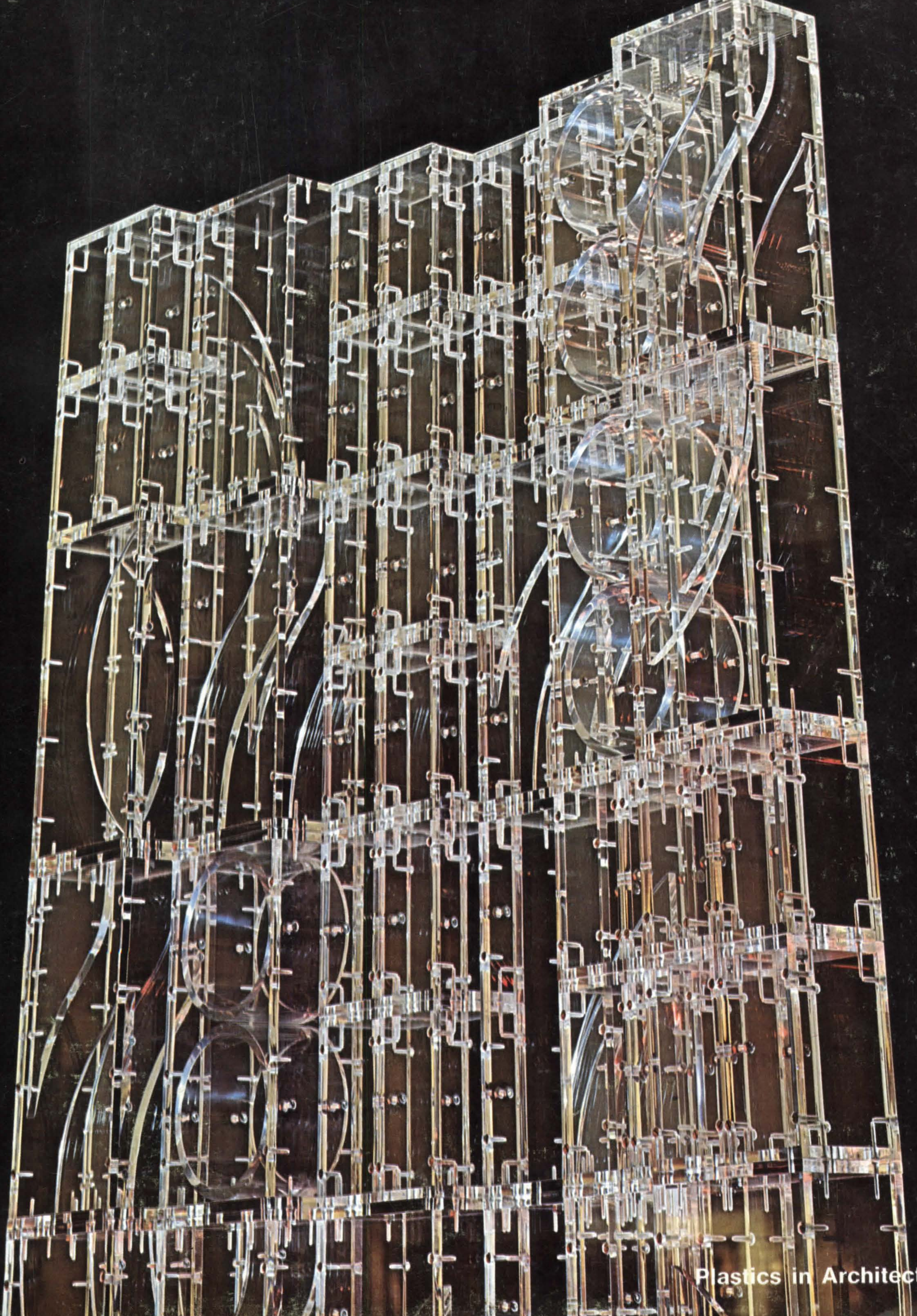
PROGRESSIVE ARCHITECTURE

A Reinhold Publication/October 1970



Plastics in Architecture

The clean, modern feel of the Center's exterior carries over to the interior components with the help of Armstrong Imperial Modern Excelon Tile. Imperial Modern's selection of 12 soft colors in a tight-mottled graining make it a natural choice for commercial and institutional interiors.

