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FROM THE INDOOR WORLD® OF Armstrong

Circle No. 308

The Young Collectors' SHOPPE
65 Introduction: Museums, the second round
Major current museum construction and renovation follows by nearly a century an earlier museum building boom.

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In a significant renovation of the Toledo (Ohio) Museum of Art, HHPA has stayed with the Classical idiom.

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A small addition by architects Levin Porter, serving as new entry to the Dayton Art Institute, performs a number of transitional roles.

76 Accommodating Pope and Pei
New ground-floor galleries have been opened in the final phase of renovation of the National Gallery of Art, Washington, D.C., by Keyes Condon Flord.

80 Jewel boxes
An existing gallery of the Art Institute of Chicago has been renovated by Krueck & Olsen to house a collection of works by Joseph Cornell.

82 Art inhabiting Nature
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94 Portfolio
P/A shows a selection of museums in progress or recently completed.

109 Radical roofing
Polymer-based synthetic roofing in sheet or liquid form has brought about a radical change in the treatment of flat roofs.

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<table>
<thead>
<tr>
<th>Material</th>
<th>Cost Inst. (per sq. ft.)</th>
<th>Taber Wear Factor</th>
<th>Flame Spread</th>
<th>Smoke Density</th>
<th>Mfr. to ASTM C-126</th>
<th>Minimum Compressive Strength*</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGFT</td>
<td>$6.90</td>
<td>less than 15</td>
<td>0</td>
<td>0</td>
<td>Yes</td>
<td>1500 psi</td>
</tr>
<tr>
<td>Glazed Concrete Masonry Unit (CMU)</td>
<td>7.10</td>
<td>less than 130</td>
<td>under 25</td>
<td>under 50</td>
<td>No</td>
<td>600 psi</td>
</tr>
<tr>
<td>Ceramic Tile:CMU</td>
<td>6.90-8.12</td>
<td>varies</td>
<td>under 25</td>
<td>0</td>
<td>No</td>
<td>600 psi</td>
</tr>
<tr>
<td>Epoxy Painted CMU</td>
<td>up to 6.83</td>
<td>needs repainting</td>
<td>varies</td>
<td>varies</td>
<td>No</td>
<td>600 psi</td>
</tr>
<tr>
<td>Epoxy Painted Drywall:CMU</td>
<td>4.06-9.36</td>
<td>needs repainting</td>
<td>varies</td>
<td>varies</td>
<td>No</td>
<td>600 psi</td>
</tr>
</tbody>
</table>

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Although we tend to think of buildings as whole creations, valued for their unity, some of our best architecture is produced in increments over time.

Architectural historians have had a hard time dealing with buildings that were not conceived all at once. Yet they have had to acknowledge that some of the finest works of architecture were built piece-by-piece through periods of changing program objectives and design concepts. Most of the English Gothic cathedrals, for instance, have come to be studied and admired for their diverse accretions over the centuries. The same can be said for many of the world's great palaces and religious structures.

Which are the greater architectural achievements—self-contained designs rigorously carried through or sensitive incremental additions? Is Wren's cathedral in London a finer work than his Trinity College Library at Cambridge or his Tom Tower at Oxford? In judging the built architecture of Michelangelo, we have little choice; all we have are fragments embedded in the work of others.

In the modern world, where palaces and cathedrals are less significant, the pattern of long-term incremental growth has been more evident in public institutions such as hospitals and museums. These are the kinds of buildings that now remain tied to one location through long periods of evolution. The works featured in this issue were chosen as examples of current museum design, but by no coincidence almost all are actually new increments in existing structures.

In the past decade, our architects have begun to consider additions to existing fabrics as seriously as the isolated creations that were the icons of the Modern movement. Now it is fashionable to refer to architectural efforts as "interventions," acknowledging the existing situation. But how well have we "intervened" so far?

Most of our major museums, such as New York's Metropolitan or the Art Institute of Chicago, have grown additions that have their good points, but are in the aggregate nothing to celebrate, architecturally. The controversial current additions to New York's Museum of Modern Art merely enshrine some elements of the old, familiar museum in a vastly different complex. The firm of I.M. Pei & Partners has carried out some of the most ambitious museum expansions in America: the East Building of the National Gallery in Washington (P/A, Oct. 1978, pp. 49-59), the new wing of the Boston Museum of Fine Arts (P/A, Sept. 1981, p. 37), and the Payson Building of the Portland (Maine) Art Museum (this issue, p. 100). While the intention to be complementary in plan and form is apparent in all these cases, their success as complementary additions is arguable. In a series of addition projects, James Stirling has adjusted his approach from the extremely self-effacing at the Rice University School of Architecture (P/A, Dec. 1981, pp. 53-61) to a bold amalgam of contextual images for the Fogg Museum annex at Harvard (P/A, June 1981, pp. 25-26) to an assertive addition to the Tate Gallery in London (P/A, Nov. 1981, p. 26) that seems to defy the rather dowdy main building. We'll have to wait to see what Michael Graves has in mind for the addition that is destined to loom over the Whitney Museum in New York.

One noteworthy phenomenon of recent years is the design of buildings as if they were agglomerations of increments. This kind of accretive design has been seen before—in Shingle Style houses, for instance, and in Collegiate Gothic dormitories—where the intention was to evoke vernacular or Medieval precedents, or both. It reappeared in the 1960s in a spate of "Italian Hilltown" designs.

A recent example is Edward Larrabee Barnes Associates' Dallas Museum of Art (P/A, June 1983, p. 37), which is an arrangement of blocks interspersed with courts—and which is already being expanded during its initial construction. Another interesting, more polemical, example of accretive design can be seen in the South Side Settlement in Columbus, Ohio, by Craig Hodgetts and Robert Mangurian (P/A, Feb. 1981, pp. 78-85).

It is common knowledge that a large and apparently growing proportion of our architectural commissions involve additions and alterations, rather than starting anew. Complementing the statistical picture is a revised set of beliefs and objectives. Our current respect for historical architecture and our awareness that each new "intervention" must contribute to a larger context make the reworking of existing buildings more rewarding. From another viewpoint—that of professional practice—many are advocating long-term architect-client relationships (P/A, Dec. 1982, pp. 64-66), the kind of ongoing design process that is exemplified in the Louisiana Museum (pp. 82-87). Given this situation, it is essential to study effective strategies for expanding and altering. Such work can enhance what is there and—at best—yield a new, more satisfying whole.

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Wm. Michael Hargis
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I was reading the article about Josep Lluis Sert on P/A News report (June 1983) by Mr. Willo von Moltke when one of his statements called my attention. Mr. von Moltke said that the Carpenter Center at Harvard University is "the only building by the master architect (Le Corbusier) in the Americas."

I would like to point out to Professor von Moltke that before the Carpenter Center was built, Le Corbusier was architect to two other projects also built in America: the Ministry of Education and Culture (Rio de Janeiro, 1945), and the Curruchet House (La Plata, 1949).

Josep Dominguez-Marzo
Former Professor of Architecture, UNBA
Gibbs & Hill, Inc., New York

I feel that Mr. Vonier is "nit-picking" ("Saving face," P/A News report, June 1983). Certainly, the architects may be faulted for poor or insensitive design detailing in the instances of ceiling lines and window heads, etc., etc., etc. The owners and/or developers obviously determined that it was both advantageous and prestigious to adapt and conserve rather than to raze. I would, in fact, praise them for preserving the human scale of the streetscape. Much more disturbing to me is the introduction of copies of ornamental detail!—W.F. Lampe, Jr., Southern Consultants, Inc., Nashville, Tenn.

[Preservation of the streetscape" is not really accomplished if an unsympathetic curtainwall looms just above the embalmed original cornice.—Editors]

Dean Malta's excellent design (P/A Furniture Competition, P/A, May 1983, p. 168) underscores the fatuousness of most of the other winners. How could a jury which included the redoubtable Frank Gehry have selected from among 870 entries these clumsy, pretentious and useless objects? I am appalled. Judith Arango
Miami, Fla.

[If the writer had seen the models and prototypes P/A displayed in New York, Los Angeles, and Chicago, she might appreciate the ingenuity, craftsmanship, and elegance of form in some other pieces. Announcement of the fourth annual furniture competition will be in the September P/A.—Editors]

All black and white photos on pages 90 and 91 of P/A in June ("A mosque for Abiquiu") should have been credited to Kevin Bubriski.


Face-saving logic
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This coffee table by architect and Formica Corporation Design Advisory Board member, Paul Segal, is a contemporary translation of a Doric column. Because COLORCORE is solid color there are no edge lines to be seen.

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Actually, Charlie roasts every sunny afternoon. In fact, during July and August he’s well done at about 5:00 P.M.

You see, Charlie’s desk is next to a south facing window-wall in a nifty, new office building in Virginia. The architect’s idea of collecting passive solar energy was great last winter. But this summer Charlie needs help and neither the building’s air conditioning nor solar tint glazing are quite up to the task. Sure he could close the blinds. But Mildred over in accounting would complain that she couldn’t see the Blue Ridge Mountains just over his left shoulder. And Agnes in sales service would say she can’t work in the dark.

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The passing of an iconoclast
R. Buckminster Fuller, visionary and inventor, died July 1 in Los Angeles at the age of 87 of a heart attack. His wife Anne Hewlett Fuller, who had been hospitalized, died 36 hours later.

Although he was never trained or licensed as an architect, Fuller converted countless architectural students to his optimist's doctrine of salvation through technology. His well-known inventions, such as the geodesic dome and the Dymaxion house, and his writings helped spread the word.

An article on Fuller's life and work will follow in an upcoming News Report.

France drops the fair
The French Government has abruptly dropped its plans to host the 1989 World's Fair.

The decision, officially attributed to rightist Mayor Jacques Chirac, nevertheless reflects the reigning Socialist Party's austerity line and the widespread concern that Fair crowds and construction would damage the city of Paris.

While some of the grandiose building projects tied to the Fair, notably le parc de la Villette (PA, May 1983, p. 26) and le Ministère de l'Économie et des Finances are reportedly unaffected by the decision, others may be reconsidered, among them projects for la Défense and L'Opéra de la Bastille.

Knoll goes public
Knoll International has announced its decision to sell stock publicly. Shares will start at $17-$20 each.

Meanwhile, Knoll directors Steven Swid and Marshall Cogan have bowed out of the battle to buy Sotheby's, the British auction house, leaving the field open to Detroit developer Alfred Taubman whose suit the Brits preferred.

Too close a call
New York's religious establishment has failed to push through a bill exempting houses of worship from preservation laws.

Lobbying by New York's Municipal Arts Society, the Landmarks Conservancy, and Mayor Koch kept a formidable coalition of the New York Board of Rabbis, the Roman Catholic Archdiocese of New York, and the Council of Churches from convincing legislators that landmark laws infringe upon religious freedom. The claim, dead for this legislative session, should remain so.

New landmarks chief
Gene Alfred Norman has been named the chairman of the Landmarks Preservation Commission in New York. The architect, who was executive vice president of the Harlem Urban Development Corporation, replaces Kent Barwick, now Executive Director of the Municipal Arts Society.

Building the Building Museum
The D.C. firm Keyes Condon Florence and Giorgio Cavaglieri, New York, will renovate D.C.'s Pension Building, home of the National Building Museum.

Bartlesville:
The Goff-fest
Oklahoma was still cool when 450 ex-students and architects gathered June 6-9 in Bartlesville to celebrate the 80th birthday of Bruce Goff who died last year. This was the first and maybe the last time so many Goff houses were open to the public in Bartlesville, Tulsa, Oklahoma City, and Norman. They stood out from surrounding houses like the last lingering Indian paint brushes burning an orange hole in the fields.

Goff followers came from as far away as Israel, Japan, and Belgium. Their compatriots in this country, the so-called American School, proved to be no more ethnocentric than their accents: the flat vowels of Chicago blended with the nasal twang of Oklahoma and Texas, rectangular plans mixed with hexagons and curves, and the generalized rootless California accent and design were much in evidence.
At the races:  
\textbf{A/E Systems '83}

More than 8500 design professionals crowded into Dallas's Market Hall for the opening of A/E Systems '83, looking to pick the winners from over 380 computer and reprographics vendors. The big names in computer graphics—Computervision, IBM, Intergraph were all at the show. So too were smaller but no less promising firms, including McAuto, Summagraphics, Sigma, Arri-goni, CADAM, Formative Technologies, and others.

Apart from lower prices (as low as $50,000 to $60,000 per workstation, versus $100,000 last year), other notable advances this year included more accurate 2-D and 3-D color resolution, reaching photographic quality, and faster, friendlier programs, some as responsive as pencil on paper. A few companies have made their screen image more "architectural," using black lines on a white background. Others have refined furniture and lighting to complement their equipment.

As evidenced at Systems '83, computer graphics technology is changing quickly, perhaps too quickly for the average architect striving to keep up or for the vendor seeking a payback on hefty investments. The confusing change, however, signifies greater diversity and choice, promising more hardware and software tailored to an office's particular operation. [TF]

The group had in common their love of a remarkable teacher who had inspired them to trust their own creativity. All had learned from Goff's pragmatism, drawn from the baling wire school of thought (things made for one purpose will serve another). Goff's treasure troves were war surplus yards or five-and-tens. Building an officers' clubhouse in the Aleutians in the 1940s, he had a warehouse full of scrap moldings cut up and painted gold and silver to change the shape of the posts. Later, he made the skeleton of the Hopewell Baptist Church (1950-55) out of a waste material plentiful in Oklahoma—used oil pipes. Stainless steel cables from airplane surplus anchored the spiral tower of the Bavinger house (1950-55). Even when the budget was ample, as in the Joe Price house (1956-58), Goff used coal with occasional cullets of waste glass for walls, the aquamarine chunks shining out of the rich black.

The general perception of Goff as a surface decorator with a love of Klimpt ignores his skill as an engineer. By age 12, Goff was working part time in the office of Rush, Endacott & Rush; he passed his engineering exams for his license at age 19, and in 1929 the firm became Endacott & Goff.

Goff's early practice in Oklahoma responded to every breeze from here and abroad. He worked early in the Deco style (Boston Avenue Methodist Episcopal Church 1926-29), then in the stripped-down style of Loos/Gill before setting his own unique style.

Goff supporters now have a newsletter, Friends of Kebby, 7430 S.W. Canyon Dr., Portland, Ore. 97225. Future birthday celebrations are planned.  
[Esther McCoy]
Introducing Colorcore

Formica Corporation's Colorcore, the integrally colored laminate that does away with the black line, made its debut at Neocon XV. Scale models of five projects, winners among over 700 entries in Formica's Surface and Ornament Competition I for conceptual design, were shown together with invited commissions from ten American designers.

The "Temple Chair" by Lewis & Clark of Columbia, S.C., took first prize; "Neopolitan," gelati cum coffee table by Lee Payne (Atlanta, Ga.), second; "Strata," a table and trompe l'oeil tablecloth by Brian Faucheux (Metairie, La.), third; a classical cabinet by Paul Chiasson (New York), fourth; and a table sculpture by Cary Siress (University of Kentucky), the student prize. Five citations were also awarded. The competition, juried by Charles Boxenbaum, Joe D'Urso, Paul Segal, and William Turnbull, Jr., of Formica's Design Advisory Board with Niels Diffrient, David Gebhard, and Robert Maxwell, totaled $28,000 in prize monies.

Commissioned objects ranged from pragmatic prototypes to playthings: L System, Emilio Ambasz/Giancarlo Piretti; Cart-Mobile, Ward Bennett; "Ryba," Frank Gehry; "Modern Post-Neo Table," Milton Glaser; an elevator cab, Helmut Jahn; a corner cupboard, Charles Moore; a door, SITE; "Tete-a-tete," paired chairs, Stanley Tigerman; a mirror in the Greek Revival manner, Venturi, Rauch & Scott Brown; and "Broken Length," a table, Massimo and Lella Vignelli.

Entries for Part II of the Colorcore competition for completed room installations are due Feb. 15, 1984. Inquiries should be addressed to Colorcore, Formica, One Cyanamid Plaza, Wayne, N.J. 07470. [DDB]

Brainstorming at MIT

Approximately 35 invited representatives of the building and academic communities who assembled for the two-day Hennessy Symposium at MIT's Endicott House were quick to identify problems that face the building industry. Among acknowledged difficulties were the building industry's low productivity and crafts-based mechanics, its poor innovation record, and its problems attracting or keeping talent.

According to keynote speaker Ezra Ehrenkrantz, such problems stem from the government's use of the building industry to either slow or stimulate the economy. The resultant three-year recession cycles inhibit industry innovations that typically take five or six years to develop, lower employee productivity and morale, sponsor layoffs, and discourage capital investment.

Potential courses of action were identified: develop a more unified voice within the building community to achieve economies of scale and to compete against cohesive foreign competition; coordinate research activities between universities and industry to better compensate for shrinking federal research dollars.

