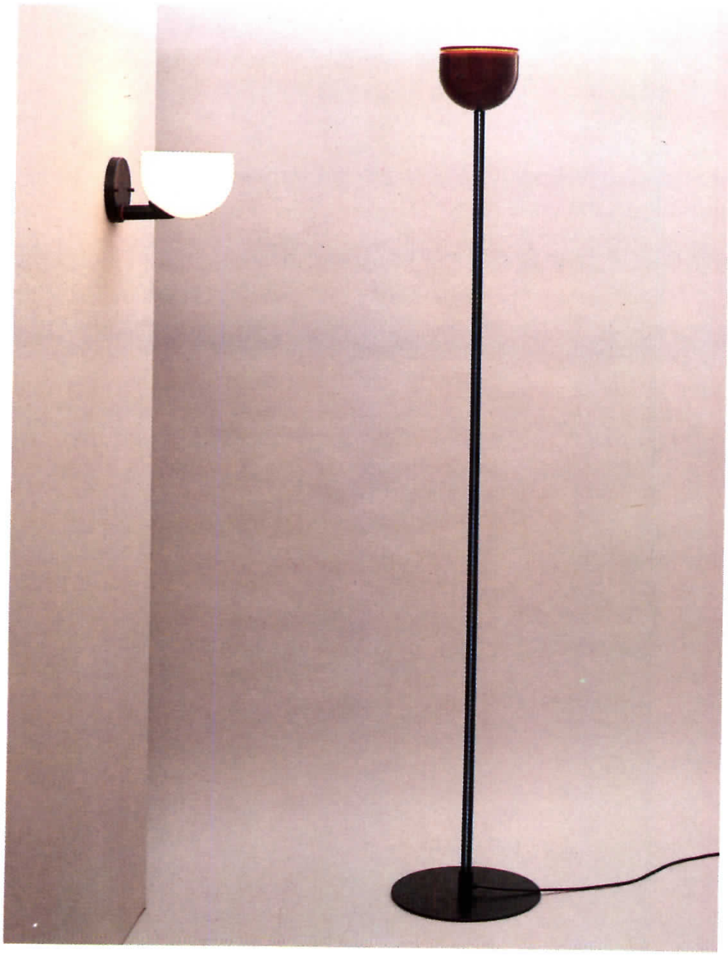
Entries, due March 25, will be accepted from anyone: architects, interior designers, artists, lay persons. Only two submissions will be accepted from any one individual or firm. Any information that communicates the design to the jury may be submitted, but all photos should be prints, and nothing should be larger than 9x12 inches.

The jury will consist of two architects versed in interior design and three members of ARCHITECTURE's editorial staff. Interiors of any kind are eligible but must be completed works, not projects.

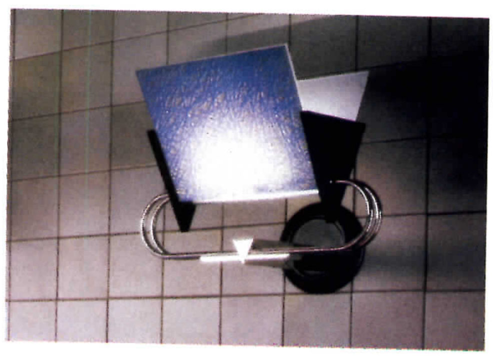
Entries should be sent to:
Interior Awards Competition
ARCHITECTURE
1735 New York Ave., N.W.
Washington, D.C. 20006.

The Cary house, 1961, by Esherick, Homsey, Dodge & Davis. Photograph by Roy Flamm, courtesy of the Bancroft Library.

PRODUCTS



Floor Lamp
The Flip, model F-5004 (left), is designed by De Majo and distributed by Koch + Lowy. The 72-inch-tall lamp has a 13-inch base and features a 250-watt double envelope and full-range floor dimmer. The finish is either black or white, and the glass comes in white with a clear reveal or burgundy with orange reveal. A halogen bulb brings out the intensity of the burgundy color when lit.
Koch + Lowy
Circle 241 on information card