This is the Loyola University Medical Center in Maywood, Illinois. A center in the truest sense, it houses medical and dental schools and a fully equipped hospital.

ARCHITECT: Alexander H. Bacci, FAIA, of Schmidt, Garden & Erikson, 104 South Michigan, Chicago, Illinois

INTERIOR DESIGNER: Miss Ruth M. Flaks of Schmidt, Garden & Erikson

GENERAL CONTRACTOR: M. A. Lombard Co., Chicago (Dental School); George Sollitt Construction Company, Chicago (Medical School)

FLOOR CONTRACTOR: Johnson Floor Company, Inc., 3107 South Oak Park Avenue, Berwyn, Illinois

With Imperial Modern Excelon Tile, looks and durability are combined in a crisp yet pleasant look. Because the pattern goes all the way through the vinyl-asbestos tile, design and colors last the life of the floor.

Imperial Modern Excelon offers a rich appearance at no premium in price, so the installed cost is ideal for controlled budgets. Put this together with Excelon's proven reputation for economical maintenance, and the total cost picture is outstanding—a key consideration for any building planner.

Editor
FORREST WILSON, AIA, CSI

Executive Editor
BURTON H. HOLMES, AIA

Features Editor
C. RAY SMITH, AIA

Managing Editor
RITA ROBISON

Associate Editors
DON RANEY
DAVID A. MORTON
JOYCE REBACK
SUZANNE STEPHENS *News*
ESTHER MC COY *Los Angeles*

Copy Editor
CHARLOTTE VAN VOORHIS

Assistant to the Editor
ROSEMARY LACERENZA

Assistant Editor
CHET MANTOLESKY

Editorial Assistant
ROSE CALOMINO

Graphics
JOEL PETROWER *Art Director*
GEORGE CODERRE *Assistant Art Director*
ANNE MARIE SAPIONE *Art & Production*
NICHOLAS R. LOSCALZO *Architectural Drawings*

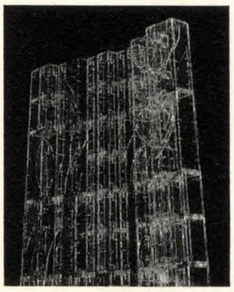
Contributing Editors
NORMAN COPLAN *It's The Law*
BERNARD TOMSON, Hon. AIA *It's The Law*
E. E. HALMOS, Jr. *Washington/Financial*
HAROLD J. ROSEN, PE, FCSI, *Spec. Clinic*
SYSKA & HENNESSY, INC. *Environmental Engineering*

Publisher
HARRINGTON A. ROSE

WILLIAM F. BONDLOW Jr. *Adv. Sales Manager*
BURCHARD M. DAY *Promotion Director*
JOSEPH M. SCANLON *Production Director*
DANIEL H. DESIMONE *Production Manager*
RICHARD H. DI VECCHIO *Circulation Director*
SUE FELDMAN *Subscription Manager*
WALTER L. BENZ *Research Director*
E. M. WOLFE *Reader Service Manager*

Progressive Architecture, published monthly by Reinhold Publishing Corporation, 600 Summer Street, Stamford, Conn., 06904. A subsidiary of Litton Publications. Philip H. Hubbard, Jr., President; Harry I. Martin, Group Vice-President; Charles O. Bennewitz, Treasurer; Kathleen A. Starke, Secretary; Robert W. Roose, Vice-President. Executive and editorial offices, 600 Summer Street, Stamford, Conn. 06904.