Given the complexity of the problems, a search for firm solutions is unrealistic. We may hope, however, for further industry-wide discussions as broad and probing as the Hennessy Symposium. MIT is to be applauded for this first effort and encouraged to continue it. [TF]

Contrapuntal fugue

"California Counterpoint," a show of new West Coast architecture at the National Academy of Design, New York (through Sept. 15), is a mix of separate melodies set in a common key. Craftworks by architects Andrew Batey and Mark Mack (1982 Hildebrandt residence shown above), Frederick Fisher, Frank Gehry, Craig Hodgetts and Robert Mangurian (Studio Works), Coy Howard, Thom Mayne and Michael Rotondi (Morphosis), and Stanley Saitowitz embellish simple, abstract themes with elaborate technique. The show, curated by Helene Fried and Lindsay Stamm Shapiro, is accompanied by a catalog with essays by Nory Miller and Michael Sorkin. [DDB]
[News report continued on page 33]
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Competitions

The current craze for competitions has touched all building types—museums and art schools among them. Two such contests are documented here. Although the charrette format of Santa Barbara may have stressed presentation technique over design, it offered five teams of relatively unknown architects, selected anonymously from the first phase, an opportunity to compete as equals for a major commission. A more structured competition to design OSU's Center for the Visual Arts drew divergent solutions from five prominent architects and their Ohio affiliates.

University Art Museum, UC Santa Barbara

Supported by the National Endowment for the Arts and the UCSB Foundation, the Santa Barbara Art Museum competition is the latest in a nationwide spate of two-stage competitions, climaxed by a three-day, on-site charrette. The list of 450 registrants, 256 of whom completed the first stage judged April 16, attests to the format's popularity.

William H. Liskamm served as Professional Advisor for this competition, as for the Triton Art Museum competition in Santa Clara, Calif. (P/A, March 1983, p. 35). Although similar to the Triton model, the UCSB museum program required a more complex mixture of public and academic components. The proposed $5.3 million, 18,270-sq-ft museum will double campus gallery space. A 100-seat lecture hall, a 3190-sq-ft program/research area for prints, graphic arts, and architectural drawings, administration, and gallery service spaces fill out the program. The campus site is an open area west of the administrative building, bounded by parking and circulation.

The winning scheme by Michael Dennis and Jeffrey Clark of Newton, Mass., with Greg Conyngham and Gary Lapera, was the only one-story solution out of five. The jury found its welcoming forecourt and enclosed courtyard for outdoor exhibitions particularly appropriate to the local environment. The scheme was also judged to be the most functional and energy-efficient.

Also participating in the final or charrette stage were Antony Unruh and David Seeley of Los Angeles, with Ken Saylor and Don Nutty; Mark Cigolle, Katherine Coleman, Gregory Lombardi, and Boo Wong Kim of Inglewood, Calif.; William Palmore, Gavin Bromell, W.E. Kuykendall, Martina Perez, and Marcia McNelly of New York and El Paso, Texas; and Vladimir Arsene and James Lambros (A/L Design, New York), Abby Suckle and David Hu, and Anthony Z. Panu.

[Sally Woodbridge]

[Competitions continued on page 34]
Above and left: Vladimir Arsene, James Lambros (AIL Design), Abby Suckle and David Hu, and Anthony Z. Panu.

Above and left: William Palmore, Gavin Bromell, Martina Perez, Marcia McInnely
Above: east elevation facing Cheadle Hall.

Above and left: Tony Unruh and David Seeley with Ken Saylor and Don Nulty.

[Competitions continued on page 38]
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**TIMETABLE:**
Entry requests will be filled from September 1 to December 1, 1983.
Deadline for submissions: January 18, 1984
Judging: January 24, 1984
Awards Presentation: June 12, 1984

**INFORMATION:**
For full details, please contact:
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Center for the Visual Arts
Ohio State University

The proposed $16 million Visual Arts Center at Ohio State University in Columbus, Ohio, would integrate research, exhibition, and performance for all the arts, including such allied pursuits as landscape design and video.

Five final teams, composed as required of an Ohio firm and a non-Ohian affiliate, were selected to participate in the design competition's second phase. OSU's elaborate program offered two site options, both situated at one end of the campus's central oval where the art, art history, and theater departments are already concentrated. The schemes were judged in May by a jury composed of four OSU faculty and administrators and five invited guests. Henry N. Cobb of I.M. Pei & Partners served as jury chairman and Robert Miller of OSU as competition coordinator.

The final submissions catalog various postures of contemporary practice, from Arthur Erickson/Feinknopf, Macioce & Schappa Architects to Michael Graves/Lorenz & Williams; from Cesar Pelli/Dalton, van Dijk, Johnson to Kallmann, McKinnell & Wood/Lyndon Buchanan/Nitschke Associates. The winning scheme by Trott & Bean and Eisenman/Robertson Associates (see p. 96) differs radically from the other solutions not only in its overt imagery but in its underlying ideology, which the jury termed "adventurous and challenging." (At the other extreme, the jury also praised its detailed technical and cost report.)

The mandatory teaming of "name brands" and local firms, the detailed and yet open-ended program and the high stakes ($25,000 to each finalist) put the competition on a par with such recent events as the Humana Building competition in Louisville or the Southwest Bancshares in Houston despite obvious programmatic difference. Predictably perhaps, the contest is to be documented this fall in a Rizzoli publication organized by the peripatetic Ted Bickford and Peter Arnell. [DDB]

[News report continued on page 42]
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In progress: museums

This portfolio documents six museums and art galleries, two recently completed and the remainder underway. Also included are a wrap-up of projects from Texas, where museum plans proliferate, and a shortlist of museum projects around the country.

1a–d Fayette County Heritage Museum & La Grange Library, Fayetteville, Texas. Clovis Heimsath, Architect, Fayetteville, Texas. Drawing not only upon local heritage but upon European antecedents, Heimsath’s museum and library for Fayette County recreates a German-Czech barn. Traditional and modern techniques are mixed: timbers were fabricated using a modern laminating process, while Austin ashlar stone, board and batten wood siding, and plank wood floors apply simpler methods of construction. Necessary fireproof vaults for county documents form the base for a second-floor gallery set beneath the exposed pitched roof.

2a–c Everard Read Gallery, Rosebank, South Africa. Meyer, Pienaar & Partners, Inc., South Africa. This commercial art gallery extends an existing house now converted to administrative use. A ramped spine provides access to four discrete galleries, which grow successively larger and deeper down the sloping site. The grid of lateral showroom walls, reinforced in clerestory windows, is carried beyond curved and colored perimeter walls by beams supported on blue columns that delineate the site’s edge. One of several outdoor rooms can be closed over with a sliding acrylic vault.

[In progress continued on page 46]
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In progress continued from page 50

Vassar College Art Department and Museum, Poughkeepsie, N.Y. Michael Graves, Architect, Princeton, N.J. Michael Graves uses a large, domed hall to solve the difficult planning and massing problems entailed in adding to an existing collegiate Gothic building. The program is fairly complex: the existing Taylor Hall (Allen & Collens, 1913) will be renovated to reorganize its museum, offices, slide library, and teaching spaces; the new wing will contain gallery space, a 600-seat auditorium, seminar rooms, and study areas. Vassar is only one of several museum projects in the Graves office; also underway are additions to Emory University's art department/museum, the Newark Museum, and the Whitney Museum.

[In progress continued on page 56]
J.B. Speed Art Museum addition, Louis­ville, Ky. Geddes Brecher Qualls Cunningham, Architects, Philadelphia. Featured in the 1982 Whitney exhibit on new American art museums (along with Graves's Vassar) the Speed Museum is now nearing completion. The $4.2 million addition increases museum floor area by 20 percent. New galleries are formed of 20' x 20' modules organized enfilade and illuminated by skylights set into barrel-vaulted ceilings. Precedents for these “cabinet” galleries include Sir John Soane's Dulwich Museum and Louis Kahn’s Yale Center.

In progress continued from page 55

In progress, Texas-style

Leading the pack of new Texas museums in size and budget is the $29.6 million, 145,000-sq-ft Dallas Museum of Art by Edward Larrabee Barnes Associates and Pratt, Box & Henderson Associates (P/A News Report, June 1983, p. 35), due to open this fall. Foundation work on The Menil Collection (P/A, Sept. 1982, p. 40) is finally beginning to show above ground in Houston. The 70,000-sq-ft, $10 million project by Renzo Piano and Richard Fitzgerald & Partners will be completed in fall, 1984. At a different scale, Ford Powell and Carson of San An­tonio have completed the 12,000-sq-ft, $3 million Cowboy Artists of America Museum in Kerrville. Residential in character, the three-gallery building makes use of the firm's regional repertoire, using native stone, stucco over masonry, and bóvedas, the traditional, brick-vaulted skylights of Guadalajara. A similar ambience will charac­terize the same firm's Museum of the South­west in Midland, projected at 14,000 sq ft and $6 million. Venturi, Rauch & Scott Brown are now programming the downtown Laguna Gloria Art Museum in Austin with Renfro, Steinbower & Petty, Architects.

Other undercurrents suggest that a Museum of Fine Arts at the University of Texas, subject of a feasibility study completed in 1981 by Cesar Pelli & Associates, can be expected to move ahead within a year. In Corpus Christi, rumor has it that Philip Johnson, original architect of the Art Institute of Chicago's new addition, is now looking into the project.

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In progress continued from page 56

Museum of South Texas, is recommending Batey and Mack to design its expansion. Finally, a new building for the Tyler Museum of Art supersedes that on the Tyler Junior College campus (E. Davis Wilcox, 1971) may be the subject of a competition. [Peter C. Papademetriou]


Metro Dade Cultural Center, Johnson/Burgee.

In the works in other places . . .

In New York: Cesar Pelli's MoMA tower and extension nears completion; the Metropolitan Museum of Art's big building program by Kevin Roche/John Dinkeloo & Associates is nearly done; Michael Graves's Whitney Museum addition has yet to be revealed. In Los Angeles: HHPA's Los Angeles County Museum of Art will be joined by Bruce Goff's Price Museum; Frank Gehry's Temporary Contemporary will house the shows until Arata Isozaki's Museum of Contemporary Art is complete. In Atlanta: Richard Meier's High Museum of Art nears completion. In Miami, the delayed Dade County Cultural Center, Johnson/Burgee, plans its fall opening.


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Calendar

Exhibits


Competition:

Aug. 22. Application deadline, The Artist Views the City (all media). Contact Gallery at the Old Post Office, 120 W. 3rd St., Dayton, Ohio 45402 (513) 223-6500.

Aug. 31. Postmark deadline, 31st P/A Awards. See page 15 for information and entry form.


Sept. 2. Entry deadline, competition to design student services building at Virginia Tech. Contact Design Competition, College of Architecture and Urban Studies, Virginia Tech, Blacksburg, Va. 24061 (703) 961-6415.

Sept. 3-12-4, Sotokanda, Chiyoda-ku, Tokyo, Japan.

Sept. 10. 10th Tokyo International Lighting Design Competition ’83. Contact The Yamagiwa Art Foundation, 3-12-4, Sotokanda, Chiyoda-ku, Tokyo, Japan 104 (03) 253-2111.


Sept. 10. 10th Tokyo International Lighting Design Competition ’83. Contact The Yamagiwa Art Foundation, 3-12-4, Sotokanda, Chiyoda-ku, Tokyo, Japan 104 (03) 253-2111.


Conferences, seminars, workshops
Aug. 15-18. Second International Federation of Interior Designers forum, Winnipeg, Manitoba, Canada. Contact Department of Interior Design, University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada.

Sept. 5-10. 8th National Passive Solar Conference, Santa Fe, N.M. Contact American Solar Energy Society, 205B McDowell Hall, University of Delaware, Newark, Del. 19711.

News report continued from page 58

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<th>4-Ply Hot BUR</th>
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<tr>
<td>Squares per Man/Day*</td>
<td>Loose-Laid Ballasted</td>
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Museums: the second round

The current museum building boom in the U.S. is unprecedented—the first one was about 100 years ago.

By even a casual count, there are currently at least 30 major museum buildings, additions, or renovations in construction or about to begin construction in this country. A number of others have recently been completed. If one believes that things happen in cycles, a case can be made that museum building follows that norm.

Our first rash of activity occurred just about 100 years ago and extended through the period around the turn of the century sometimes referred to as the American Renaissance. Museums at that time, as outlined by Helen Searing in her *New American Art Museums* (published by the University of California Press in association with the Whitney Museum of American Art during its 1982 exhibition of the same name curated by Searing) had "a family resemblance, fostered by the employment of a classical vocabulary and a Beaux-Arts compositional method." They, in turn, she adds, were based on an evolution of design that traced its origins back to the work of J.-N.-L. Durand, Leo von Klenze, and Karl Friedrich Schinkel of roughly 100 years earlier.

The American museums of the first big cycle, and those that were later to follow the type, were based primarily on the idea of the institution as a repository and safeguard of precious objects. But today, the museum is no longer the place of quiet marble halls where one leisurely contemplates great artistic achievements of the past in serene tranquility. Attendance has soared, and with it most museums have greatly expanded their educational, cultural, exhibition, and even retail activities. Museums are now not only school, concert hall, and shop, but places where one must sometimes wait longer for admission than for a hit Broadway show. This has placed great demands on the museums, particularly the older ones, which now must address such problems as increasing exhibition space, adding new entrances from expanded new parking areas, and updating environmental and security systems.

Three of the museums shown on the following pages, in Toledo (p. 66), Dayton (p. 72), and Washington, D.C. (p. 76), have recently completed major alterations or additions dealing with just such problems. In Chicago, where the Art Institute completed a major expansion a couple of years ago, a new jewel-like setting (p. 80) has been created for some very special objects. In New Jersey, a new Environmental Education Center (p. 88), while not a museum in the conventional sense, becomes part of an extensive network of cultural, educational, and entertainment facilities on or in New York Bay, which include its own Liberty State Park site, Liberty Island, Ellis Island, and the South Street Seaport.

Not all of the activity is in this country, though. As our News Report (p. 42) and Portfolio (p. 94) show, the current building cycle is worldwide. Recognizing this, we single out a museum near Copenhagen for feature presentation (p. 82); additions to an institution that has been widely looked to as a model of modern museum design, we reasoned, would be of interest to both those who have, and those who have not, made the pilgrimage there. [David Morton]
Class distinctions

In past years a number of older museums across the country have added new entrances to their backs, and sometimes sides, for the purpose of providing direct access from the only direction in which adequate parking is usually available. As a rule, this is not a bad idea if handled with some discretion and if the typically grand original entrance is left intact and operable. But sometimes, as is the case with the very handsome Chrysler Museum in Norfolk and the Minneapolis Institute of Arts, to name just two examples, the old fronts were simply sealed off. Entering either of these museums now, however, is as spiritually uplifting and aesthetically exhilarating as a trek to a suburban shopping mall. (It should be noted that the Chrysler plans to rectify this problem—see p. 46).

Fortunately, the Toledo Museum has been spared such indignities. There, Hardy Holzman Pfeiffer Associates has added a new and rather grand entrance to the rear of the museum. It not only leaves undiminished the original front entrance, which is still very much in use, but allows a new formal procession through the building that was not possible before. Until the renovation, the transverse circulation axis had been amputated a quarter of the way back by an auditorium that (strangely for an institution whose primary interest is in exhibiting) occupied the building's two floors directly at its center.

By removing the auditorium, the museum could accomplish three important goals: a new rear entrance at ground level, a formal connection between it and the main front entrance on the piano nobile above, and most important, an additional 7000 square feet of exhibition space. Although all of these new functions were important to the museum, the one of the most urgency was the need for...
At the Toledo museum, the original front entrance (far left) remains in use, but the entire central portion of the building was renovated and a new entrance (left and below) was cut from the five middle windows at the back, where a new entry plaza now leads directly to the new formal hall.
The new rear entrance hall (left and below) is of marble, with 9000-pound granite columns. At its end, where Paul Manship's "Diana and Gazelles" is now seen in the new stair court, a large Matisse glazed-ceramic mosaic will soon be installed in that space, which was specifically designed for it. In the stair court (far right), green marble repeats pattern used in original front entrance.
additional galleries. In today's museum world, such facilities are essential to any institution that hopes to accommodate the blockbuster traveling shows, or even to organize them. Toledo in fact, organized the superb El Greco show that inaugurated the new space last fall. Before the renovation, such shows could be mounted only if the museum stored much of its own permanent collection.

As originally designed in 1910 by Edward B. Green, architect of the much-admired Albright-Knox Art Gallery of 1900-1905 in Buffalo, N.Y., and the Dayton Art Institute of 1930 in Ohio (pp. 72-75); the Toledo Museum, completed in 1912, was much smaller than what we see today. A major rear extension of 1926 enlarged the original auditorium to 800 seats and added a "Gothic" Hall to the upper level, thus doubling the building's size. Work completed in 1933 brought expanded gallery space in a new west wing, and the new 1750-seat Peristyle Concert Hall in a new east wing. With that completed, and also with the existing 180-seat Little Theater, the poorly ventilated auditorium, which did not compare to the rest of the interiors in architectural distinction, was of little
But what can be seen shows a quite sophisticated intervention into a highly refined milieu in which the architects did not mimic the Classical style of the original, but enhanced it through their own restrained and uncompromising Modern interpretation of that style. The work reveals that the architects, many of whose efforts in the past have been notably exuberant, and who set precedents for some of the freedom we see today, know very well how to be restrained and sedate. Before concluding that they have turned coat, however, it should be recorded that one museum official reported that “we had to put the brakes on a couple of times.” So, for those who worry about such things, we can rest assured that HHPA is still HHPA, even though they may have stepped, for the moment, into the rarefied air of the Classical realm. [David Morton]
Dayton Art Institute
Propylaeum,
Dayton, Ohio

Back to front

A small building by architects Levin Porter accomplishes a large number of transitional roles.