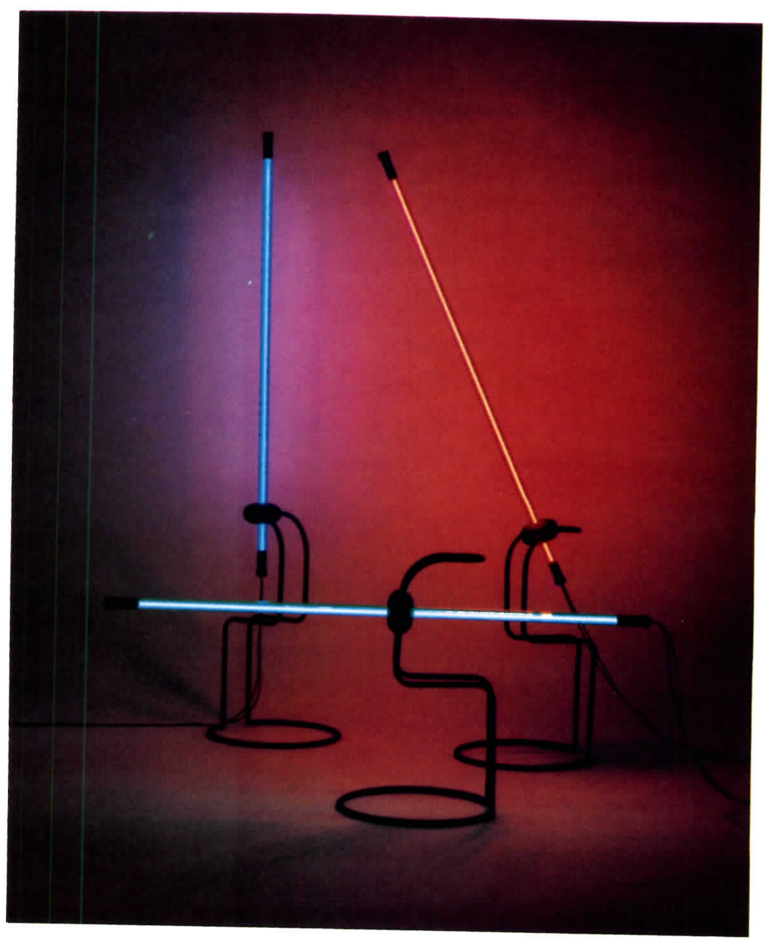


Sconce
UL-listed Murana wall sconce (top right), is made of a formed-steel backplate that supports an aluminum stem. Diffusers, which come in blue, light gray, or white with reflective backgrounds, are constructed of opal glass inner panels bonded to silk-screened glass outer panels. Two opaque blue or white triangular-shaped end caps with textured and high gloss surfaces hold the panels in place.
Atelier International Lighting
Circle 242 on information card

Laser Sculpture
The laser light sculpture (right), features a neon light source that can be moved within a 180-degree arc. The tube is encased in high-impact tinted acrylic and is available in dark icy blue, purple, krypton, uranium, and ruby red with purple aura.

A grooved black rubber grommet moves along the metal tubing of the top section of the base, allowing for many variations in the basic position of the lighting tube. The base is 24-inches tall and available in chrome or a black matte finish.
Neon Modular Systems
Circle 243 on information card

—Amy Gray Light



Sconce
The CB1700 wall sconce (below), features a 13 ½-diameter stepped opal glass diffuser combined with brass accent pieces. This European glass series also offers polished chrome or painted finishes for accenting. The sconce is 10 inches high with a 15 inch extension. This fixture requires a 100-watt incandescent lamp.
Visa Lighting
Circle 245 on information card

High Intensity Discharge Fixtures
The M700 line of Quick Ship commercial high intensity discharge recessed fixtures feature a choice of three lamp types—mercury, metal halide, and high pressure sodium—in wattages ranging from 35 to 100. The housing consists of a plaster frame, ballast tray, socket cap, junction box, and detachable ballast. A choice of eight trims can be selected: Clear and gold specular Alzak reflectors, a coilex baffle, open tri, three lens trims, and a scoop wall wash trim. The lamp socket is adjustable on the trims, providing either normal or wide distribution patterns from the same lamp and trim. Features designed to make the fixtures easy to install include ballasts that can be installed after the housing is secured, polarized plugs that make connections without tools, slide-apart bar hangers that can be used in either wood or suspended ceiling installations, and quick mount reflectors and lenses.
Halo Lighting
Circle 254 on information card

Task Lighting System
The Conservolite fluorescent light regulatory system adjusts lighting levels on a fixture-by-fixture basis. The automatic control features a light-collecting clear plastic sensor that mounts in a circular cutout of ceiling tile or can be hung directly from a fixture. The sensors can be set to deliver lower light levels over computer terminals to reduce screen glare, while certain task areas in the same room can still receive maximum light. In addition to reducing lighting costs, the system is said to lower ballast heat and thus contribute to reduced airconditioning needs.
Conservolite Inc.
Circle 246 on information card

Compact Luminaire
The Superwatt luminaire uses 150- to 400-watt HPS, 250- to 400-watt metal halide, or 250- or 400-watt mercury vapor HID lamp sources, converting up to 91 percent of a lamp's energy into usable light.

The luminaire has a 2.5:1 space-to-mounting-height ratio, so fewer luminaires than normal are required to produce even light levels for a given area.

An exclusive, laser designed refractor provides 25 percent uplight, eliminating the "cave" or dark area effect on the ceiling and projecting light to all areas within a room.