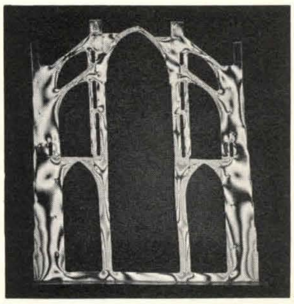
Subscriptions payable in advance. Publisher reserves right to refuse unqualified subscriptions. Subscription prices to those who, by title, are architects, engineers, specifications writers, estimators, designers, or draftsmen, and to government departments, trade associations, above title groups on temporary military service, architectural schools, architectural students, advertisers and their employees: $5 for one year; $8 for two years; $10 for three years. All others: $10 a year. Above prices are applicable in U.S., U.S. Possessions, and Canada. All practicing architects and engineers outside these areas: $10 for one year; $16 for two years; $20 for three years. All others: $20 a year. Single copy $2, payable in advance. Indexed in Art Index, Architectural Index. Second-class postage paid at Stamford, Conn., and at additional office. Volume LI, No. 10, Printed in U.S.A.

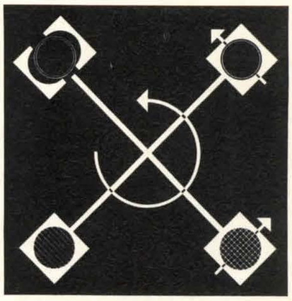


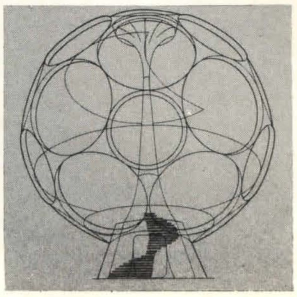
Canada Series III, a sculpture constructed of Plexiglas by Louise Nevelson at the Pace Gallery, New York City. Cover photograph: Marc Cohen. (Also appears on p. 70.)

FEATURES

In 1960, the editors of P/A believed that the future of plastics in architectural construction would permit countless new ways of solving design problems and that completely fresh and exciting structures would result. Although this forecast has not yet come true, the volume of plastics in building construction has increased handsomely and some design advances have been realized. The progress of the last decade, current developments, and a new look at the future of plastics are discussed in the following articles of this issue.





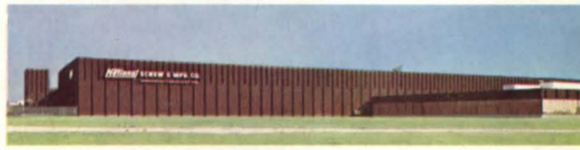


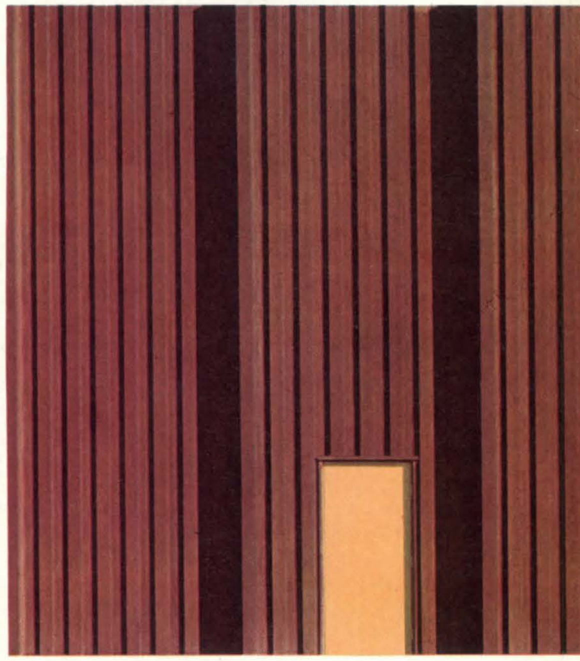
P/A THIS MONTH

PROGRESSIVE ARCHITECTURE® OCTOBER 1970

DEPARTMENTS

USS Cor-Ten Steel...naturally.
A natural choice for the combined 500,000 sq. ft. plant and offices of National Screw and Manufacturing Company, Mentor, Ohio. Another example that beauty doesn't have to cost more.
A bare COR-TEN steel exterior may look expensive but it's really one of the more economical materials you can use for industrial exteriors. And once it's up, you can forget normal maintenance costs—it takes care of itself. No painting, no cleaning, and since it's a high-strength steel it can take a pretty good beating. If it's scratched or marred, it simply heals itself. And the older it gets, the better it looks. Why not take a long hard look at bare COR-TEN steel for your next industrial structure. It's a natural.
National SCREW & MFG. CO.
MONOGRAM INDUSTRIES INC.