It is no easy task to turn the back of a monumental building into the front, especially the marvelous 1930 Dayton Art Institute designed by Edward B. Green (also the architect for The Toledo Museum of Art, p. 66). But for many functional reasons, that is what architects Levin Porter were asked to do. The original building, begun in 1928, is a striking Italian Renaissance Revival structure with a grand stair at the “front” showing direct influence from the Villa Farnese.

As in many institutions, the need for parking did not exactly set well on the dramatic hillside site; the hill that the stairs climb raises the five-sided original structure 60 feet above the Miami River, and the parking is forced to the opposite side. Because the slope is so pronounced, the actual level of the formal main entrance and exhibit areas is one floor lower than the parking. Because of its relative inaccessibility, the east entrance began to lose favor with patrons, who got into the habit of entering through the 1963 Rike Pavilion addition or through one of the exterior courtyard doors.

To solve this security problem, provide access for the handicapped, and create a fitting new main entrance to address the parking area properly, the back door needed to become the front. It now is; and it does those things admirably. If not outright in its humor, the new building at least seems to have a twinkle in its eye, a knowing one. While the program did not call for a high mass to function as entry, the scale of the addition had to be bold enough to signal from a distance that this was indeed where one should go to enter. To accomplish this, the architects have pulled the front wall up to a monumental height, leaving the actual ceiling at an ample but lower level behind it.

It was important to the architects that the references come from the older building, and hence the brickwork, limestone, and joinery do their part to recall the adjoining facility. Asymmetrical openings flank the main revolving door, with the wider one an access for wheelchairs. A patterned brick wall plane surrounds the keystone in the recess above the door, and at its right an empty niche again underscores the asym-
Dayton Art Institute

Light from the entry rotunda (previous page) penetrates to the second rotunda under the first (below). From here a visitor passes the museum store (far right) and on to the third rotunda (opposite page, left). This is a turning point in the passage into the existing main entry hall.
metry. At the south end, the limestone façade turns the corner, is notched into the brick, and disappears until the next corner. The north end of the main façade is carved away in a classically monumental way as it extends beyond the corner of the building.

Inside the front door, a visitor enters the first of three rotundas, this one capped by a quartet of domed skylights grouped to give the impression of being a single dome centered on the space. A colonnade comprising six piers with double plant-on "columns" rings the central space—the circular tubes are actually PVC pipe. Capped by stepped "capitals," the symbolic columns stop short of the floor on the upper level. Almost imperceptible among the floor tile, glass block reproduces the ceiling domes and passes light down to the second rotunda immediately below the first. From this main entry area, a visitor may enter the Pavilion wing or descend to the level of the original museum space via the angled stair which, from the landing down, becomes a series of semicircular levels. It is easy to see this area as a small amphitheater for storytelling or other intimate performances during slow periods.

As is the case with the upper rotunda, this is a transition space with light flooding down from above. It leads into or past the museum store, again ringed with paired columns—but these rest on a "base" and do not reach the ceiling. From this clearing, circulation leads down a corridor to the third rotunda, similarly treated, on the way to the main exhibit areas. From this knuckle, the path turns abruptly through a passage along the side of the existing auditorium. It culminates just before the old main lobby in a rectangular space (with similar columns) in which is the new elevator for handicapped access. The ceiling in all of these circulation areas is allowed to run in a consistent grid that ignores the angle of the walls, stopping short of them and creating a floating plane with jagged edges. It works as a device to create unexpected drama within a space that could have been a long, boring journey.

Both as an outsized object to attract attention and in its detail, the Propylaeum is a success. It is a far bigger statement than its program size of 2200 square feet would suggest. While it might look a bit tortuous in plan, it is not in experience. The details, the craftsmanship, and the colors employed add up to much more than the sum of its many parts.

[Jim Murphy]

Data
Project: Dayton Art Institute Propylaeum, Dayton, Ohio.
Richard D. Levin, principal in charge; Dale D. Smith, project designer.
Client: Dayton Art Institute; Bruce Evans, Director; Marie Ferguson, Administrator.
Site: addition to an existing 1930 museum on a relatively flat part of a hillside site.
Program: a 2200-sq-ft building to become the new main entry with visual and security functions.
Structural system: steel bar joists on masonry bearing walls and reinforced concrete floor.
Major materials: limestone, brick, and copper sheet, exterior; painted gypsum board, acoustical tile, carpet, quarry tile, and glass block, interior (see Building materials, p. 138).
Mechanical system: existing hot and chilled water from the building complex.
General contractor: Henry Stock & Son.
Cost: $868,764; $127.75 per sq ft.
Photography: Gregory Glass/ Dan Ingersoll, exterior; Glen Calvin Moon, interior.
The National Gallery's new ground-floor galleries, the final phase of renovations by Keyes Condon Florance, set up a sequence of public spaces that John Russell Pope would applaud.

The blockbuster exhibitions still snap the major headlines, and the trend among American museums towards once-in-a-century shows has scarcely abated. Yet, as the building programs of many museums indicate, the pursuit of Tutankhamen's gold has not entirely supplanted the curator's dream of opening a museum's permanent collection to public view. The new ground-floor galleries of the National Gallery in Washington, D.C., showcase objects that have languished out of public view for a decade or more. These galleries, the third and most successful phase of Gallery renovations carried out since 1978 by the D.C. firm Keyes Condon Florance, restore not only art work but also architecture to the public realm. (New York's Metropolitan Museum, the Gallery's closest competitor for the big shows, has pursued a similar path in the newly completed Lila Acheson Wallace Galleries, storehouse for its extensive Egyptian collection.)

John Russell Pope's 1941 plan for the National Gallery of Art lifted the principal galleries palazzo-fashion up one stately flight from the Mall. The first floor's sweeping east-west axis was not repeated on the more utilitarian ground floor, where a lecture hall and mechanical rooms blocked the central spine. Expansion over the years in the Gallery's non-exhibition functions (education, public adons, and conservation) and an increasing emphasis on temporary shows strained existing facilities, designed by Pope to house a relatively specific, permanent collection, and prompted planning for an addition in the early 1970s.

I.M. Pei's 1978 East Wing, with its 2:1 ratio of research/support to gallery space, replaced many of the old facilities and freed 40,000 square feet of the original ground floor for exhibition use. Keyes Condon Florance then reorganized the plan to reconnect all three ground-floor entrances via a new axis paralleling the grand sequence above. This spine, which ultimately ties in to Pei's underground concourse and cafeteria beneath the 4th Street plaza, is the key to the coyly titled "Project Breakthrough," the $10 million, 100,850-gross-square-foot renovation, funded by East Wing benefactor Paul Mellon with the A.W. Mellon Educational and Charitable Trust, the Kresge Foundation, and federal appropriations.

Project Breakthrough picked up where Pei left off and proceeded westward through Pope's building phase by phase, without dis-
A comparison of John Russell Pope's 1941 plan and the 1983 version by Keyes Condon Florance (below left, right) shows the shifting of support functions to create a new axis through the National Gallery's ground floor. The sequence of public spaces proceeds from the original 7th St. entrance (facing page, top), and passes through distinct antechambers (below) to culminate in a grand sculpture hall (facing page, bottom and left, below).
The new galleries (right and center) are open to the public without admission; the earlier café and sales shop with its poster alcoves (below and facing page, top left) are the means to more commercial ends. Conservation studies, analytical labs, and other support functions (facing page, top right) are never seen by the general public.

turbing the Gallery's public operation. The 4th Street entrance and sales shop, the first elements of the plan completed in 1976 and 1981, respectively, attempt with limited success to mediate between Pei's abstracted modernity and Pope's Beaux Arts classicism. The remodeled 4th Street entrance hall with its bulbous, brass-railed balcony at the first floor remains an unfortunate intervention by the East Wing architect. Keyes Condon Florence's extensive sales shop, a feature de rigueur in modern museums, plays at a contemporary classicism of half-barrel vaults, broken arches, and geometric floor patterns that emphasize but do not enhance the circulation axis. The shop splits a major mechanical room in two (here the "breakthrough" promised) and its construction required the removal and replacement of several columns in the renovation's most difficult structural maneuver.

The garden café, situated directly beneath the central rotunda, was completed as part of the second phase. Its new fountain under a backlit skylight pins intersecting cross axes visually and acoustically. The surrounding dense grove of columns may have inspired Mark Hampton's café decor, but his busy lattice work and lawn furnishings are too cute for this very special space.

It is the western galleries, the third and final phase of the project completed last spring, that come closest to what Pope might have preferred. Thickly articulated thresholds mold a sequence of vestibules that proceed from the 7th Street entrance to an elegant sculpture hall. Here the sales shop's awkward and trendy gestures are replaced by a more consistent and sculptural use of niches, pediments, arches, and moldings derived from Pope's examples and executed in plaster or marble. To the south of the sculpture hall are spun concentric rings of small rooms, scaled specifically for prints and drawings exhibitions, such as the opening shows of photographs by Alfred Stieglitz and prints from the Holy Roman Empire. To the north, a more random sequence of less clearly defined rooms housing decorative arts and small-scale sculpture (including the Gallery's renowned Kress Collection of Renaissance bronzes and the Chalice of Abbot Suger, used in the consecration of Saint Denis 1137-1144) surrounds the reinstalled Widener period rooms. Separating the sculpture hall from the central garden café is a long gallery; its present collection of naïve American paintings was organized, as were all installations, by gallery personnel with Charles Froom of New York. The axial extension through both the sculpture hall and the American paintings gallery is deliberately interrupted, forcing a meandering path through spaces scaled to the art exhibited.

Equal in importance to these principal public spaces are the reorganized curatorial facilities that line the central axis to north and south, filling the plan's poché. Critical conservation and photography laboratories, of-
fices, high-security vaults, and other support spaces added technical and logistical complexities to the program's exhibition content. The reorganized plan necessitated a complex refitting of mechanical and electrical systems, engineered by Nash M. Love & Associates to replace 1940s equipment and improve temperature, humidity, and fire control.

The rationalization of this previously labyrinthine backstage may in fact give the National Gallery a curatorial edge in the ongoing competition for international blockbusters. For the general public, however, the significance of this remodeling lies less in its supporting role for the East Wing's “really big shows” than in the offered alternative of small-scale treasures intimately viewed. It is finally the sculpture hall, with its careful merging of art and architecture, that may prove a more memorable space than the larger but more abstract atrium next door. [Daralice D. Boles]
The American artist Joseph Cornell (1903–1972), whose box constructions and collages combine an endless array of small, mundane, and seemingly unrelated objects and images into compositions of great poetic force, spent most of his life in relative obscurity, rarely venturing far from his Queens, New York, home. But in the eleven years since his death, Cornell's fame and reputation have risen with an almost ironic swiftness, and now a collection of his works has the distinction of occupying the only gallery in the Art Institute of Chicago devoted to the work of a single artist. With the gift of 37 objects of art and memorabilia from Chicago collectors Betty and Edwin Bergman, whose own Cornell holdings are the most extensive in either public or private hands, the Art Institute became the proud possessor of the most comprehensive Cornell collection in any museum.

Chicago architects Ronald Krueck and Keith Olsen were asked to remodel an existing gallery at the Art Institute to house this spectacular acquisition. The two chief problems in displaying Cornell's works, according to A. James Speyer, curator of the museum's 20th-Century department, are avoiding repetition among so many small-scale pieces, and lighting to eliminate shadows and illuminate
The steel and glass display cases are grouped around a central table (see plan, facing page). Glass shelves inside the cases minimize shadows and provide “invisible” support for Cornell's “boxes” and memorabilia. The cases' glass fronts are bolted to their steel frames with chrome-plated acorn nuts; the background panels in the cases are upholstered in gray silk.

Data
Location: Art Institute of Chicago.
Client: AIC—Department of 20th Century Painting and Sculpture, A. James Speyer, curator.
Program: a permanent gallery installation for the Department of 20th Century Painting and Sculpture in the Art Institute of Chicago for a collection of work by the artist Joseph Cornell. The delicate works of art are presented in a series of glass cabinets allowing for their protection while maximizing their “viewability,” with special concern for a flexible means of sensitive illumination.

Contractors: Caseworks, Inc., cabinets; Tyler & Hippach, glass and glazing.
Costs: withheld at client's request.
Photography: Karant Photography.


The means, in this instance, combine Classical symmetry with an almost Baroque luxury of detail and ornament. Three display cases, the central one of which is pierced by an arched doorway, are arranged around a steel and glass table that contains Cornell memorabilia. The cases, with their elaborately engineered, painted steel structure, glass fronts and shelves, and painted wood exteriors, evolved, according to Ron Krueck, through a reductive process that produced “a series of fractioned planes.” The glass shelves minimize shadows inside the cases, while making the boxes appear to float in space.

Krueck calls his and Olsen's approach “minimalist and constructivist,” but somehow the luxurious engineering and lush color scheme of the installation seem too sybaritic to pass muster with any card-carrying Minimalist or Constructivist. At first glance, one wonders whether the installation simply isn't too much for the homely, lovingly crafted, densely detailed constructions. But in fact, the opposite is true. The cases act as a glittering stage for these complex but unassuming works of art, treating them, in curator Speyer's words, like “the romantic jewels that they are.” [Pilar Viladas]
Evolution of Denmark’s renowned garden museum, opened in 1958, continues in new additions by the original architects, Jørgen Bo and Vilhelm Wohlert.

For decades, architects have been making pilgrimages to a little seacoast town near Copenhagen to see a building that is unassertive in form, yet vividly memorable as an experience. Since 1958, the Louisiana Museum has offered a rare integration of art-viewing with enjoyment of the landscape, in an architectural setting that mingles with the greenery and frames vistas in the graceful manner of Zen temple pavilions.

The Louisiana owes its existence and much of its special character to its founder-director, Knud Jensen, who foresaw a need for a new, less institutional kind of museum for Modern art. In 1956, Jensen sold the family dairy business, then devoted much of the proceeds and all of his time to the project. (His story and the museum’s are well told in a New Yorker profile by Lawrence Weschler, August 30, 1982, issue.)

The museum wraps irregularly around a sculpture-studded lawn. Even the 1982 wing (below) is subordinated to the original villa (bottom).

For the museum site, Jensen had acquired a derelict estate overlooking the Sound, and with it the anomalous name, “Louisiana,” bestowed by the original owner, who had three successive wives all named Louise. The 1850 main house was modest, but the plantings were exceptional, and the extensions required for Jensen’s program had to respect them. The young architects Jørgen Bo and Vilhelm Wohlert met his needs with a long, low wing threaded between specimen trees along the north edge of the main lawn. Linear galleries with glazed walls skirting tree trunks opened at one point into a tall room overlooking a pond and ended in a cafeteria at the edge of the bluff, where a lattice-shaded terrace faces back across the lawn. (The new museum was the subject of an enthusiastic feature in P/A, Dec. 1960.)

The museum was executed in a relaxed 1950s Modernism, with white-painted brick walls defining blocks set at odd angles. Flat roofs of exposed wood framing and decking stepped up at some points to provide clerestory light. Well-known Danish architects of the time, such as Utzon and Jacobsen, were working with irregular brick-walled volumes, but here horizontal planes are more dominant and volumes break open to interact with the landscape; it is not surprising to learn that Wohlert had recently returned from teaching at Berkeley and working on William Wilson Wurster’s office staff.

During the 1960s and 1970s, the Louisiana was in the forefront of developments such as environmental art and performance art. Expanding programs called for a new block of gallery space—two levels, with skylights and no windows—and a recital-theater complex—also on two levels. Both were plugged into the original wing on the north side, where they did not impinge on the public landscape, and where dropping terrain could accommodate their volumes without breaking the low silhouette.

By the end of the 1970s, the museum needed a major increase in gallery space in order to show more than a fraction of its growing collection; it also needed more storage than provided by restored outbuildings and a more expansive lobby-sales area than the first floor of the old house offered. Bo and Wohlert, who had worked continuously with the museum, responded with a complementary wing running south from the main house; starting with an expanded foyer, it extends a long, bending gallery along the...
edge of the lawn to a substantial block of galleries—some tall, some double-decked—a volume shaped and fitted into the landscape to present only fragments of its brick walls toward the main lawn. A library-lounge at the end of the wing offers sweeping views from a point that seems to project over the water. Paved terraces along the staggered exterior of the galleries replace the sculpture garden previously on this part of the grounds. Interaction between building and site get as much attention as before, but now the interior is more sharply delineated from the exterior; the experience of art, even of the outdoor sculpture, is marked off from the experience of the landscape.

In their larger scale and their interior treatment, the new galleries reflect an evolving concern for art-viewing conditions. For the 1971 galleries, the architects had developed a diffusing, low-ultraviolet skylighting system. The new painting galleries use similar top-lighting, and they break with all preceding galleries by substituting gray marble paving for the hitherto ubiquitous earth red tile. Natural wood appears in details as a reminder, but otherwise the galleries are scrupulously neutral in color in deference to Landscape views have been part of the museum concept from the outset. In the 1958 portion, even a major gallery faced north over a pond (top left). In the latest additions, the new foyer (top right) and a corridor gallery (above) look into the trees from slightly below grade.
In expansive 1971 gallery (above) wood ceilings of earlier wing were supplanted by diffused toplighting system, but red tile floors were continued. New galleries (right) have similar skylighting (above right) with gray marble floors. Wood appears in recess at edge of ceiling (above). Sculpture at right by Naum Gabo. Recital hall of 1975 (below) has woven wood seating, mounted on stepped floor, by Poul Kjaerholm. Cafeteria balcony has view across hall, through window wall, to Sound.