Only 18 inches tall, the UL-listed Superwatt is designed to be easily installed in low- and medium-ceiling height applications and can be pendent- or surface-mounted in damp or wet areas.
Harvey Hubbell, Hubbell Lighting
Circle 247 on information card

Fluorescent Lighting Brochure
A color brochure describes the features and benefits available from CEZ low-glare fluorescent lamps. CEZ fluorescents are color-corrected to produce softer, more diffused greenish-blue light that screens out unnecessary infrared rays. Shadows are softened, which reduces eye strain. They are designed for use in areas where demanding or long visual tasks are performed.
VL Service Lighting
Circle 248 on information card

Ballasted Luminaires
Multi-purpose ballasted luminaires feature optical assemblies that can be used interchangeably with a die-cast aluminum ballast housing and the appropriate ballast assembly. Multiple housing choices add to the versatility of the lighting systems, which accommodate high intensity discharge lamps from 50 to 250 watts.
General Electric
Circle 252 on information card

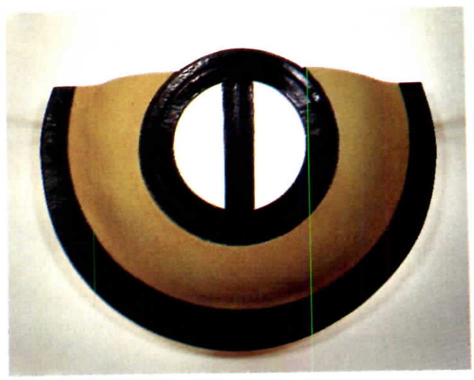
High Color Rendering Lamps
The Designer Series of fluorescent lamps are for use where good color is critical. The lamps are available in three color temperatures of 4100k, 3500k, and royal white 3000k, and a number of sizes and shapes.

The series incorporates the existing colors of warm lite deluxe, deluxe white, lite white deluxe, and royal white, and is available with color rendering indexes of 69 and 80. The lamps come in both standard and energy-saving versions, including the supersaver-plus fluorescent.
GTE Electrical Products
Circle 250 on information card

Lighting Guide
A specification guide from North American Philips Lighting lists incandescent; fluorescent and high intensity discharge lamps; miniature and sealed beams; photo projection, sound reproducer, and film viewer lamps; stage, studio, and television lamps; speciality lamps; and fixtures. They are listed in wattage sequence except for special groupings such as street lighting, quartz, infrared, tungsten halogen, high intensity, and silicone-coated lamps. Complete ordering information is included, as well as a list of sales offices and addresses to write for more technical information.
North American Philips Lighting
Circle 251 on information card

Lighting Control System
The Model 6120 stand-alone energy management system is designed to reduce energy cost by controlling lighting equipment. Several features of the system include variable power lighting control, user-selected lighting load detection, ambient light control, and data reporting of energy savings on a daily and monthly basis.

Functions of the lighting controller include: time-based control, which defines each load with an on/off schedule for days or the week and holidays; demand control; after hours-timed, manual, and remote override; and time of day scheduled reductions.
Control Systems International
Circle 258 on information card



Ceramic and Glass Sconce
One of six featured ceramic and glass wall sconces (above) from a special edition, this one measures 17x20x5 inches and is incandescently lit. The sconces are positioned one inch from the wall, radiating a soft halo of light that makes them particularly suited for ambient lighting. The textural surface is hand-painted with ceramic glaze and oil paints and sealed with polyurethane. Custom designs and colors are also available.
Freeman Lighting Designs
Circle 244 on information card

Metal Halide Lamp
A compact 100-watt Metalarc lamp features low wattage, medium base features, and a high color rendering for low and medium ceilings.

The metal halide light consumes 61 and 42 percent less energy than 300-watt incandescent and 175-watt mercury lamps, respectively, while delivering more light
continued on page 122

What made manual AEC drawing obsolete in Japan?

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HITACHI

Circle 30 on information card

Products *from page 120*
than the incandescent sources or the same wattage and about the same light as mercury sources. The lamp can be burned base up or base down and has a warm 3200k color temperature with a color rendering index of 65.
GTE Lighting Product
Circle 249 on information card

Parabolic Louvers
Six parabolic luminaires offer a variety of baffle sizes for office applications—the Microcube, Parabaffle, Parabaffle 20-inch, Tribolic, D3V Deep Cell 3-inch, and D4 Deep Cell 4-inch.

Precision parabolic louvers are designed to provide high visual comfort and high fixture efficiencies by shielding glare from the field of vision. The louvers are available in semi-specular, vertical grain, specular or painted finishes, with a choice of anodized aluminum, champagne gold, or white acrylic enamel.

All six fixtures are designed to be compatible with a variety of ceiling systems and include sturdy, easy-to-install one-piece housings. The fixtures have uniform, four-side reveal and mitered corners.
The Genlyte Group
Circle 253 on information card

Area Luminaire
The Parklane area luminaire features a light control design incorporating a rear-surface metalized, prismatic glass reflector. Clear prisms direct light, while the supplemental metalized surface provides reflection and control. This combination of optical elements allows a choice of square or offset rectangular light patterns without the need for refractors or an inordinately large number of fixtures.