An artificially lighted lower level, introduced in the 1971 addition, reappears here on a larger scale, as a setting for light-sensitive works on paper, projection exhibits, etc. As in the earlier instance, this inserted level is part of a planned gallery circuit that directs visitors back from the end of the addition toward the main lobby.

Throughout all of these additions, the entrance to the museum from its modest-scaled neighborhood has remained the same. Country-style wood gates lead through a cobbled court, framed by trees and service buildings, to the original, domestic front door. A recent fringe of parking spaces along the front of the property, insisted upon by the community, has displaced some greenery, but there is still a canopy of foliage above. Once through the house, the visitor can still overlook the Sound from the original gingerbread-detailed verandah.

Although architectural continuity has clearly been a major objective, the new galleries at the Louisiana undoubtedly represent some loss of distinctiveness for the sake of universal exhibition standards. (In fact, the highly effective toplighting system has been adapted by Arata Isozaki for use in the...
Alongside new wing is a series of paved sculpture terraces (left, and below, sculpture by Nobuo Sekine). Behind the white brick walls are galleries that step up in height (section below), then divide into skylighted upper level and lower level for works that need more controlled lighting. At end of upper level is a crow's nest lounge (opposite page, top right and below), with stair that connects levels to complete circuit of galleries. From porch of original villa (opposite, top left) one of three monumental Moore sculptures can be seen silhouetted against view across Sound to Sweden.
Museum of Contemporary Art in Los Angeles.) The circuit of new galleries bespeaks a universal, international institution, even though characteristics of the original Louisiana survive: small areas of fine wood detail appear, juxtaposed to the informal texture of painted brick walls; passages of dramatic confrontation with nature occur, but alternating with the viewing of art, no longer integrated with it.

Because of the passage of time, however, the Louisiana has gained added significance as a demonstration of the special pleasures that Modernism can yield. No other kind of architecture has offered the ever-shifting spatial definition, the interpenetration of outdoors and indoors, the adaptability to changing contents accomplished here. And here, as well, we find the human scale and the nice modulation of materials and details that characterize the best Modern work of Scandinavia (and the American West Coast, as well). At the Louisiana, Modern architecture has by no means failed, but has maintained a particular grace and vitality over a 25-year span. [John Morris Dixon]

Data
Project: Louisiana Museum of Arts extensions, Humlebaek, Denmark.
Architects: Jørgen Bo and Vilhelm Wohlert. Niels Halby, chief architect; Niels Presskorn, Stig Løche, Erik Mannik Sørensen, architects, design team; Folmer Kristensen, architect, clerk of works.
Site: estate of about ten acres, with fine lawns and trees, on bluff overlooking Sound to east.
Program: existing museum, included 19th-Century house, plus 1958 gallery and cafeteria extensions; more galleries, theater, and recital hall added in late 1960s and 1970s; 1982 additions include foyer and lounges, gallery space equal to existing, and underground storage; total, about 35,000 sq ft.
Structural system: brick walls with H columns built in; mineral wool insulation; steel and wood roof framing; concrete floors.
Major materials: exterior, white-painted brick walls, black steel or wood mullions, teak sills; gray marble floors, with white Carrara stairs, ceilings of stretched fiberglass fabric under skylights; interior walls, white-painted brick or plywood covered with fiberglass fabric, painted white.
Mechanical system: air system in galleries, with heating and humidification; underfloor heating in foyer and lounge.
Costs: 36 million Danish Kroner (about $4.4 million at 1982 rate); 1040 DKr per sq ft.
Photography: K. Helmer-Petersen, except as noted.
Michael Graves has designed an Environmental Education Center—a 1983 P/A Awards winner—that will inform visitors of the area's natural and man-made features.

The Environmental Education Center's sphere reaches beyond its countryside location. Standing in Liberty Park, N.J., it is a small museum that guides visitors through the park's marshland, providing exhibits that will explain its wildlife features. At the same time, it is within easy reach of New York and furnishes spectacular views and information about Lower Manhattan, Ellis Island, and the Statue of Liberty. Its architecture reflects this dual nature. The wood-framed pavilions are as basic and nearly primitive in their conception as Abbé Laugier's Classical hut. Yet the total composition, the colors, and the finishes have a decidedly urban sophistication. This is a city-dweller's retreat in the countryside, an urbane Laurentian villa for Pliny.

The Environmental Center is also Michael Graves's clearest and most satisfying work to date, and must give observers on both sides of the fence pause. Graves's work has excited extreme reactions of both polarities—cultist devotion and unreasoning hatred—ever since it became known, in drawing and built form, about 15 years ago. No sooner was his Portland Building deemed acceptable, and indeed premiated this year by the establishment body, the American Institute of Architects, than panic ensued: some members mounted a slur campaign, other influential ones challenged the award itself, and the AIA Journal awards issue singled the building out for negative criticism.

It is commonly understood that book-burning and like actions serve to discredit the burners more than to suppress interest in the book, whose message, if valid, is disseminated nevertheless, and with heightened energy. It might be said, however, that the Portland Building gave nay-Graves-sayers grist for their mill, as its office environments are lackluster and its exterior materials are skimpy compared to the depth of its formal intentions. The same can be said, however, of scores of faceless buildings that rise, without arousing professional ire, in almost all American cities. It must be, then, that the building's possession of a face and a personality frightens practitioners who have devoted their professional lives to designing abstract buildings, often with distinction. With the completion of the Environmental Education Center, fair-minded critics of Graves's work might reexamine their prejudices and consider the validity of his approach.

The Environmental Center has the power not only to charm admirers by its parts and attract theoreticians by its references and associations, as other Graves projects have; it also delivers the promise of fully realized architecture, complete (while simple) in its enclosure of space, clear in the balance of its parts, and appropriate in its choice and use of materials. It is generous, seemingly effortless, and self-assured. It adds meaning and pleasure to its environment. While, it is unmistakably the creation of Michael Graves, restating the themes and reaffirming the personality revealed in earlier works.

Like all architects, Graves has experienced the teeth-cutting phase of learning through building; at the same time, he has struggled to find his own voice outside the mainstream of Late Modernism. He has felt the importance of celebrating movement into and through buildings by a ceremonial organization of spaces, heightened by the use of forms derived from earlier architectural elements (themselves based upon the image of the human body) and by colors inspired by nature, but filtered through his own sensibilities. His work neither slavishly applies traditional elements in what may be called a "typical Postmodern" way, nor overintellectualizes them. It is an intuitive, personal interpretation, original neither in an "organic" way, seeming to grow and be undistinguished from the earth, nor in a way that makes statements by the unusual use of materials.

Graves's work is also characterized by the expression of gravitational pressure exerted by great mass, a pressure contradicted by a light-hearted anthropomorphism that brings humor and charm to the composition: the fat-legged windmills in the early sketches (right) of the Environmental Center seem to be about to prance down the road, and the

Pliny's villa
actual building's pavilions retain that quality, subdued.

As Graves has matured, the choice and application of architectural elements has developed in his work. For example, from the celebrated Fargo-Moorhead cultural center of 1977 (the Moorhead side of which has been redesigned and will soon be built) through the Portland Building of 1980-82 to the Environmental Center, one can trace the following progression. In Fargo-Moorhead (a design sketch for its bridge center is shown below), architectural fragments are assembled. Beyond the symbolic implications of the fragments, their meanings are not fully explored; volumetric implications are secondary, and are accommodated by adjustment, often awkwardly. By the time of the Portland Building (sketch, p. 89), the architectural elements are complete and differentiated: the base, the body, the column/keystone. Here, the problems are scale, and lack of relief in the column/keystone configuration, which mitigates its clarity. In the Environmental Center, the architectural forms are clear and fully expressed volumetrically. There is the high massive central space, whose fortress quality is reinforced by the
ccanting out of the walls towards the roofline, and by the smallness of its square glass-block-filled windows. Then, collected about the central space, there are the trabeated pavilions, their trussed roofs supported on thick square columns, an exaggerated, stylized version of the tree trunks holding a pitched roof in Abbé Laugier’s prescription.

The high central space holds a deeply inset porch, then a lobby, and finally a small auditorium whose height, “rose window” (actually, a high window with a multiple birdhouse behind it), and low side aisles give it a chapel aspect. The major spaces are separated by double layers of wall, creating depth and transition between outside and inside, and between the lobby and the auditorium. The three waterside pavilions hold the exhibition rooms, to be used together or individually, depending upon the size of the shows. Their sections are strong; in each, the flat ceiling turns up to high clerestory windows and the timber roof above. Exhibits will consist of photographs and works on paper (not requiring a high level of security) that will be mounted on the walls and on freestanding pavilions and cases not yet commissioned by the State agency. An exhibition schedule has not yet been planned.

Motifs in the auditorium (above) and the lobby (below) intensify the height and the formality of the central building form, where they occur. In contrast, the exhibition spaces (left and far left) are more intimate and gain distinction from their well-defined section with its clerestory windows and timber trussed roofs. Exhibitions have not yet been planned for the newly completed building.
Waystations (below), three in number, are located as incidents on the nature path, and will provide information about the plant and animal life of the marshland and about the man-made artifacts—Ellis Island, the Statue of Liberty, and Lower Manhattan—in the distance.

The Center guides the visitor skillfully through its educational facilities and into the landscape. The entrance gateway gives views that radiate out to the harbor, with no focal element standing in obvious axial relationship, but all captured subtly, at an angle. After one visits the building, one exits with a view directed into a natural hillock, framed by a pergola, whose square, yellow-stuccoed columns seem Mediterranean in their tonal relationship with the southern sky, the eye having been accustomed to interior light. From the end of the pergola, a path meanders through the land to three somewhat graceless waystations, from which bridges will eventually be built by the Parks Service to lead visitors over the marshland and closer to the water’s edge.

Building materials are as simple and appropriate as the forms. Timber seems a natural choice for the pavilion structure, in keeping both with the basic Classical imagery and with the wildlife program. The gray-bleached cedar siding brings to mind the maritime architecture found in the Northeast, while metal is the obvious and best choice for roofing in industrial New Jersey, far better than the clay tile originally planned, which would have been pedantic in the setting. Wood trellises invite nature to garland the building’s roofline and entrance arch. In the interior, Graves has used painted hardboard, in places ornamented with stenciling and trompe-l’oeil effects (marbleizing, scrubbing) which strike a too-urban, too-Gravesian note in the setting: more site-specific motifs might have been developed. A mural is to be painted in the lobby.

Plans for energy-generating windmills were dropped early in the design development, but other sensible energy-efficient measures were incorporated in the building. Glazing was kept to a minimum, and geared to the functional need for daylighting: in the exhibition rooms, clerestories provide daylighting, with a relatively small proportion of the walls fenestrated to provide views to the harbor. All windows have some operable sash for ventilation. Four roof-mounted electric heat pumps (gas being unavailable and oil, surprisingly, more expensive) can be operated individually for separate zones. Air returns are located in the clerestory, with warm air being recirculated to the heat pumps. For the entire envelope, the recommended level of insulation is exceeded.

The Environmental Education Center is one feature in a master plan for Liberty Park, designed by Geddes Brecher Qualls Cunningham. The plan includes the restoration, now underway, of a ferry/railway terminal; the formation of ponds to separate the Park from the industrial park near the turnpike; and infill along the waterfront to form a two-mile seawall along which visitors will be able to walk, gaining spectacular views of the harbor.

Meanwhile, the Environmental Center can be seen, and both admirers and critics of Michael Graves can judge the work for themselves. [Susan Doubilet]
From its north end (left) the Environmental Center stands as a tall, refined, man-made element in its marshy environment, with its clear forms and natural materials paying homage to its natural origins. A multiple birdhouse is perched as a totem in front of the auditorium window.

Data
Project: Environmental Center, Liberty State Park, Jersey City, N.J.
Client: State of New Jersey, Division of Building and Construction; Department of Environmental Protection; Division of Parks and Forestry.
Site: Liberty State Park, a new state park facility on the New Jersey side of the New York harbor.
Program: the building will accommodate exhibitions, lectures, and conferences concerning the indigenous wildlife and the environmental context of the surroundings. A path system extends into the marshy landscape, looping through three descriptive waystations.
Structural system: timber piles, structural grade beam, structural slab on grade. Glue-laminated timber columns, beams and trusses framing.
Major materials: horizontal “Channel Rustic” cedar siding, stucco, weathering copper roof (see Building materials, p. 138).
Mechanical system: four electric heat pumps, roof mounted, independently zoned.
Consultants: Blackburn Engineering Associates, structural; Thomas A. Polise, Consulting Engineers, mechanical.
General contractor: Sempre Construction Company, East Brunswick, N.J.
Costs: $1,233,729.
Photography: Cervin Robinson, David Morton.
Unlike quantifiable information that can be reduced to microchip size, cultural artifacts must be treasured, analyzed, and collected in the original. Their numbers inevitably multiply with each generation, and as the public taste for viewing these artifacts increases, the need for space grows.

One city, in fact, is planning an area that will be a collection of museums, akin to the Mall in Washington in variety if not in building scale. In Frankfurt-am-Main, West Germany, an astonishing number of museums are in progress near the well-known Städel art gallery. Many of them are renovations and additions to existing villas. The area along the Main River, between the Cathedral and the Römer Town Hall, is being called “the Riverbank of Museums,” and among the buildings in the design or construction stage now are: a Museum of Ancient History by IBA director Josef Paul Kleiheus, a Museum of Cinematography by German architect Helge Bofinger, a Postal Museum by Gunther Behnisch, a Museum of Musical Instruments, a Jewish Museum, a Museum of Decorative Arts by Richard Meier, and two museums that begin our portfolio—a Museum of Modern Art near, but not on, the riverfront by Hans Hollein, and a Museum of Architecture by O.M. Ungers.

National museums are expanding. In West Germany, James Stirling has designed a major art gallery addition to the National Museum in Stuttgart, which is to open this fall; in Korea, a large National Museum of Modern Art is to be built, to consolidate scattered facilities, and these are shown, here.

Colleges and universities are renovating, expanding, and building new museum facilities. In the News section, we show the plans for those of Vassar and Princeton; in this portfolio, we show the design by Peter Eisenman for the Ohio State University Center for the Visual Arts.

We show as well in this portfolio a small museum for industrial arts in Canada, and the recently opened addition to the Portland Museum in Maine, by Henry Cobb of I.M. Pei & Partners, a medium-sized but important regional museum.

Generations pass away, but their artifacts remain, cherished almost religiously for the historical roots they provide. Church congregations dwindle while cultural storehouses are needed. Perhaps the obvious conclusion should be followed. [Susan Doubilet]
Unlike the many other museums being developed on Frankfurt's riverfront, the Museum of Modern Art is landlocked. Its image, on the other hand, resembles a great triangular ship, complete with objets d'art as a figurehead on its prow. The shape results from the decision, for urbanistic reasons, to hold to the boundaries of the site, as well as the intention to create a building that is striking from afar. Arches in the sandstone base reflect the arcaded landmark buildings nearby.

The entrance to the museum is not located at or near the "prow," but at a corner of the site closest to the Old City, in order to become part of that area's street activity and to contribute to it by providing a Museum cafe with a terrace at that point, which can be entered directly from the street and which can operate during museum off-hours.

From the entrance, carefully designed for security, one goes up several steps to the large entrance hall, and from there either to the lecture room area or up to the main Exhibition Hall at the center of the building, which is trapezoidal, skylighted, and rises the height of the whole building. From here, one catches glimpses of the museum's upper levels. Because the museum will be heavily used for educational purposes, a ramp is provided so that individual visitors can bypass instructional groups that may be gathered in the central space.

The top levels contain exhibition rooms of variable sizes, and the trip upwards through the building to its point culminates in a large skylighted room.
This complex scheme by Eisenman/Robertson and Trott & Bean won a two-stage competition (p. 38) for a Visual Arts Center in Columbus, Ohio.

A radical departure from architectural conventions that shaped Ohio State, the Center for the Visual Arts proposed by Eisenman/Robertson Architects and Trott & Bean Architects posits a new matrix of intersecting town and gown grids. The entrance path, flanked by a grove of buckeye trees, extends 15th Ave. into the campus. A perpendicular, glass-enclosed circulation spine cuts between and connects Mershon Auditorium and Weigel Hall (site plan, top right). The critical knuckle reconstructs fragments of the Armory building (above) demolished in 1959.

The Armory is the most obvious device in the scheme's archaeological metaphor. Less a building than a link between buildings, the Center "excavates" hidden connections between past and present, campus and city, art and education.
Architectural Museum
Frankfurt

One of several museums now in progress on the Main River in Frankfurt, West Germany, the Architectural Museum by O.M. Ungers is a house within a house within an enclosure.