The optical system is enclosed in a one-piece, integrated prismatic cube/cone constructed of seamless acrylic. After dark, the cube/cone shape appears to sparkle with light, providing an esthetic glitter without glare. The cube/cone gives low brightness definition to the luminaire and helps disperse the light while eliminating both hot spots and dark holes under the fixtures. The luminaire offers optimum horizontal light cutoff to avoid wasted light and utilizes a vertically burning HID lamp, which is said to be the most efficient position for this type of lamp.

The luminaire has a corrosion-resistant, extruded aluminum housing with welded seams and is enclosed and gasketed to keep out rain, snow, dirt, and insects.
Holophane
Circle 255 on information card

Low Voltage Track Lighting
Two track lighting fixtures, the 75-watt Super Beamer and the 50-watt Mini Beamer, provide a narrow, concentrated beam spread without spill light or glare.

The Super Beamer's beam pattern can adjust from a narrow 6-degree range to a medium 18-degree range, providing several different lighting effects with a single lamp. A reflector built into the shell is designed to enhance output efficiency and minimize spill light.

The Mini Beamer has the same engineering and design features as the Super Beamer, but with a fixed, narrow 8-degree beam pattern. The unit extends only 4 inches from the track. While the housing is stationary, the head swivels, providing light in any direction.
Lightolier
Circle 259 on information card

Lighting for Low-Ceiling Offices
The Softshine indirect lighting system can be mounted on stems as short as one foot, making it appropriate for low-ceiling offices with video display terminals. The 10 x 3 ⅝-inch wide spread indirect system can be mounted as close as 12 inches to the ceiling and is designed to provide excellent illumination in small offices with ceilings as low as 8 feet, even where extensive VDT tasks are performed.
Peerless Lighting
Circle 260 on information card

Miniature Halogen Light
The Tectrac MR-11 consists of a miniature recessed-adjustable light source contained in a channel only a little over two inches in profile, the most compact form of adjustable halogen lighting available and the industry's first integrated low voltage fixture.

Consisting of a sleek aluminum channel into which a miniature housing for the MR-11 lamp is recessed, the lamp possesses very good color rendition, long life, and a variety of beam-spreads. The MR-11 is compact size—just over one inch in diameter.
Starfire Lighting
Circle 256 on information card

Slide Control Dimmer
The Glyder low voltage dimmer, model GLV-600, controls up to 600 volt-amperes of incandescent low voltage or standard 120-V lighting load and can be used in track lighting, recessed ceiling fixtures, accent lights, and outdoor lighting.

The linear slide control provides smooth, continuous, full-range dimming, and clicks on and off like a regular light switch, yet has a distinctive design so it can be differentiated from other switches in the same installation.
Lutron Electronics
Circle 257 on information card

Exterior Perimeter Lighting
"Sundowner" wall mounted lighting fixture features a sharp cut-off design to eliminate light pollution and uncontrolled brightness. The downlight design is achieved from a tapered housing that offers a light cutoff of 85 degrees.
Guth Lighting
Circle 270 on information card

SKYLIGHTS

Skylight Brochure
A 15-page, color brochure of different skylight models features line drawings of construction details. Skylights offered range from small residential domes or pyramids to custom applications involving thousands of square feet. Technical data sheets for the models are available upon request.
Skyline Sky-Lites
Circle 265 on information card

Roof Windows and Skylight Brochure
A four-color brochure provides information on Barra Corporation's Lift and Slide roof window and the Fixed Glaze skylight.

The lift and slide roof window can be elevated to any position and features glazing that slides from the left or right with any movement of an interior grip rail. A variable lifting mechanism allows for increased air flow and easy cleaning. The fixed glaze model is designed for applications requiring skylight openings without the need for ventilation.

Both models are made of double-glazed tempered insulating glass to provide improved thermal efficiency. They are built of one-piece aluminum construction with a PVC steel-reinforced curb system.
Barra Corporation of America
Circle 267 on information card

Solar Sunroom/Greenhouse Brochure
Garden Way solar rooms (above) employ an integrated system of components to collect, store, retain, and transfer the sun's heat. An 11-page color brochure features technical specifications, illustrations, photographs of various applications, and an explanation of how the sunrooms function as passive solar heating systems.
Garden Way SunRoom Solar Greenhouse
Circle 261 on information card