The German Architectural Museum, directed by historian Heinrich Klotz, will serve as an information and study center, and will document contemporary international architecture. The building, designed by O.M. Ungers and now half complete, is itself a set of nesting architectural exhibits. An old villa on the Main's South Bank is encased in a wall, colonnaded on the river side, so that the villa and its gardens are seen as exhibits; the shell of the villa, now gutted, encases a new inner house (photos at left). The ground floor (shown above) indicates the sets of enclosures. Exhibition spaces occur in the basement, second, and third floors, and the fourth floor holds offices and a double-height library.
Seagram Museum
Waterloo, Ontario

A museum displaying artifacts of the distillery industry is located on the site of the original 1857 Joseph E. Seagram distillery plant, still active in Waterloo, Ontario.

Barton Myers Associates of Toronto have designed a specialized industrial arts museum in two buildings, one a renovated 19th-Century barrel warehouse, the other a new structure.

The entrance court defined by the active distillery building (top right in photo) and the warehouse (bottom left) has a pyramid of barrels at its center. From the court, the visitor enters the warehouse, a five-story space rimmed with heavy timber barrel-storage racks, now skylighted and used as the museum lobby and restaurant. The new building (top right in photo) is entered from here. It is a room that is likely to be striking: Forty feet high and 17,000 square feet in area, it acts like an Indian fort, clustering within its protective (against the climate) brick-striped walls, under its skylighted roof, a group of little structures. These freestanding pavilions will hold the permanent exhibits and a film theater. On their second levels will be archives and offices.

National Museum
Stuttgart

James Stirling of Great Britain has designed an art gallery addition to the National Museum in Stuttgart, West Germany. The building is scheduled to open this fall.

SECOND LEVEL PLAN
Stirling's art museum in Stuttgart is organized (loosely) along the lines of a Neo-classical museum. Galleries line the sides of a rectangular plan, with a cupola at the center flanked by courtyards. In Stirling's museum, however, the fourth (front) side of the plan is left open; the portico is replaced by a double row of trees that soften the effect of the adjacent major roadway; and the central element is, in fact, an open-air "drum," along the walls of which spirals upwards a section of the ramp that leads from one side of the site to the other.

Among the elements that promise to be striking are the banded stone walls with flaring cornice (bottom left), the leaning curved glass wall of the entrance pavilion (above), the mushroom-shaped columns in the first-floor Kunsthalle, and the piano-shaped music school.

Important metal elements, such as the framing of the curved glazed entrance pavilion wall, the handrails, and the giant air intake ducts, are brightly and variously colored in high-tech contrast to the solidly traditional look of the carefully crafted masonry walls.

On the lower, expressway side of the site the museum sits on a podium enclosing a parking garage. In addition to the skylighted galleries that are arranged enfilade, the Kunsthalle, and the music school, the museum contains a lecture hall and a separate workshop theater wing. At its second level, the museum bridges across the street to the old Staatsgalerie.
The Payson addition to the Portland (Maine) Museum of Art opened in May. It was designed by Henry Cobb of I.M. Pei & Partners.

Six years ago, the gift by Maine-born financier C.S. Payson of a group of Winslow Homer paintings inspired the Portland (Maine) Museum of Art to begin plans for a building of 63,000 square feet to greatly augment its original 12,000-square-foot facility provided by the 1800 McLellan-Sweat House and the 1911 Sweat Memorial. The new building faces one of Portland's major public squares, Congress Square, within an area that has recently undergone major restoration of many of its 19th- and early 20th-Century buildings. The museum's front façade, similar in height to several of the nearby buildings, represents an attitude radically different from its other façades, in response to the different contexts.

Sheer confidence, as well as fine brickwork, allow the unusual 67-foot-high billboard-like front to assume an imposing and important presence on Congress Square (middle photo). Arches over the street-level arcade are repeated as full circles at the upper level, the top segments of which rise above the roofline to reveal the building's most successful features, daylighting lanterns, and to "engage the sky," according to Cobb. Associations with Kahn are inevitable, with maritime imagery, unintended. The granite strips, the brickwork, and the fine brick vault over the loggia tie the frontal façade somewhat ambiguously to the volumetric sides and rear (bottom photo), which sit heavily about the side garden and step down and back to meet the existing buildings at a sympathetic scale.

Inside, the clever combination of 20-foot-square modular spaces, separated by six-foot-wide interstices, creates rooms that are most pleasant and, in keeping with the community's size, both intimate and important. The top floor gallery, however, is flawed by the ambiguity between enclosing wall and mezzanine. The modular plan appears simple in drawings, but because of the noncontinuous orientation of the stairs, is in fact confusing.

Most noteworthy are the top-lighted roofs above the modular spaces (top photos: entry-level Great Hall, left; third-story gallery, right). They were inspired, says Cobb, by the Dulwich Picture Gallery in London, and they suffice the galleries with subtly varying natural light. Their geometry provides a beautiful cap to each space. The gallery floors, pine planking inlaid within granite strips, are the most sensuous surfaces. Walls and ceilings are clad in hardboard and painted in gently neutralized tones.
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Technics: Synthetic roofing

Radical roofing

Polymer-based synthetic roofing has revolutionized the flat roof. Like any new technology, the synthetic roof deserves our full understanding and a cautious embrace.

Synthetic roofing, whether in single plies or in liquid form, simplifies the roofing of skyscrapers (right) or other hard-to-reach places because of its easy transport and safe, clean application. Reprinted by permission of Thames and Hudson Publishers, New York, from Laura Rosen’s Top of the City: New York’s Hidden Rooftop World, 1982.

The energy crisis of the past decade has affected our technology as much as it has our politics and economy. One of the technologies most affected has been flat roofing. Radical change is not characteristic of the roofing industry; since the latter part of the 19th Century, that industry has made only minor refinements to the traditional built-up roof, with its alternating layers of bitumen and felt, surfaced with gravel.

The energy crisis affected the built-up roof in several ways. The cost of petroleum-based bitumen rose steeply during the 1970s while the quality of distilled asphalt declined with the unpredictability of oil supplies. Higher wages, brought on by energy-induced inflation, also raised the cost of the labor-intensive built-up roof. The real blow, however, came with the insulating of roof decks for greater thermal protection. Built-up roofs over insulated decks began to fail at alarming rates: approximately 9 percent within the first five years of installation, 20 percent prior to the expiration of their warranties. By separating the built-up membrane from the warm roof deck with a layer of insulation, we exposed the membrane to greater temperature extremes, leading to the increased failure of the bitumen or felts.

Polymer-based synthetic roofing first emerged in the 1950s in Europe as an alternative to the built-up roof. European companies initially fabricated tear-resistant polymer plastics, mainly polyvinyl chloride, into single-ply sheets. They also began modifying bitumen with polymers to give it greater elasticity and weather resistance, manufacturing the bitumen in single sheets with glass fiber or polyester reinforcement. In the early 1960s, our domestic rubber industry began to market synthetic rubber roofing in single-ply sheets as our waterproofing industry began to develop and market several liquid-applied polymer roofs. Those various synthetic roofing systems saw only limited use in the U.S. throughout the 1960s and early 1970s, suffering from technical problems such as poor tear resistance, rapid ultraviolet deterioration, and inexperienced applicators. By the late 1970s, as demand for synthetic roofing grew, many of those initial difficulties had been resolved.

That demand has not subsided. Synthetic roofing—elastic, durable, lightweight, uniform in appearance and color, easily applied...
Technics: Synthetic roofing

and repaired, tear resistant, and adaptable to unusual roof configurations—has gained almost 25 percent of the roofing market, tripling its share in just four years. Projections show it with anywhere from a third to a half of a 2.4 billion-square-foot roofing market by 1990.

Choosing the right material, though, is no easy task. The single-ply roofing industry contains over 80 manufacturers with well over 100 products. To add to the confusion, few performance standards and design criteria have been established. In order to judge the relative merits of a particular synthetic roof, the architect must look at a company’s legitimacy: (how many years has it been in the business? how many roofs has it installed?); its track record: (what architects and owners have used that particular system? what changes in the chemical formulation of the product have occurred?); its product testing procedures: (does it test the roofing at room temperatures or at cold temperatures using new or aged material? what sheet thickness is used to measure tensile strength?); its warranties: (what are the conditions for the company’s acceptance of liability? does the warranty cover the initial, prorated, or replacement cost of the roof?); its service package: (how many pre- and post-job services does the company offer? what are its inspection procedures? how accessible are its technical people?); and its contractor authorization program: (how does it qualify applicators? how are they trained?). Such questions can help identify marginal companies.

The architect then must look at the performance of each type of roof in relation to the requirements of a particular job. With at least eight generic types of single-ply sheets, four generic types of liquid-applied systems, and four generic types of application methods on the market, proper selection demands an understanding of both their physical and chemical differences.

Polymer chemistry

The polymers in synthetic roofing consist of large, repetitive chains of molecules or monomers. The longer the polymer chain, the greater the tensile strength of the material. Most synthetic roofing utilizes either thermoplastic polymers, with molecular chains, loosely intertwined at room temperature, that disengage and slide past each other when subjected to heat; or thermosetting polymers, with molecular chains, cross-linked into permanent two- and three-dimensional structures, that remain unaltered when subjected to heat. Those chemical differences directly affect the performance of a synthetic roof. Thermoplastic materials have the advantage of easier and faster seaming in the field because of their ability to melt and reform with the application of heat or solvents and the disadvantage of possible shrinkage and permanent deformation with repeated exposure to the sun. Thermoset materials are highly elastic and weather-resistant but have the disadvantage of being difficult to field seam because of the inertness of the cross-linked polymer structure. Thermoplastic materials, for instance, might perform better on roofs with many penetrations; thermoset materials, on large, unbroken surfaces.

The chemical differences among synthetic roofing tend to affect their aging characteristics. Over time, most materials will decrease in thickness and elongation, increase in their modulus of elasticity and specific gravity, and remain about the same in their tensile strength. Thus, when judging the long-term performance of a synthetic roof, the usual comparison of tensile strengths may offer less information than the other criteria.

Modified bitumen

Modified bitumens offer a transitional technology between built-up and synthetic roofing. Bitumens modified with the polymer SBS (Sequenced Butadiene Styrene) have greater elasticity at low temperatures, while those modified with APP (Attactic Polypropylene) have greater resistance to high temperatures. Modified bitumens come either reinforced with glass fibers, polyester or polyethylene as a single sheet or, like a built-up roof, they can be field-applied in layers between reinforcing plies. Seams between sheets can be heat-welded with torches or adhered with hot asphalt, contact cement, or, in some cases, with just pressure. Bitumens modified with SBS usually require protection from ultraviolet radiation. Mineral aggregate, stone ballast, or embossed aluminum foil all serve as surface coatings. Application methods also vary considerably. Some systems self-adhere to the roof deck with pressure-sensitive backings; some depend upon torches to melt the bitumen, which then acts as an adhesive; and some have bitumen-coated reinforcement set in hot asphalt.

While not nearly as common here as in Europe, modified bitumens, according to some analysts, will receive a growing share of the U.S. market over the next decade. Many people prefer modified bitumens because of their familiarity; the technology is similar to, and in many ways a direct outgrowth of, the built-up roof. Modified bitumens lend themselves to reroofing jobs because of their compatibility with bitumen. And the multi-ply systems accept less exacting workmanship and greater room for field errors. Problems with modified bitumens arise when they are poorly made, with inadequate polymers, and when poorly applied, with careless seaming and adhesion.

Thermoplastics

Among the various thermoplastic sheets, PVC (Polyvinyl Chloride) holds the largest share (about 30 percent) of the synthetic roofing market. PVC comes either reinforced, reinforced with materials such as polyester or fiberglass fabric, or coated on a carrier material such as nonwoven fiberglass. The reinforced sheets usually have less shrinkage and a lower coefficient of thermal expansion than the unreinforced products. Like most thermoplastic roofing, PVC resists biological attack, most acids, alkalies, and
It has excellent fire resistance, mainly because of its chloride, and good field-sealing properties. Seaming techniques include the use of a solvent, usually THF (Tetrahydrofuran) or a hot air tool or iron to melt and then fuse two sheets together. While that bond usually is stronger than the PVC material itself, manufacturers recommend checking for gaps and then caulking the lap end.

Most of the difficulties encountered with PVC stem from the material's inherent rigidity. To give PVC the pliability and elasticity needed in a roofing application, manufacturers add a variety of monomeric and polymeric plasticizers, which can migrate out of the material under certain conditions, embrittling the PVC. Ultraviolet radiation can degrade the plasticizers unless inhibiting agents or a protective surface are added; polystyrene insulation can absorb the plasticizers under high heat; and coal tar and asphalt can attack the plasticizers without a slip sheet separating the PVC from the bitumen and its fumes. The latter problem, in the opinion of some roofing consultants, makes PVC less attractive in reroofing projects. Despite those limitations, PVC remains popular because of its low cost, long use (especially in Europe), and its easy handling and installation.

Several other thermoplastic materials hold a small share of the synthetic roofing market. They have overcome some of the limitations of PVC although they often are considerably more expensive. They generally lack plasticizers and share some of the properties of bituminous or thermosetting material.

A highly inert, tear-resistant thermoplastic is ECB (Ethylene-Copolymer-Butylenes). ECB can have direct contact with polystyrene insulation and coal tar, and despite the bitumen in its formulation, it resists ultraviolet degradation, overcoming the need for a protective surface coating. Most ECB roofing comes with a glass fiber backing to ease its handling and field application. The material is expensive, though, and not widely used in the U.S.

CPE (Chlorinates Polyethylene) resists most chemicals because of its inert molecular structure, has good color retention, and resists ultraviolet and ozone attack. The major use of CPE roofing occurs in projects that cannot accept stone ballast on the roof, since CPE can be exposed, and in projects that require a light-colored roof to reduce air-conditioning loads or to enhance the roof's appearance, since most CPE sheets come in light colors. CPE's fire resistance depends on its chloride content. It is also more difficult to solvent weld than PVC.

CSPE (Chlorosulfonated Polyethylene) often goes by the name of Hypalon. As a liquid coating over other roofing materials susceptible to ultraviolet attack, Hypalon became one of the first synthetic roofing materials used in the U.S. in the early 1960s. In addition to ultraviolet radiation, Hypalon resists most chemicals, oils, grease, bitumens, salts, acids, fire (it's self-extinguishing), ponded water, abrasion, ozone, and temperature extremes. It remains sensitive to certain hydrocarbons in products such as leaded gasoline and jet fuel, and it is difficult to solvent weld.

In recent years, manufacturers have developed Hypalon sheet roofing. The thin sheets (often 30 mils thick) have the capacity of being seamed like other thermoplastics, with solvents or heat, and then curing in place to become a thermoset material, with highly inert cross-linked polymers. Like the less expensive CPE, Hypalon's color retention and weather resistance find it most often used in sheet form on lightweight, exposed roofs.

PIB (Polyisobutylene) contains several synthetic rubber additives, giving it some of the advantages of thermoset polymers, such as ultraviolet resistance, and some of their disadvantages, such as a susceptibility to attack by gasoline, oil, kerosene, turpentine, solvents, and nitric and sulfuric acids. The unreinforced PIB, itself, is quite expensive. It becomes competitive, however, when judged by its installed cost, for it offers savings in labor by allowing quick, easy seaming, using liquid polyisobutylene and/or the pressure of a hand roller. Adhesion to the roof deck can occur with hot asphalt, a less expensive alternative to cold adhesives. The material's lack of crystallinity can allow it to creep.

Thermosets
The thermoset polymers in synthetic roofing are often called synthetic rubber or elastomers because of their elastic, rubberlike qualities, able to stretch up to three-to-five times their original size without breaking and without permanent distortion. That, combined with the inert character of their cross-linked polymers, makes elastomers a very popular roofing material, currently holding over 50 percent of the U.S. synthetic roofing market.

One of the first commercially available synthetic rubbers was Neoprene (Chloroprene Rubber), developed in the 1930s and first used as roofing in the early 1960s. Like other elastomers, Neoprene has good aging and weather resistance. Unlike others, it also resists the attack of animal fats, oils, and fire. Neoprene, however, remains susceptible to ultraviolet degradation as well as certain acids, solvents, and peroxides, so it often receives a liquid Hypalon coating.

Other elastomer roofing materials use uncured Neoprene as flashing. In its uncured state, Neoprene lacks elastic properties, enabling it to conform to the sharp angles required of flashing. Within a year, the Neoprene cures, forming cross-linked polymer chains to become a highly resistant thermoset material. Neoprene also constitutes the active ingredient in many of the contact adhesives used to bond synthetic roofing.