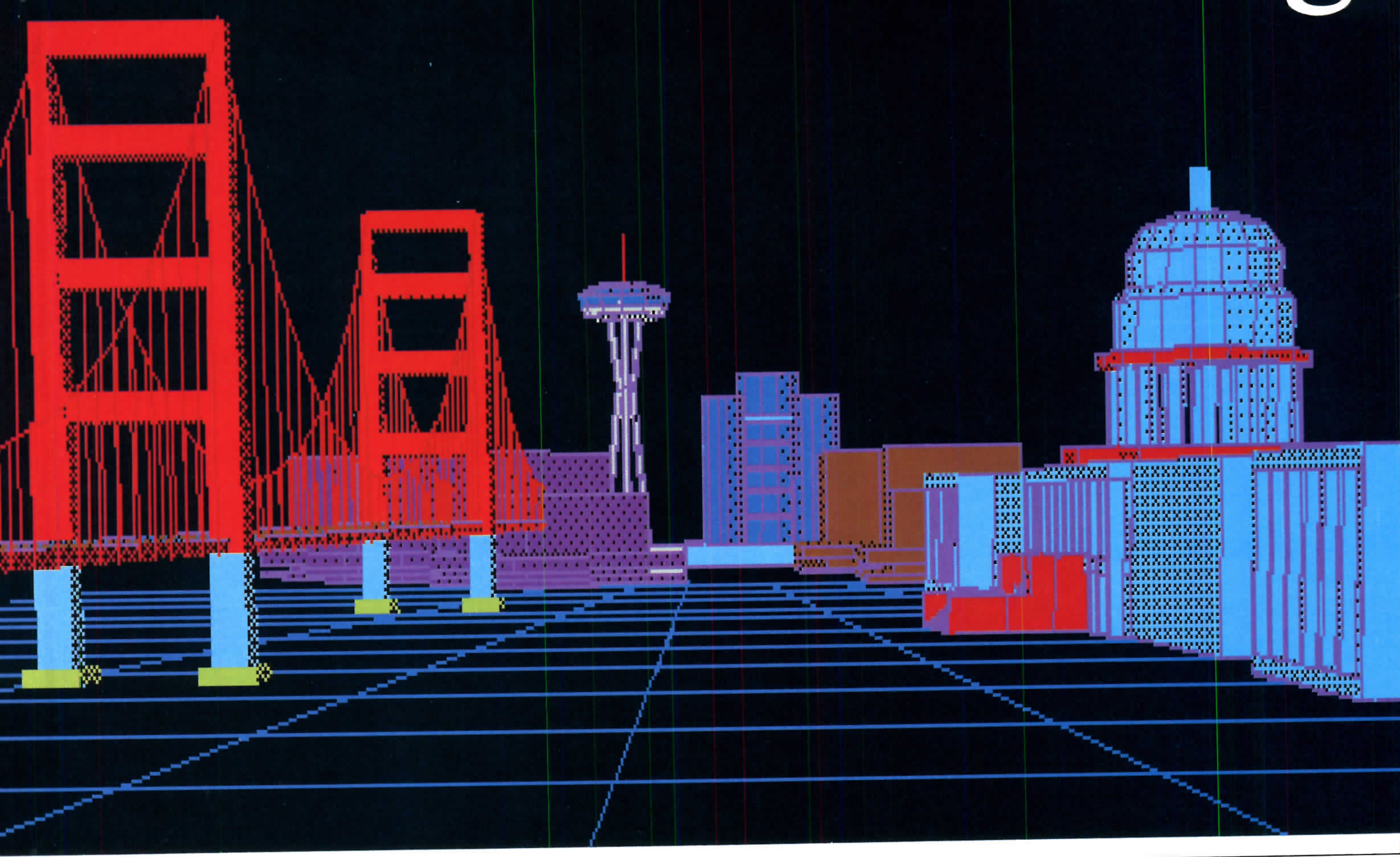
Standing Seam Skylight
A new standing seam skylight system is designed to prevent leaks by incorporating two roofing techniques—standing seam and step flashing. The skylight system has vertical risers on the outside edges without through-fasteners to provide a run-off channel for water and to avoid creating conduits.

The skylight's continuously formed 1½-inch to 2 ½-inch vertical risers are angled at 90 degrees on opposite outside edges. The risers mate with metal step flashing and are capped with press-fitted weather caps. Metal clips lock the flashing and skylight risers together and attach the entire system to the roof sheathing. Weather flashing shrouds at the high pitch end of the weather cap further protect against leakage.

The double- or triple-glazed skylight consists of an earth-tone outer dome and an inner layer or layers glazed with Lexan, a polycarbonate sheet. The outside surface of the dome features a clear ultraviolet treatment that provides resistance to yellowing, surface hazing, dulling, and prolonged sun exposure. Each inner insulating layer, available in transparent or diffused tones, is bonded to the outer skylight, creating dead air space for extra insulation and zero air filtration.

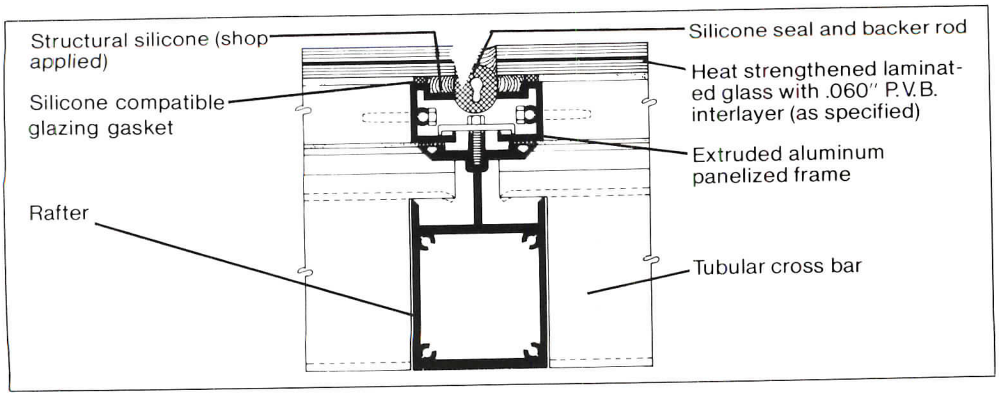
The skylight comes with a step flash-
continued on page 124

Design



Products *from page 123*
ing kit that includes continuous pre-caulked weather caps, flashing shrouds, and roof fastening cleats. Skylight sizes range from 22x22 inches to 46½x69½ inches.
Kenergy
Circle 262 on information card

Structural Silicone Glazing Systems
Structural silicone glazing systems (SGS) (below) create a seal to impede water and air infiltration. Proper joint design, tooling and curing time, compatible cleaners and primers, as well as handling methods for glazed frames, are inherent in good SGS system installations.
O'Keeffe's
Circle 268 on information card



Framework Skylights
Skylights, made of high-performance thermoplastics that resist moisture damage from indoor humidity and outside weather, also feature integral frameworks or base curbs. The bases are formed with built-in condensation gutters, weather gaskets, and insulating air channels. The base is fused at the corners to provide an airtight seal.
Wasco Products
Circle 266 on information card

Low-E Glass Coatings
Hardcoat low-e glass is standard on Sunrise venting and fixed roof windows from Roto Frank, with tinted low-e glazing optional.

All seven models have EPDM gaskets and a step-flashing system for weathertightness. The roof windows come with inside screens attached and a hardware base plate installed. Versatile hardware permits hand-crank, pole-crank, and motorized operation.
Roto Frank of America
Circle 264 on information card

Clearspan Skyroof
Kalwall/Structures Unlimited Clearspan Skyroof is completely predesigned and engineered. The translucent skyroof, a modular and independent structure with 2 ¾-inch-thick panels, is fully insulated and weighs less than two pounds per square foot.
Structures Unlimited
Circle 263 on information card

NEW AND NOTEWORTHY

3-D Project Capability Software
3-D Projections software, formerly sold as a separate package and now bundled with Cadvance design and drafting software, provides oblique, isometric, and perspective projections. These projections are based on information in the 2-D designs developed on Cadvance. It is then projected into the "Z" plane, creating wire-frame drawings.

Designers can produce marketing-

quality drawings by performing their own hidden-line removal and then rendering the piece after plotting.
Calcomp
Circle 271 on information card

Glass-Clad Polycarbonate

Arm-R-Secur glass-clad polycarbonate laminate, when used in conjunction with Arm-R-Clad heat-strengthened glass, offers resistance to abrasion and scratching and provides substantial protection against ballistic and physical attack.

Arm-R-Secur products are recommended for security applications such as detention facilities, bank and teller windows, and guardhouse installations.

Gun ports, speak-holes, pass-throughs, tinted glass, and polished edges are all available.
Hordis Brothers
Circle 272 on information card

Silicone Architectural Gaskets

Silicone-based architectural gaskets reputedly offer better characteristics than conventional gaskets, providing additional structural integrity in window installations where there are high loads on the glass light, such as rain, snow, or wind pulse. Silicone rubber is designed for resistance to sunlight, UV light, weathering, air pollution, and extremes in temperature and age, without degrading. The silicone compounds range in hardness from 50 to 80 durometers and are suited for the manufacture of glazing strips, seals, spacers, wedges, and setting blocks.
Stalwart Rubber
Circle 273 on information card

Lap Splicing Chart

A rebar lap splicing chart determines precise rebar lap splice lengths for all rebar slips, Grade 40 or 60, and different concrete strengths (3,000 psi to 8,000 psi).

The charts detail both compression and Class A, B, and C tension splices for normal and lightweight concrete, and for top and bottom bars. Standard hook embedments and dimensions for 90 inch, 135 and 180 hooks, such as seismic stirrups and ties, are also included.

The charts are available in a wall or desk size. The wall size (28x5 inches), shows full-size 90 and 180 bends on #18 bars; the desk size (11x23 inches) folds easily into a briefcase.
The Concrete Reinforcing Steel Institute
Circle 274 on information card

Machine-Erasable Drafting Film

This drafting film takes 20 or more erasures in the same area of a drawing without surface "burn-off" or ghosting. The only requirement states that the erasing machine be fitted with a vinyl eraser and be used dry for pencil lines and slightly moistened for ink images.