At less than half the price of Neoprene is the elastomer EPDM (Ethylene Propylene Diene Monomer). EPDM, first developed in 1963, has become the largest selling synthetic roofing material in the country. The material...
## Technics: Synthetic roofing

### Materials

<table>
<thead>
<tr>
<th>Modified Bitumens</th>
<th>Advantages</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Good for reroofing, material compatible with bitumen.</td>
<td>• Flammable. Cover with fire retardant where required.</td>
</tr>
<tr>
<td></td>
<td>• Fully adhered systems good on unusually shaped or steeply sloped roofs.</td>
<td>• Sensitive to ultraviolet light. Cover with protective material: ballast,</td>
</tr>
<tr>
<td></td>
<td>• Familiar material and familiar application and seaming technology</td>
<td>foil, mineral aggregate.</td>
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<tr>
<td></td>
<td>• Good water resistance</td>
<td>• Some reinforcing material can be affected by ponded water</td>
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<tr>
<td></td>
<td>• Comes both unreinforced and reinforced with polyester, polyethylene,</td>
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<tr>
<td></td>
<td>or glass fiber.</td>
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</tr>
<tr>
<td>Thermoplastics</td>
<td>• PVC easily applied and seamed, fire retardant, light colored, resists</td>
<td>• Softens under high heat. Protect from possible damage from ballast or</td>
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<tr>
<td>PVC</td>
<td>many pollutants.</td>
<td>roof traffic.</td>
</tr>
<tr>
<td>ECB</td>
<td>• Some thermoplastics not affected by polystyrene insulation, bitumen,</td>
<td>• Durability depends, as in other synthetic systems, on the quality and</td>
</tr>
<tr>
<td>CPE</td>
<td>and ultraviolet light.</td>
<td>proportion of polymers used</td>
</tr>
<tr>
<td>CSPE</td>
<td>• Most have outstanding resistance to ozone attack</td>
<td></td>
</tr>
<tr>
<td>PIB</td>
<td>• PVC inexpensive and easily fabricated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• CPE and Hypalon have good color retention.</td>
<td>• PVC must be separated from polystyrene insulation and coal tar.</td>
</tr>
<tr>
<td></td>
<td>• Hypalon and PIB behave like elastomers once installed.</td>
<td>• Poor quality PVC can embrittle, shrink, or deform with ultraviolet</td>
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<tr>
<td></td>
<td>• Chlorinated hydrocarbons (PVC, CPE, CSPE) will not sustain fire</td>
<td>exposure.</td>
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<tr>
<td></td>
<td>• With loose-laid ballasted systems, insure the capacity of the roof</td>
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<td></td>
<td>to carry ballast and the capacity of perimeter</td>
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<tr>
<td></td>
<td>• PVC must be separated from polystyrene insulation and coal tar.</td>
<td>• Neoprene attacked by ultraviolet light and many acids.</td>
</tr>
<tr>
<td></td>
<td>• Poor quality PVC can embrittle, shrink, or deform with ultraviolet</td>
<td>• Contact adhesives flammable.</td>
</tr>
<tr>
<td></td>
<td>• With loose-laid ballasted systems, insure the capacity of the roof</td>
<td>• Avoid polystyrene insulation under exposed, black membranes.</td>
</tr>
<tr>
<td></td>
<td>to carry ballast and the capacity of perimeter</td>
<td>• Neoprene and silicone relatively expensive</td>
</tr>
<tr>
<td></td>
<td>• EPDM relatively inexpensive. Often comes in large sheets for rapid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>installation.</td>
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</tr>
<tr>
<td></td>
<td>• EPDM and silicone resistant to ozone attack, durable, vapor permeable.</td>
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<td></td>
<td>• EPDM readily available with large scale production by domestic rubber</td>
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<td>industry</td>
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<tr>
<td></td>
<td>• Neoprene resistant to grease, oils, and animal fats</td>
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<td>• EPDM requires careful seaming procedures in the field.</td>
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<td></td>
<td>• EPDM flammable. Use chlorinated sheets or protect with fire resistant</td>
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<tr>
<td></td>
<td>• Silicone difficult to bond once cured, with low tear resistance</td>
<td></td>
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<tr>
<td>Liquid Systems</td>
<td>• Self-flashing.</td>
<td>• Neoprene attacked by ultraviolet light and many acids.</td>
</tr>
<tr>
<td>Polyurethane</td>
<td>• Easily installed.</td>
<td>• Contact adhesives flammable.</td>
</tr>
<tr>
<td>Silicone</td>
<td>• Good on roofs with many penetrations.</td>
<td>• Avoid polystyrene insulation under exposed, black membranes.</td>
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<tr>
<td>Butyl</td>
<td>• Spray applications good on steeply sloped roofs.</td>
<td>• Neoprene and silicone relatively expensive</td>
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<tr>
<td>Acrylic</td>
<td>• Leaks easily spotted and repaired. (True with fully-adhered sheets as</td>
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<tr>
<td>Neoprene/Hypalon</td>
<td>as well.)</td>
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<td></td>
<td>• Roof deck should be monolithic and free of cracks, unevenness, dirt,</td>
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<td></td>
<td>oil, or debris.</td>
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<td></td>
<td>• With few exceptions, must be applied in moderate temperatures, on dry</td>
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<td></td>
<td>surface, without anticipated rain.</td>
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<tr>
<td></td>
<td>• Spray applications should occur on windless days.</td>
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<tr>
<td></td>
<td>• Workmanship important to insure uniform thickness and to avoid pinholes</td>
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<tr>
<td></td>
<td>or gaps in membrane.</td>
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</tbody>
</table>

### Advantages

- Good for reroofing, material compatible with bitumen.
- Fully adhered systems good on unusually shaped or steeply sloped roofs.
- Familiar material and familiar application and seaming technology.
- Good water resistance.
- Comes both unreinforced and reinforced with polyester, polyethylene, or glass fiber.
- Resists most pollutants.
- Easily applied and seamed.
- Greater resistance to slumping than traditional built up roofing.
- Requires less exacting workmanship than some other systems.
- Flammable. Cover with fire retardant where required.
- Sensitive to ultraviolet light. Cover with protective material: ballast, foil, mineral aggregate.
- Some reinforcing material can be affected by ponded water.
- Softens under high heat. Protect from possible damage from ballast or roof traffic.
- Durability depends, as in other synthetic systems, on the quality and proportion of polymers used.
- PVC easily applied and seamed, fire retardant, light colored, resists many pollutants.
- Some thermoplastics not affected by polystyrene insulation, bitumen, and ultraviolet light.
- Most have outstanding resistance to ozone attack.
- PVC inexpensive and easily fabricated.
- EPDM and Neoprene highly elastic, resistant to ozone attack, durable, vapor permeable.
- EPDM and silicone resistant to ultraviolet light.
- EPDM readily available with large scale production by domestic rubber industry.
- Neoprene resistant to grease, oils, and animal fats.
- EPDM is attacked by grease, oils, solvents, and animal fats.
- EPDM requires careful seaming procedures in the field.
- EPDM flammable. Use chlorinated sheets or protect with fire resistant surface.
- Silicone difficult to bond once cured, with low tear resistance.
- Neoprene attacked by ultraviolet light and many acids.
- Contact adhesives flammable.
- Avoid polystyrene insulation under exposed, black membranes.
- Neoprene and silicone relatively expensive.
- Self-flashing.
- Easily installed.
- Good on roofs with many penetrations.
- Spray applications good on steeply sloped roofs.
- Leaks easily spotted and repaired. (True with fully-adhered sheets as well.)
- Roof deck should be monolithic and free of cracks, unevenness, dirt, oil, or debris.
- With few exceptions, must be applied in moderate temperatures, on dry surface, without anticipated rain.
- Spray applications should occur on windless days.
- Workmanship important to insure uniform thickness and to avoid pinholes or gaps in membrane.
This chart (below) lists the considerations in choosing synthetic roofing and illustrates various application and seaming methods.

### Application Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most are fully-adhered by torching underside.</td>
<td>Some are pressure adhered.</td>
</tr>
<tr>
<td>Many thermoplastics are mechanically fastened.</td>
<td>Many are also loose-laid with ballast.</td>
</tr>
<tr>
<td>Most systems can be mechanically fastened.</td>
<td>Elastomers are fully adhered using contact adhesive.</td>
</tr>
<tr>
<td>Some liquid systems are spray applied using a spray gun.</td>
<td>Some are applied using a brush, squeegee, roller or trowel.</td>
</tr>
<tr>
<td>Some systems can also be loose-laid with ballast.</td>
<td>Liquid systems all form a continuous, seamless membrane.</td>
</tr>
</tbody>
</table>

### Seaming Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
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<tr>
<td>Many use torches to melt the material at the lap.</td>
<td>Many can also use hot asphalt or contact adhesive.</td>
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<td>Most thermoplastics can be solvent welded.</td>
<td>Most can also be heat welded.</td>
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<tr>
<td>Most elastomers are seamed using contact adhesive.</td>
<td>Some use uncured rubber tapes that are pressure sensitive.</td>
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<tr>
<td>Most elastomers are loose-laid with ballast.</td>
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<td>Elastomers are fully adhered using contact adhesive.</td>
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<tr>
<td>Most systems can be mechanically fastened.</td>
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<td>Some are pressure adhered.</td>
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Technics: Synthetic roofing

has complete elasticity in temperatures ranging from 200 F to -60 F, a fivefold elongation capability, a high vapor permeance, and a resistance to ozone, coal tar, and most atmospheric pollutants. But like every other synthetic roofing product, EPDM has its limitations. The material will burn; to meet flame spread tests, it must be either chlorinated or protected by stone ballast or a fire-retardant coating such as Hypalon and sand. EPDM also swells in contact with grease, animal fats, leaded gasoline, solvents, and oils. Many manufacturers call for the insertion of Neoprene under rooftop equipment or at air exhausts from restaurants.

What most troubles some roofing consultants, though, are the difficulties encountered when bonding two EPDM sheets together. EPDM usually arrives at the job site in a roll with a release agent such as talc or mica separating the sheets. When making a field seam, a roofer must completely remove the release agent, usually with a rag saturated with a chlorinated hydrocarbon such as unleaded gasoline; roughen the surface at the lap joint to insure better bonding, usually with a primer provided by the manufacturer; and apply contact adhesive to both sides of the lap, wait until the adhesive becomes tacky, press the two sheets together, and caulk the joint. Poor workmanship at any point in that process, such as the incomplete removal of talc because of a dirty rag or the incomplete bond of the adhesive because of a change in the ambient temperature or because of condensation at the lap, can lead to joint failure. Manufacturers have responded to many of those problems. Some offer talc-free EPDM sheets, and provide uncured EPDM adhesive tapes that are easier to use than contact adhesives. One company even offers EPDM attached to 4' x 8' insulation boards, seamed together with adhesive tape. Improvements in seaming will only strengthen the position of EPDM which, in the opinion of most analysts, should continue to lead the synthetic roofing market because of its durability, availability, and competitive price.

A product with elastomeric properties that is fairly new to the market is silicone single-ply roofing. The sheets come unreinforced or reinforced with an inorganic material such as fiberglass. Silicone has the advantage of chemical- and fire-resistance combined with a reflective white color. The disadvantage lies in its high price, although it can be competitive with several thermoplastic sheets.

Liquid-applied systems

The radical nature of synthetic roofing technology becomes most apparent in the liquid application of the roof membrane, using a brush, roller, squeegee, or spray gun. The liquid-applied systems are mostly thermoset materials: polyurethane, silicone, butyl rubber, acrylic, and Neoprene/Hypalon. Single-component systems cure on the roof through the evaporation of a solvent, leaving behind solids such as Neoprene and butyl rubber. Two-component systems involve the mixture of a base material and catalyst that chemically react to form a continuous membrane with materials such as silicone and polyurethane. Fluid-applied roofs have some distinct advantages over single-ply sheets. The fluids fully adhere to highly irregular surfaces or steeply pitched roofs, providing a self-flashing membrane that is easily applied. The disadvantages lie in their dependence upon exacting workmanship and ideal weather conditions. The roof deck must be free of dust, dirt, and debris to insure the complete adhesion of the membrane; have no unevenness, to insure the fluid's uniform thickness; have a slightly rough surface, to insure its mechanical bond with the membrane; and be monolithic in construction, to insure against the membrane's cracking. Weather conditions at the time of application also affect the long-range performance of liquid-applied systems. They should not go down in temperatures below 40 F (silicone and polyurethane are two exceptions); in high winds or humidity (especially systems that cure upon evaporation); and in anticipation of rain (which washes away the cured fluids). Nevertheless, when those conditions are met, especially on roofs with unusual shapes or many penetrations, the liquid-applied roofing systems fill a real need.

Installation methods

There are essentially four methods of installing synthetic sheet roofing. Fully adhering a sheet, whether it be by torching it or embedding it in hot asphalt (modified bitumens) or by contact adhesives (thermoplastics, elastomers), has advantages on roofs with irregular or steep surfaces, with extreme wind uplift exposure, with weight limitations, or with high visibility. All of the components of the roof assembly, including insulation and any separation sheets, must be fully adhered to the roof deck. The synthetic sheets themselves are usually thicker (60 mils plus).

Those conditions point to some of the disadvantages of full adhesion. It can add to the time and expense of an installation and subject the synthetic sheet to building movement. In response, many manufacturers offer partially adhered or mechanically fastened roofing systems. The sheet, instead of being fully adhered, is fastened to the roof deck, usually about every 20 inches on center, with fasteners and an assortment of plates, discs, or bars, depending upon the manufacturer. Lap joints or separate pieces of membrane cover the fasteners.

The mechanical fastening of synthetic roofing saves in time and labor over fully adhered installations, while retaining their light weight, uniform appearance, and wind resistance. Most important, mechanical fastening separates the sheet from most substrate movement, preventing the tearing or buckling of the membrane. Not unexpectedly, many foresee mechanical fastening becoming a dominant means of attaching single-ply roofs.

Another popular but somewhat controversial installation method is the loose-laid/ballasted roof. This involves laying out the synthetic sheet, anchoring it at the building...
perimeter, and weighting it down with river run gravel at ten pounds per square foot. The sheet moves independently of the substrate underneath, and the gravel ballast protects the membrane from external fire, ultraviolet and ozone attack, and wind uplift. It is with wind uplift that the controversy has occurred. The ballast, in a strong wind, should blow in place, eventually becoming heavy enough to resist the wind’s suction forces at the building’s perimeter. The blow-off of loose laid roofs, nevertheless, has occurred, prompting their rejection by some building officials in windy areas of the country. Loose-laid/ballasted systems also present difficulties when a leak must be located (since the unattached membrane allows the horizontal migration of water) and when a roof structure cannot bear the ten pounds per square foot weight of the ballast (a common problem in older, wood-framed buildings or in new buildings with long-span structures and lightweight decks). Those problems aside, loose-laid systems will probably remain a fairly common installation method if only because of their simplicity, cost, and speed.

A fourth method of applying synthetic roofing involves the placement of insulation, a filter cloth, and ballast on top of the membrane, protecting it from temperature swings and weather-induced deterioration. Developed in response to the thermal shock of membranes insulated from the warm roof deck, the protected membrane roof (PMR) has proven most popular in very hot and very cold climates, on high humidity enclosures, and on roofs with a good deal of foot traffic. The roof deck, however, should slope to drain the roof adequately; the roof structure must be able to carry the weight of the ballast (although a concrete-topped insulation board can reduce that weight considerably); and the insulation should have a adequate perimeter attachment to resist wind uplift or flotation and have adequate ventilation to prevent the growth of vegetation or fungi.

**Workmanship**

The success of synthetic roofing ultimately depends as much upon the quality of workmanship as it does upon the material and its installation. The new single-ply systems are less forgiving than the multi-ply built-up roof: a single-ply sheet must have completely watertight seams and a liquid-applied roof must be absolutely free of pinholes or thin spots. To achieve that requires the use of company-certified applicators, proper detailing (and, if possible, proprietary specifications), and perhaps most important, the provision of full-time on-site inspection by qualified people.

Some people remain skeptical of synthetic roofing because of the lack of performance criteria and of long-term experience with the product. For that reason alone, the built-up roof will remain a dominant force in the market, especially with the increased usage of nonorganic felts and the increased awareness that poor workmanship and inadequate inspections are as much to blame as the materials themselves for the failures of built-up roofs. Built-up roofing currently holds 68 percent of the flat roof market, with an expected 50 percent share through the early 1990s.

Work on developing guidelines and setting standards for synthetic roofing, meanwhile, continues. The National Roofing Contractors Association has begun publication of a thorough guide to the new materials, manufacturers have formed the Single-Ply Roofing Institute to provide technical information and to assist design professionals, and ASTM committees plan to have standards out that many analysts see leading to an eventual decrease in the number of companies in the industry. Those developments should ease the architect’s task of choosing among the many roofing options now available. But after so many years depending upon the traditional built-up roof, at least we now have real choices to make. [Thomas Fisher]

**Acknowledgments**

We would like to thank the following people and organizations for their assistance in the preparation of this article: (modified bitumen) Charles Whitley, Bowe; P.K. Daniels, Tamko; Barnett Mitzman, Guain; Dick Smersky, Koppers; Jim Sattler, John Stoddard, Derbigum/Owens-Corning; Bob Mathews, HeyDi UPM; Jesse Stewart, W.R. Grace; Jerry Matthews, Tropical Industrial Coatings; (thermoplastics) Bruce Abbott, J.P. Stevens; Ken Brazowski, Tremco; Al Farahish, Rubber and Plastics Compound Co.; Jack Glassman, PIB Roofing Products and Systems; Ruth Warshaw, Sarnafil; Robert Smith, Rainer Gerbatsch, Tocol; Bill Gurley, IPW Interplastics; Joe McCusker, Cooley; John Mascharka, U.S. Mineral; Joe Chew, Republic Powdered Metals; (elastomers) Richard Boon, Firestone; Lou Benoit, Benoit; Bill Young, Manville; Doc Pingree, Paul Oliveira, Goodyear; Patricia Farley, GAF; Walter Mullen, Celotex; Len Whann, Terry Andrews, Gates; Michele King, Carlisle; Tom Kelly, Kelly Energy Systems; Pat Clough, Otto; (thermoplastics and elastomers) Bill Muller, Watpro; Charles Taft, Plymouth; Kerston Russell, General; (liquid-applied) Jim Cox, 3M; Jeff Gonyou, Geocel; Ed Jarger, American Hydrotech; (roofing components) Peter Deal, Dow; Cathleen Branciaroli, Sam Cypressi, Du Pont; (consultants, organizations) Werner Gumperts, David Adler, Simpson, Gumperts & Heger, Inc.; Dick Fricklas, Roofing Industry Educational Institute; Doug Burns, RTD & Associates; C.W. Griffin; Julian Elias, Jeter, Cook & Jepson; Bill Cullen, National Roofing Contractors Association; Jerry Teitsma, Roof Systems Consultants; Ruth Warshaw, Single Ply Roofing Institute.

**Further reading**

The National Roofing Contractors Association (8600 Bryn Mawr Avenue, Chicago, Ill. 60631) publishes the magazine Roofing Spec and several guides on the subject including the NRCA Roofing and Waterproofing Manual (revised April 1983), the NRCA Materials Reference & Guide, and conference proceedings on roofing technology. The NCRA also publishes a pamphlet entitled The Single-Ply Roofing Membrane. Two other magazines covering the field are RSI and Roof Design, both published by Harcourt Brace Jovanovich (circulation offices: 1 East First Street, Duluth, Minn. 55802). A good overview of both built-up and synthetic roofing occurs in the Manual of Built-Up Roof Systems, 2nd edition, by C.W. Griffin, McGraw-Hill, 1221 Avenue of the Americas, New York, N.Y. 10020. The address of the Single-Ply Roofing Institute is 1800 Pickwick Avenue, Glenview, Ill. 60025.
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Certifying integrity of exterior walls

Norman Coplan

Certifying the soundness of exterior building elements opens the architect or engineer to liability for damage if a passerby is injured.

The responsibility of owners for unstable building elements is a subject much in the news in recent years because of the number of injuries to pedestrians resulting from falling parts of a structure. It is the legal rule in most jurisdictions that a building or structure that abuts a street or highway must be maintained so that it will not fall and cause injury to persons lawfully on the street or highway. The owner of a building is not an insurer against injury resulting from falling parts of his building, but he is required to use reasonable care and skill in the construction and maintenance of the structure. Further, he is required to inspect the building from time to time and to remedy any defect that is revealed by such inspections.

Falling cornices seem to be the most common object causing injury to innocent pedestrians. The legal rule of liability applicable in such a situation is reflected in the Connecticut case of Howard v. Riden (93 Conn. 604). This litigation involved a claim for damages for death caused by a falling cornice brought against both the builder and the owner of the building. The wood cornice, overhanging the sidewalk, was 3 feet wide, 36 feet long, and weighed 800 pounds. The court found that the cornice construction was such that it would, by natural action of the elements and by reason of its own weight, eventually fall to the sidewalk unless protective measures were taken. The court further found that the tin roof of the building, by natural causes, became worn and rusted, and rain water and other elements leaking into the cornice rotted the woodwork and furring strip on the inner side of the cornice and rusted away the nails by which the cornice was fastened.

In holding the owner liable for damages, but absolving the contractor from liability, the court said:

"It appears . . . that the (owner) failed and neglected to inspect the cornice to determine its condition and failed and neglected to remove the cornice. . . . Whether the original (construction) was well done or not, it distinctly appears, and this is the controlling factor in the case, that the fall of the cornice was not due to the condition the contractor left it in but to the neglect of the owner to inspect and guard against the result of rusting and rotting that inevitably takes place in every structure in which nails, tin and wood are used. The structure stayed up as long as the structure did not rust and rot out . . . A contractor is surely not the insurer of the everlastingness of the materials of a cornice built by him. The owner . . . is under obligation to give such inspection and make such repairs as will at least preserve the structure from the dangerous effects of natural causes—wind, rain, dampness—which no foresight of construction can guard against."

The City of Chicago was one of the first municipalities to come to the conclusion that despite the potential liability of building owners, exterior wall maintenance, particularly on upper level stories of high-rise buildings, was either ineffective or nonexistent and constituted a continuing potential for serious pedestrian injury. As a consequence, an ordinance was adopted requiring periodic inspections of the exteriors of buildings to be performed under the supervision of a licensed architect or structural engineer. New York City has since adopted an ordinance requiring a periodic critical examination of the exterior walls of any building more than six stories in height, to be conducted by or under the direct supervision of a licensed architect or a licensed engineer (P/A News Report, Nov. 1982, p. 29). The New York law further requires the architect or engineer to submit a written report "certifying" the results of such examination.

Insofar as owners are concerned, these statutory enactments not only codify their common-law duty to examine the exteriors of buildings in order to remedy defects that may exist, but set forth an explicit standard as to when and how often such examinations must occur. Thus, the potential liability of owners for injuries resulting from unstable exterior building elements has been increased by these explicit rules. Whether such examination is conducted directly by the architect or engineer or performed by inspectors under his supervision, the architect or engineer is subject to liability to members of the general public who sustain bodily injuries or property damage from falling structural fragments, even from buildings that have been examined, if it is established that the examination had not been conducted with due care.

The New York City statute, in requiring the architect or engineer to "certify" his findings, creates an additional hazard. The claim may be made that the certification constitutes a representation or warranty on the part of the architect or engineer as to the condition of the exterior of the building and that therefore the architect or engineer is liable for breach of that representation or warranty independent of whether he conducted the examination with due and reasonable care. Professional liability insurance does not normally afford coverage for guarantees or warranties made by the professional; thus if a certification was construed as a guarantee, the professional could not only be held liable in the absence of negligence, but would have no insurance protection. In acting under such a statute, therefore, the architect or engineer must be concerned and guarded in respect to how his "certification" is worded.

Norman Coplan, Hon. AIA, is a member of the law firm Bernstein, Weiss, Coplan, Weinstein & Lake, New York.
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valuation of the past. Despite their propensity for disjunction and defamiliarization, they are vitally and radically conservative.

Tschumi's book announced an important distinction. "Books of architecture, as opposed to books about architecture, develop their own existence and logic. They are not directed at illustrating buildings or cities, but at searching for the ideas that underlie them." He then compares the experience of The Manhattan Transcripts to film books that establish continuity by a montage of stills. Although Tschumi mentions Sergei Eisenstein and Lázlo Moholy-Nagy, he must be perceived as an analytic architect closer to Godard or Straub and Huillet. Tschumi's explorations, like those of geologists, psychoanalysts, and Marxists, are attempts to decode resistant surfaces while paying homage to the obstinacy of the conventional. That is why he pays so much obeisance to the clichés of violence and the norms of theatricality from Hollywood to New Wave music. Tschumi is trying to disenthrall us of our usual oblivion to power in architecture by showing it, as Michel Foucault has demonstrated, everywhere. In the past, he has accomplished this by using extremely condensed means, as in his series of postcards where he places puzzling or disruptive slogans beneath photographs of Le Corbusier's decaying oeuvre, thus laying bare a new strategy. Tschumi has the resilience of a graffiti artist, but in this case, we are given intelligent graffiti on walls and spaces erected by the graffiti artist himself.

The basic problem for Tschumi has been to create without "primal forms" and without a mere mimetic or representational bias. He has done this by making a film-architecture abstracted from objects, choreography, and events. As in the poetry of John Ashbery, the music of Elliot Carter, or the dances of Merce Cunningham, action itself is the content of this architecture. "Events, movements, spaces" make his city-photographs characteristically vital and surreal, yet not in a whimsical sense. Just as novels have been positively influenced by movies since the turn of the century, so has architecture, but usually through the flamboyant quotation of the most luxurious aspects of cinematic set design, rather than the formal qualities inherent in the medium. Here the "fade-ins" and "inserts" are strategies to create unlikely, variable, and insistent spaces. There is an explosive pleasure-element in all this, as Tschumi predicts: "reality is made infinitely malleable, so that emotive, dramatic, or poetic attributes can change and unfold."

Reading The Manhattan Transcripts is a great pleasure intolerably akin to detective fiction. It begins with a little Borsian joke: "They found the Transcripts by accident." One is constantly engaged in reading a collage of drawings and photographs. Architecture has rarely included the element of suspense so happily. For Tschumi, like the French aestheteian and novelist Georges Bataille, art is transgression, and by movies since the turn of the century, so has architecture, but usually through the flamboyant quotation of the most luxurious aspects of cinematic set design, rather than the formal qualities inherent in the medium. Here the "fade-ins" and "inserts" are strategies to create unlikely, variable, and insistent spaces. There is an explosive pleasure-element in all this, as Tschumi predicts: "reality is made infinitely malleable, so that emotive, dramatic, or poetic attributes can change and unfold."

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Certainly a virtuoso draftsman, Daniel Libeskind, Dean of Cranbrook Academy's Department of Architecture, records in Between Zero and Infinity a significant series of images he has generated. Born in 1946 in Poland, Libeskind was first trained as a musician. Investigating simultaneously every possible permutation of rhythm and interval, his architecture possesses a complexity akin to Elliot Carter's compositions. It is fitting that Between Zero and Infinity should be introduced by John Hejduk, the dean of narrative architectonic structures, whose contributions lie in a complex series of formal and fictive fabrications, although he is too often associated with purism. Hejduk is perhaps the key figure for understanding the fictional and fictive fabrications of both Tschumi and Libeskind. Initially he has produced a critical history of the ideas that underlie them. The work of photography.
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American art. These machines are primarily engaged in self-consumption, as in Jean Tinguely's self-destructing homage to New York. Yet these are truly machines of desire, of which the French philosopher Gilles Deleuze has spoken.

Libeskind's work is an incisive, yet devastating expression of an infinite lack of hierarchy and subordination. He has created an epic architecture in which all elements are foregrounded. He has achieved boldness in black-and-white in which perspective and geometry are catastrophically disrupted and need no shading or chiaroscuro to heighten the drama, like the geometric paintings of Al Held. Lionel Trilling has stated that the shattering of narrative ensued deterministically after the sociological shattering of the family in the late 19th Century. Libeskind has extended shattered, nonnarrative structure into architecture. His latest drawings, "The Grim Reaper" and "Ossification," betray the violence of William Burroughs. These wild drawings, filled with trees, images, and masks, are indeed allegories of a ruined world and of our own nuclear predicament.

Tschumi and Libeskind have dissolved the necessity of describing them as Modern or Post-Modern; they avoid a comfortable collage technique without eschewing collage. In much recent eclecticism, the problem is that historical modes have been appropriated with too much ease. The imagination in Tschumi and Libeskind is one of a difficult, even tortured, kind. They are both theatrical, metaphysical architects, who have gone beyond conventional architecture to prophesy the necessity for a cleansing of the conventions.

Tschumi and Libeskind have been considered mere dreamers or conceptualists. Yet let us recall that dreams are a necessary form of adaptation. Without dreams, we have no way to deal with trauma and dislocation. If the dream is too mellifluous, it becomes a mere escape or screen, as in most contemporary historicism, that becomes architecture by way of nostalgia. Tschumi and Libeskind maintain a minimum of nostalgia. By inventing radical, split forms, their dreams permit a novel vision of openness that is not falsely discreet.

Landscape art


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REEMAY exceeds 100,000 flex cycles without cracking. fiberglass fails at 100 in the same test. Over years of freeze/thaw cycles, REEMAY holds up, to provide long, reliable service life.

9 times lighter
Lightweight REEMAY adds very little to load-bearing requirements. And it helps keep the lid on construction costs, because it goes down faster and easier. One 9 lb. roll gives the same coverage as a 150 lb. roll of felt.

Used with most common cold mastics, for multi-ply, built-up roofs, remarkable REEMAY Roofing Fabric gives you a more trouble-free, more lasting roof. Add REEMAY to your spec file today. Call or write for complete details: (302) 999-5077. DuPont Company G-39980, Wilmington, DE 19898.

*DuPont registered trademark

<table>
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<tr>
<th>REEMAY vs. FELTS</th>
<th>Organic Felt, 15 Lbs.</th>
<th>Fiberglass Felt</th>
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<td>1 Strength, pounds</td>
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<td>2 Elongation, percent</td>
<td>1.5</td>
<td>1.8</td>
<td>43</td>
</tr>
<tr>
<td>3 Flex-life, cycles to failure</td>
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<td>100</td>
<td>100,000</td>
</tr>
<tr>
<td>4 Weight, pounds/100 sq. ft.</td>
<td>45,000</td>
<td>36,000</td>
<td>4,050</td>
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All materials tested in 3 plies in asphalt.

Circle No. 320 on Reader Service Card
The following items are related to the Technics article on synthetic roofing (p. 109).

Products

Scotch-Clad® coated foam roofing system is a sprayed-on, self-flashing coating that forms a seamless, weather-resistant shield tightly bonded to a sprayed urethane-foam insulation base. It also forms a seamless cove around rooftop penetrations. It is watertight, withstands normal maintenance traffic, resists ultraviolet degrading, and withstands thermal stress. It is available with UL Class A and Factory Mutual Class 1 ratings. 3M Company, Adhesives, Coatings & Sealers Div. Circle 100 on reader service card

Futura liquid applied roofing combines a reinforcing fabric with urethane elastomers to form a weather-resistant, waterproofing membrane. The lightweight, flexible system is 100 percent bonded to the substrate, eliminating the lateral movement of water. Futura-Ply offers design flexibility because of its ability to adhere to a variety of shapes and contours. Futura Coatings, Inc. Circle 106 on reader service card

Elastaseal and Colorseal fluid-applied roofing materials form seamless, waterproof membranes having elasticity that accommodates normal roof expansion and contraction. Elastaseal 30 is a urethane/pitch multipolymer composition that is tough, durable, and resistant to temperature extremes, chemical attack, and biological degradation. Colorseal is an all-acrylic copolymer-base material that can be applied to pitched roofs without slumping. It is available in several colors providing solar reflectivity. London Chemical Co. Circle 107 on reader service card

Futura-Ply liquid applied roofing is made of either polyester or fiberglass matting impregnated on both sides with a modified bitumen compound. It is said to offer a high degree of puncture resistance, tensile strength, elasticity, bondability, high temperature resistance, cold weather flexibility, resistance to oxidation, and seam integrity. Seams are heat welded to form a single, continuous membrane. U.S. Intec, Inc. Circle 109 on reader service card

Brai roofing membrane is made of either polyester or fiberglass matting impregnated on both sides with a modified bitumen compound. It is said to offer a high degree of puncture resistance, tensile strength, elasticity, bondability, high temperature resistance, cold weather flexibility, resistance to oxidation, and seam integrity. Seams are heat welded to form a single, continuous membrane. U.S. Intec, Inc. Circle 110 on reader service card

SAM self-adhering membrane roofing is modified bitumen reinforced with a puncture-resistant web of polypropylene fibers. Overlapping edges bond securely to form a watertight surface. Small holes tend to self-seal in the sun's heat; major damage can be patched quickly. Although it is not usually required, ballast can be applied as extra protection against weather extremes. Apache Building Products Co. Circle 111 on reader service card [Products continued on page 134]
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Circle No. 339 on Reader Service Card
Rhinohide\textsuperscript{\textregistered} MB/R roof systems resist roof traffic damage, aging, ultraviolet light deterioration, thermal shock, puncturing, and splitting. Four finishes available are slate aggregate, aluminum, copper, and black. The roofing has a bonding resin built into the material which is activated by propane torch as the roofing is laid out. Seams are heated and compressed with a trowel. Ballast and mechanical fasteners are not required. Monroe, Inc. Circle 112 on reader service card

Awaplan MB/R roofing is an asphalt-saturated mat of multidirectional polyester fibers with asphalt coating on the underside and mineral granules embedded in the top. It provides a tough, weather-resistant and wear-resistant surface on new roofs or on existing gravel-surfaced or inorganic smooth-surfaced membrane roofs. Colors are white or black. Tamko Asphalt Products, Inc. Circle 113 on reader service card

Derbigum\textsuperscript{\textregistered} HPS MB/R roofing has a multidirectional tensile strength of 200 psi, greater than that recommended by the National Bureau of Standards for bituminous membranes. Triple reinforcement of glass fiber weathering mat, interior glass fiber web, and woven polyester core provides dimensional stability. The material has a built-in adhesive that is torch-bonded to the substrate. It is compatible with most commonly used construction materials and requires no granular cover. Owens-Corning Fiberglas Corp. Circle 114 on reader service card

Veral roofing has a base ply of Irex high-melt, glass-reinforced asphalt and a top ply of Veral woven glass-reinforced modified asphalt with a protective metal foil facing. A thin layer of low-melt asphalt beneath channels in the foil facing accommodates the different expansion rates of the foil and the asphaltic materials. Foil finishes available are copper, reflective aluminum, and chemical-resistant stainless steel. Siplast. Circle 115 on reader service card

Nuralite mineral-reinforced bitumen roofing is easily fabricated to conform to varied deck configurations and roof penetrations. It resists atmospheric corrosion even in industrial and coastal areas. It has UL Class A and B and Factory Mutual Class 1 ratings. It can be used for flashing and gutter details for a homogeneous roof having uniform properties. GRM withstands temperature extremes and resists thermal shock. It is lightweight, flexible, self-sealing in the case of small punctures, and easily repaired when accidentally damaged. Construction Products Div., W.R. Grace & Co. Circle 118 on reader service card