Ageproof Satin coated polyester film draws its name from a smooth drafting surface said to yield uniformly dense, crisp lines in pencil or ink even after repeated revisions. The film also has a satin (nondrafting) back surface to aid handling and filing. The new material comes in standard roll and cut-sheet sizes.
Dietzgen
Circle 275 on information card

Office Chair

The Techair is available in three models: Management, Operator, and Dual-height, and is designed for technical work stations.

On the Operator and Dual models, the back adjusts to provide lumbar support. Front to rear positioning of the back supports any seated angle. The pitch of the seat is set in relation to the back angle and the task requirement. The Management model has a larger, pivoting back with a conventional swivel tilt. Pneumatic or manual height adjustments of the Operator and Management models provide more than a four-inch range of seating height. The Dual model adjusts for either high or low work surfaces with a

continued on page 126

Products *from page 125*
seven-inch height range and comes with or without a foot ring. The foot ring adjusts independently for additional comfort.

The chair meets or exceeds test standards developed by the Business and Institutional Furniture Manufacturing Association and is approved by the American National Standards Institute.
American Seating
Circle 276 on information card

Advanced Formula Latex Paint
Weather King II Latex Exterior Paint features a new formulation offering moisture-repelling properties and low-temperature tolerance. The paint has fast-drying properties and it is suitable for application on hardboard, wood, and aluminum and vinyl siding. Weather King II comes in more than 1,000 ready-mixed and custom colors, and O'Brien Corporation claims it offers all the benefits of latex paint, including easy cleanup, low odor, non-toxicity, and fire and mildew resistance.
O'Brien
Circle 277 on information card

Ultra-Board for Exterior Surfaces
Nonasbestos Ultra-Board resists impact yet flexes enough to form curved facades. These properties enable the board to provide a resilient backing for coatings.

Eternit designs the "Class 1" building board specifically for non-asbestos fire performance and resistance to weather, moisture, rot, and insects. Various aggregates and textured surfaces can serve as coatings, and standard tools can cut the board. The board can withstand drilling or nailing up to ¼ inch from the edge; it is guaranteed not to crack or chip.
Eternit
Circle 269 on information card

CREDITS

Williams College Museum of Art, Williamstown, Mass. (page 28). *Architect: Robert L. Harper, FAIA, and Charles W. Moore, FAIA, Centerbrook, Essex, Conn.* (Phase I) Structural engineer: Spiegel & Zamecnik. Mechanical and electrical engineer: Flack & Kurtz. Security: Joseph M. Chapman, Inc. General contractor: Fontaine Brothers. (Phase II) Structural engineer: Besier Gibble Norden. Mechanical and electrical engineer: Isidore Schiffman Consulting Engineers. Security: Joseph M. Chapman, Inc. General contractor: Breadloaf Construction. Project managers: Dennis Dowd, AIA, and Richard L. King, AIA. Ceiling surfacing system: Armstrong, U.S. Gypsum, Chicago Metallic. Doors: Falconer. Elevators: Dover. Environmental control systems: Carrier, Trane. Floor surfacing: GAF, Stratton, Wellco. Lighting: Edison Price, Eliptipar, Keene, Daybright, Lightolier, Chloride. Roofing: NRG Barriers, Firestone, Owens Corning. Waterproofing and sealants: Tremco. Lavatories: Kohler, American Standard. Water closets: Kohler, American Standard. Kitchen sink: Elkay. Handicapped lift: Garaventa. Kitchen: Hobart, St. Charles, King. Signage: Lynn Signs. Columns: Architectural Shapes. Windows: Pella. Skylights: Imperial Glass. Blinds: Bally. Hardware: Stanley, Russwin, Ives. Paint and stain: PPG.

Museum of Contemporary Art, Los Angeles (page 40). *Architect: Arata Isozaki & Associates, Tokyo, Japan.* Associate architect: Gruen Associates. Developer: Grand Avenue Associates. Principal in charge: Arata Isozaki, Hon. FAIA. Project designer: Makoto Shin Watanabe. Design team: Makoto Kikuchi, Ron Rose, Hajime Yatsuka, Allyne Winderman. Partners in charge: Herman Guttman, AIA; Kurt Franzen, AIA. Project architect: Robert Barnett, AIA. Production team: Jonathan Hankin, AIA; Anna Marie Howell, AIA; Chad Dasnanjali. Construction supervisor: Mike Enomoto, AIA. Construction coordinators: Teresa Sanchez, Victoria Austin. Structural engineer: John A. Martin & Associates. Mechanical engineer: Syska & Hennessy. Architectural consultant: Marcy Goodwin. Lighting consultant: Jules Fisher & Paul Marantz. Acoustical consultant: Bolt, Beranek & Newman. Graphics: Chermayeff & Geismer Associates. Architectural graphics: Particia Moritz Design. General contractor: HCB Contractors. Elevators: Fujitec Elevators. Security system: Access Control Technology Systems. Roofing: Koppers, Aetna Sheet Metal. Wall surfacing: Sekigahara, Carrara/Hatch, Weiss Sheet Metal, Nippon Electric Glass. Paving: Carrara/Hatch, Stepstone. Office windows: Fentron Industries, Fischer, Schlain. Skylights: Okalux Kapillarglas. Carpet: Royalty Carpet Mills, Hutchison, Kettering/Krussman, N.E.G., Armstrong.

Alabama Shakespeare Festival, Carolyn Blount Theatre, Montgomery, Ala. (page 66). *Architect: Blount/Pittman & Associated Architects, Atlanta.* Design Partners: Thomas A. Blount, AIA; L. Perry Pittman, AIA. Job captain: M. Durwood Dixon, AIA. Theatrical consultants: Artec Consultants. Structural, mechanical, and electrical engineers: Blount Engineers. Landscape and civil engineers: Hunter ReynoldsJewell. Interiors consultant: Bear-McGowin Interiors. General contractor: Blount International, Ltd. Other consultants: Michael Stauffer, Allene Reagin. Ceiling surfacing: Armstrong World Industries, U.S. Gypsum. Custom woodwork: Columbus Cabinet, Woodcraft Manufacturing. Doors: Columbus Cabinet, Firedoor Corporation of Florida, Industrial Acoustic Co. Elevators: General Elevator. Environmental control systems: York Division of Borg Warner Corporation. Floor surfacing: Lacey-Champion Carpets, Garner Stone, Custom Floors, Mt. Airy Quarry. Foundation: Blount International. Handrails: Julius Blum & Co., Construction Services. Lighting: Imperial Bronzelite, Western Lighting Standards, Prescolite, Strand-Century, Winona Studio of Lighting, Kurt Versen. Waterproofing and sealants: Standard Roofing, Dow Chemical U.S.A. Flush valves: Sloan Valve. Plumbing and showerheads: Kohler. Sprinklers: Automatic Sprinkler Corporation of America. Toilet stalls: Bobrick Washroom Equipment. Lavatories: Kohler. Washroom and bathroom accessories: Bobrick Washroom Equipment. Water closets and fountains: Kohler, Filtrine Manufacturing. Communication/intercom: Ancha Electronics. Stage rigging and equipment: Hoffend & Sons. Wire grid rigging: J.R. Clancy. Kitchen: Fixture-World, Commercial Millwork. Public seating: Race Furniture, Clarin. Security and fire detection: Simplex Time Recorder. Signage: American Graphics Signs, Charleston Industries, Henley Memorial. Stairs: Columbus Cabinet Co. Wall surfacing: Jenkins Brick, U.S. Gypsum. Skylights: SuperSky Products. Hardware: Rixson-Firemark, Stanley, Schlage Lock, Von Duprin, Baldwin. Paint and stain: Sherwin-Williams. □

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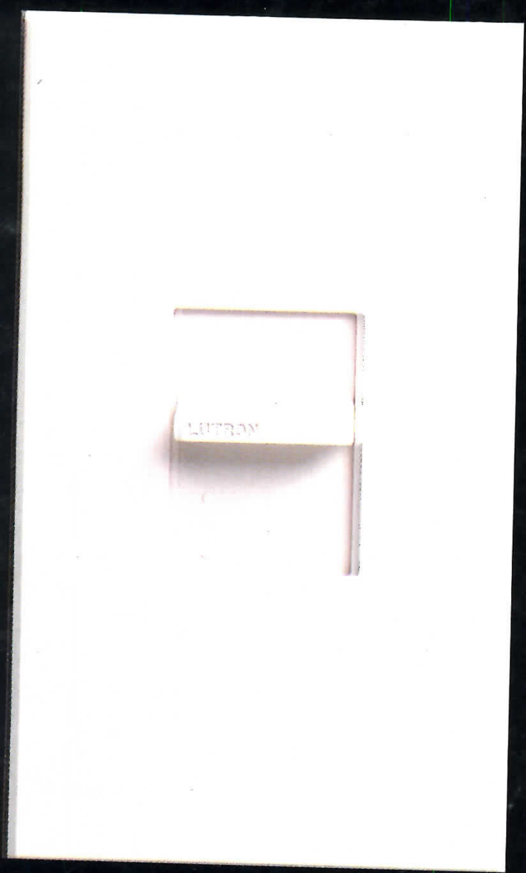

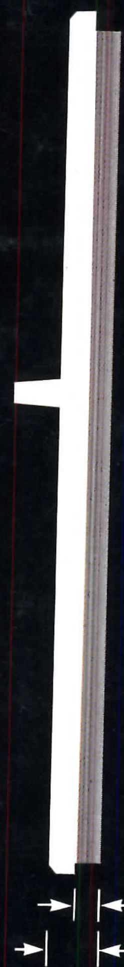

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