Dibiten one-ply roofing, manufactured in Italy, is a plasticized bituminous membrane with either polyester or fiberglass core, which is extruded to various thicknesses. It is Factory Mutual-approved for fire resistance and wind uplift resistance. The material bonds to most surfaces, requiring no adhesives or sealants. It can be installed over existing roofs of asphalt or tar pitch provided they are clean and free of loose ballast or debris. The material is unaffected by standing water and ultraviolet light and does not require ballasting or coating. Bowe Company, Inc. Circle 117 on reader service card

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sulation, a stone mat, and gravel. The aluminum membrane, either cold- or hot-applied, is used on sloping roofs, those with load restrictions, or where a smooth surface is desired. Koppers Co., Inc., Building Materials Div. Circle 119 on reader service card

Coated, heavily aluminized film provides smooth surface is desired. Koppers Co., Inc., Building Materials Div. Circle 121 on reader service card

Circle 120 on reader service card

Parsec Reflective Roofing of specially coated, heavily aluminized film provides a highly reflective surface that reduces the heat normally absorbed by conventional roofing materials. The single-ply roofing is applied with adhesive that is aggressively pressure sensitive. It resists UV degradation, oxidation, and corrosion. Parsec. Inc. Circle 121 on reader service card

Clarmac RM single-ply roofing membrane is a flexible, asphalt-impregnated polyester fabric. It is applied directly over a tack coat, then covered with a finish coat of emulsion or hot-mopped asphalt. Aggregate topping is optional. The membrane is suitable for new roofs, wooden or steel decks, and for roof patching. Clark-Cutler-McDermott Co. Circle 122 on reader service card

Single-ply roofing of PCR-30 Celanese Fortrel® polyester fabric with seven coats of Trimeric polyester resists UV light and microorganisms. It has excellent tear and puncture strengths, is impervious to most caustic chemicals and acids, and is not affected by temperature extremes. It is mechanically fastened and needs no ballast. It reflects up to 85 percent of the sun's heat. Durolast Roofing, Inc. Circle 123 on reader service card

Isofoam rigid urethane foam spray-applied to roofs provides low-cost, seamless roof insulation. It bonds securely around cornices and in valleys. A membrane coating is required to prevent UV and moisture degradation. Witco Chemical Corp., Isocyanate Products Div. Circle 124 on reader service card

Hi-Tuff single-ply roofing is heat-sealable, scrim-reinforced rubber membrane. Made from Du Pont's Hypalon chlorosulfonated polyethylene, the vulcanizable material retains flexibility for a long period of time. Its welded seams and mechanical attachment to the roof with fasteners hold it secure against wind uplift. It is compatible with asphalt, making it suitable for reroofing applications over built-up roofing. J.P. Stevens & Co., Inc., Elastomeric Products Div. Circle 125 on reader service card

The Interoof® mechanically attached roofing system is lightweight, resistant to ultraviolet light, and has high dimensional stability. Consisting of PVC-coated metal strips and wear-resistant 60-mil-thick membrane, it maintains flexibility for the life of the product. The company's solvent welding machine speeds application of the roofing by welding the membrane to the PVC strips and then welding the seams together. IPW Interplastic, Div. of Semperit of America, Inc. Circle 126 on reader service card

Nerva-Ply® PVC is single-ply roofing membrane for flat roofs having slopes of less than 1 inch per foot. The waterproof, flexible material is made with inhibitors that prevent ultraviolet light damage. The membrane can be laid over roof deck or roof insulation and ballasted with gravel. Standard sheets can be factory assembled into large, roof-size dimensions. Rubber & Plastics Compound Co., Inc. Circle 127 on reader service card

Flexhide® 34 PVC (polyvinyl chloride) roofing membrane waterproofs low-slope roofs by solvent- or heat-welding lapped sheets to form a watertight cov-

The eight architectural moldings presented here were introduced by FRY in response to needs expressed by architects and contractors. Designed for easier, faster installation of gypboard or panels plus more esthetic appearance. Made of extruded aluminum; available in painted or anodized colors. For more information, write Fry. Circle No. 332 on Reader Service Card
Silicone single-ply roofing combines silicone rubber and fiberglass to form an inorganic, weather-resistant system with a Class A/B fire rating. The white membrane reflects over 90 percent of the sun's rays and resists UV light and most chemicals. It is fully adhered with silicone adhesive to insulation board that is mechanically fastened through the deck. It requires no ballast, which eliminates the problem of adding significant weight to the structure. Otto Fabric Inc. Circle 129 on reader service card

AlphAgard® PIB roofing membrane has a UL fire rating of Class A and Factory Mutual wind test rating of I-90. It is applied with hot asphalt or cold adhesive and has a prefabricated self-sealing edge for faster application and long-term waterproofing. The unbonded roofing reduces dead load. It is resistant to weather, UV light, normal industrial gases, and natural aging, and is compatible with bitumen. AGR Company. Circle 130 on reader service card

Roofing and flashing system consists of rigid polyurethane foam insulation and a white elastomeric coating. The insulation is sprayed in place in layers to the desired thickness, followed by sprayed or roller-applied coating. Applied over a noncombustible deck, it has a UL Class A rating. Its reflective surface reduces heat absorption, and the material resists dirt to remain white. The coating also allows trapped moisture to escape, although it bars entry of water. Carpenter Insulation & Coating Co. Circle 131 on reader service card

RubberCard® EPDM roofing membranes are waterproof and resistant to ozone, ultraviolet light, and weather. The sheet is available in two sizes: 45 mils thick in panels up to 40' x 150', and 60 mils thick in 54-inch and 10-foot widths, up to 150 feet long. Also available is RubberCard Neoprene Flash self-curing flashing that is adaptable to irregular surfaces and is both weather resistant and impervious to water. Firestone Industrial Products Co. Circle 132 on reader service card

SuperRoof® is a tough, flexible, EPDM rubber membrane one-piece water barrier applied over the entire roof. Large sheets are adhesive-bonded in place, forming a covering that stretches with building movement and resists deterioration from ultraviolet light, ozone, atmospheric chemicals, and other conditions. A white EPDM installation, reflecting up to 60 percent of solar-induced heating, reduces energy costs of air-conditioning. Proco Protective Coatings, Inc., of Fort Wayne. Circle 133 on reader service card

Talc-free EPDM roofing membrane is ready for field seaming, without cleaning, using a two-inch-wide self-vulcanizing tape. Called Super- Seam, it requires no cleaning, priming, adhesive, or caulking and offers expected labor savings of approximately 40 percent. It can be ballasted, batten-fastened, or fully adhered. The material withstands temperatures from -50 to 240°F without cracking or deteriorating and has good elongation properties. Benoit, Inc. Circle 134 on reader service card

Whaleskin/81® roofing membrane is made from Uniroyal's Royalex® EPDM rubber in sheets 10-40 feet wide and up to 200 feet long. Available in black, gray, and white, the material resists ultraviolet attack, organic decomposition, weathering, and ozone. Five application techniques include loose-laid and ballasted, totally adhered, plate-bonded, grid-adhered, and reverse furled. The ballasted roofing system is classified by Underwriters Laboratories and used in the construction of Class A roofs. Kelly Energy Systems, Inc. Circle 135 on reader service card

GAFPLY-EP single-ply roofing systems are made from EPDM rubber. The material is said to offer superior weatherability, demonstrated in continuous-exposure applications for more than 15 years. The system is designed for fast, cost-effective applications that provide long-term performance with a minimum of maintenance. GAF Corp. Circle 136 on reader service card

Hydro-Seal® roof membrane of EPDM sheet rubber can be used for new roofing or reroofing. It is a flexible, single-ply, elastomeric, watertight material that can be ballasted, fully adhered, mechanically fastened, or applied by the IRMA method. It can be applied to concrete, steel, or wood decks, and is adaptable to [Literature continued on page 138]
CAN A TAMKO AWAPLAN™ ROOF STAND UP TO A LEGEND?

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In all fairness we then tried the same over-abuse with other roofing materials. The Vise-Grip® locking pliers lived up to their legend. The competition did not. But why take just our word for it?
Flag single-ply PVC roofing membranes include: Flagon® C loose-laid with ballast for flat roofs; Flagon SFR fully adhered, suitable for flat, sloping, domed, and unballasted roofs; and Flagon MF mechanically fastened systems. Descriptions, installation information, and physical properties, along with detail drawings, are provided in a 4-page brochure. WatPro.

Trocal® SMA roofing of polyvinyl chloride is a stretchable thermoplastic sheet that is loose-laid and solvent-welded into a one-piece skin. It is fastened at roof edge and roof penetrations, then ballasted with washed gravel. It can be installed at temperatures from below freezing to uncomfortably hot and in wet, snowy, or humid weather conditions. The system, its application, detail drawing, and specifications are covered in a 24-page brochure. Trocal Roofing Systems, Dynamit Nobel of America.

Plyroof® single-ply roof sheetings include Plyshield® Neoprene, Plyshe® EPDM, and Plyroof® PVC. All are sealed on the roof to provide a barrier to rain, snow, and ice, and the ponding they may cause. They are flexible at sub-freezing temperatures and will not split or crack. Technical data for each type is available in a 12-page booklet. Plymouth Rubber Co., Inc.

BRAAS Renofol® single-ply PVC roofing is available in two ballasted systems for flat roofs sloping no more than 1 1/2 inches in 12 inches, and a mechanically fastened sheet reinforced with fabric for dimensional stability and strength. It is ultraviolet stable and contains antioxidants. The roofing systems, materials, and installation methods are covered in an 8-page illustrated catalog. Barra Corp. of America.

NRCA Roofing Materials Reference & Guide lists all elasto/plastic sheet-applied roofing membrane and built-up roofing products being distributed in the U.S. The guide is published three times a year, allowing it to be updated every four months. The annual subscription rate is $85; information is available from the National Roofing Contractors Association, 8600 Bryn Mawr Ave., Chicago, Ill. 60631.

Building materials

Major materials suppliers for buildings that are featured this month as they were furnished to P/A by the architects.


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Industrial Systems Division

Circle No. 327 on Reader Service Card
Not everyone can paddle away from the corporate world as John Burton did, shucking his three-piece suit for swim trunks and life vest. Not everyone would want to, leaving a job as security analyst for a Philadelphia bank to return—with a healthy slash in salary—to the wild whitewaters where he had achieved prominence as a national champion canoeist.

For John Burton, however, becoming a “river runner,” a professional outfitter providing instruction, guides, and gear for others to thrill to the grand outdoor adventure of whitewater rafting, was “really great.” He adds: “I had been canoeing and kayak racing all my life. Now I’m combining avocation and vocation.”

As director and co-owner of Nantahala Outdoor Center, Bryson City, N. C., he is, says his older brother Bob, “the happiest man alive... But it’s not for me. I couldn’t live in the middle of nowhere, and I like the business world.”

A vice president of the Goldman Sachs & Co. investment brokerage office in Houston, Bob Burton also enjoys riding the rapids. But, like an increasing number of executives, only as a break from business. He and his son have rafted on the Nantahala River, and this summer were set to ride the rapids of the more challenging Chattooga, location for “Deliverance,” the movie which did so much for the popularity of Whitewater rafting.

Riding an inflatable rubber raft through Whitewater (moving water that turns turbulent or frothy by passing over rocks) is a memorable experience. It has been a few years since Bob Rogers rode the Rio Grande in Texas and Colorado, and the Salmon in Idaho, but the president and CEO of Texas Industries Inc., a Dallas gravel and concrete firm, still thrills to “the contrast between the serenity of floating down a placid river, so calm and peaceful you hear all the birds, then hearing up ahead the roar of the falls and rapids you’re about to enter. The serenity turns into apprehension and excitement, then into relief as you reach the other side in one piece. Sometimes even staying in the raft,“ he chuckles.

Whitewater rafting, says John Burton, is “a great way to spend a day outdoors and it’s fun, greatly exhilarating. There’s excitement, some challenge, and risk. The best rivers have an element of danger that raises the anxiety level—and that makes it very interesting.”

A fun test. To Melvyn N. Klein it is an “adventure.” Says the president and CEO of Altamil Corp, a Corpus Christi, Tex., manufacturer: “You’re out in the wilderness and it’s a test of skills, mental and physical abilities.”

John C. Whitehead, senior partner in Goldman Sachs’ New York headquarters, calls Whitewater rafting “as much of a change from the active business world as you can possibly get, far away from civilization and the telephone. You see absolutely beautiful country and you see how a group of people, most of whom don’t know each other, become close friends and a unit that works so well together in such a short time.”

For the last four years Mr. Whitehead has gone rafting with the Outward Bound School groups assembled by American Stock Exchange Chairman Arthur Levitt Jr. These trips, about a week apiece, have taken them down the
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For meeting information, Circle No. 382
Colorado (whose passage through the Grand Canyon remains the “grand­
daddy” of whitewater rivers), the Green in Utah, the Rogue in Oregon, and the Chattooga in South Carolina and Georgia.

“The purpose,” Mr. Levitt explains, “is to get people who are sometimes in adversarial roles to begin a better dia­
log and work together under stressful circumstances. The benefits are a greater appreciation of your own limits and greater understanding of the envi­
ronment that many city dwellers can’t comprehend. Yes, it’s a lot of fun. Is it dangerous? No, the safety standards [of the outfitters] make it safer than walk­ing across Broadway and 42nd Street. The stress is more cerebral than phys­
ical.”

Before challenging the Chattooga, for example, the group even practiced “swamping,” or deliberately capsizing, on the nearby Ocoee River. Rafters need not know how to swim (since life jackets and sometimes even helmets are required dress), but they should know how to handle themselves in the river. Instructions: float on your back, knees up and feet downstream—so that your head doesn’t strike a rock, one of the major dangers. Don’t try to stand your foot could get stuck between rocks and then the current might drag you under.

The teamwork required to follow the guide’s instructions impressed Mr. Klein the most. The guide generally takes his party (usually four other peo­ple on a raft) through the first rapids, but after this he fades into the back­
ground, letting the others take turns steering and acting as “captain.”

Read the rapids. The group learns to pull the raft over to shore and then walk ahead and study a rapids, plotting their course, before attempting to ma­
neuver through it. They must “read” the water, which changes daily. For safety’s sake, they must spot any dan­
gerous rocks ahead of time.

“A good rafting crew knows what to do before you hit the rapids,” says Mr. Klein. “Then somebody steers and ev­
everybody else paddles as fast as he can. It takes lightning reactions and split­
second timing.”

“It’s not like going fishing, where you can think about other things. You don’t have time,” points out Atlanta outfitter Claude Terry of Southeastern Expeditions Inc. “You’re caught in a rush and you have to obey the guide and his signals and do it quickly—or else you’ll be upside down, or pinned on a rock, or swimming in a river.”

Mr. Whitehead admits to “moments

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Children: supervised by a staff trained to keep every
Adults: absolutely carefree days for your kind of

A детальная информация о скидках и ценах представлена в тексте.

PERSONAL TIME

of nervousness. Maybe you don’t want
to go through the rapids, but there’s a
certain group pressure to do it. It’s in­
teresting to see how leaders develop,
how people with certain abilities cope
with situations like this,” he says. And
it’s not always the top executives who
take charge; sometimes their juniors
become the leaders on water.

Except for people with severe physical
limitations, nearly anyone—even
children—can enjoy some level of
whitewater rafting. It is not nearly as
difficult as canoeing. “We require no
experience of any kind,” John Burton
says. “The only thing we recommend is
that they not be afraid of the water.”

Skip Class VI. The degree of safety
(and enjoyment) depends largely on
the river, and whitewater rapids are
classified in terms of strength and
turbulence—from Class I (very small
rapids, slow current, no hard obstacles, great for beginners) to Class VI (nearly impossible, for experts only, to be
taken at risk of life). A “quality” white­
water river will feature a drop in gra­
dient (slope) of 30 ft to 50 ft and more
per mile, high water levels from heavy
snows, spring thaws, or dam control;
and natural ledges, falls, dams, eddies,
and obstructions.

Although many ride the rivers on
their own, it’s wisest to go with an ex­
pertly trained professional outfitter, li­
censed (by such agencies as the Forest
Service and the National Park Service) to operate on certain rivers.

Three good sources for choosing a
reliable outfitter are the Eastern Profes­
sional River Outfitters Assn., Ocoee,
Tenn.; the Western River Guides Assn.,
Denver; and the Idaho Outfitters &
Guides Assn., Boise. The amount of paddling on most trips is largely left up to you. On the
shorter trips in the East, most rafters
choose to actively participate. But in
the West, rafts are also powered by oar
(the guide does all the work) or motor.

Outfitter Bob Bolpert reports: “On our
six-day trips, most people paddle two
days and then want to sit back and re­
lax.” Mr. Bolpert is another former
businessman; he gave up his job as a
stockbroker to start Outdoor Adven­
tures, San Francisco.

Besides consulting the outfitters, ex­
cutives planning to Whitewater for
the first time are advised by Mr. Levitt
to “read as much as you can about
the terrain, animals, plant life, and
geology.”

One should also try to leave the busi­
ness world behind—unlike the Man­
thattan brokerage partner whom one
outfitter can still picture. “We were
floating [down the Salmon River] by a
number of ranches, very isolated
places. Their only contact with the out­
side is by radio telephone, and the
phones are supposed to be for
emergency use. Well, we stopped at
all of these places and the one guy said
to use the phone. You know, he called
to see how the market was doing!”

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