National Screw & Mfg. Company Building, Mentor, Ohio.
ARCHITECT: Outcalt, Guenther, Partners, Cleveland, Ohio.
STRUCTURAL ENGINEER: Barber & Hoffman, Inc., Cleveland, Ohio.
GENERAL CONTRACTOR: Turner Construction Co., Cleveland, Ohio.
STEEL FABRICATOR: Kilroy Structural Steel, Cleveland, Ohio.
SIDING MANUFACTURER: The R. C. Mahon, Detroit, Michigan.

For information, contact a USS Construction Marketing Representative through the nearest USS sales office, check your Sweet's Architectural or Industrial Construction File, or write to United States Steel, Box 86, Pittsburgh, Pa. 15230.

USS and COR-TEN are registered trademarks.

On Reader Service Card, Circle No. 387

YOUR POINT OF VIEW

Goodbye "Jobs and Men" Welcome — "Job Mart"

Dear Editor: I am writing in reference to the column "Jobs & Men" which appears on the last page of each issue of P/A. I am sure you are aware of the fact that there are many qualified women architects as well as men who may seek employment through this column.

I question the legality as well as the good taste of such subtle discrimination. I have noticed that your editorial staff goes to great lengths in the front of the book to create a "progressive" if not avante-garde image.

Why is it then that you insist on capping each issue with typical 19th century male chauvinism?

Phyllis Sperling
Brooklyn, New York

(We wish to thank Miss Sperling for her contribution to an improved P/A. We accept her criticism, and since action speaks . . . if she will turn to page 162 she will find "Jobs and Men," so-called since October 1944 [when P/A was still Pencil Points] now labeled "Job Mart." Ed.)

Views Exchanged

(The following two letters are an exchange of views between members of the Ohio State Board of Examiners of Architects. As Mr. Sidells states: "It indicates the deep concern which was expressed in a number of ways during the recent NCARB Convention. This kind of dialogue must be encouraged between all four of the architectural organizations — AIA, NCARB, ACSA and NAAB. Only by understanding and respecting the problems which face each group can we work out an intelligent total solution to the future needs of our profession.")

To: All Members of the Board of Examiners of Architects

Subject: Review of 1970 NCARB Convention in Boston, Mass.

As a relatively new board member, I was impressed with the very aggressive and vital leadership that NCARB is displaying, despite the fact that I disagreed with much that was said and done at the convention. By comparison, AIA seems to dissipate its energies in its more diverse interests. Both groups need to examine the definition of the practice of architecture before they go much farther.

In his speech to the convention, Ralph Nader recognized that the professional person, by his client's interests, is inevitably placed in a position that requires a disregard for society's interests. For example, the engineer ignores safety features in favor of performance in the design of an automobile. The lawyer strives to gain freedom for a client who is an obvious menace to society. For these reasons, Mr. Nader believes that the professions must see to it that a segment of their membership devotes total service and support to the public policy area so that society's interests are upheld. Mr. Nader *did not* advocate any change in the traditional client-professional relationship.

The current general trend in our profession is to require architects to serve the community's general interests first and his client's specific interests second. The implementation of this new policy means that the technical capabilities of the architect are subordinated to his understanding of society's general needs and welfare. The foreseeable result will be that sociologist-architects will starve to death while the technical-engineer will meet the demands of the construction industry for construction documents needed in the building of building projects.

In reviewing the report of the NCARB Examination Development Committee, June 1970, under "Professional Examination," part of the new examination states:

a. . .architect responsible for making strategic decisions regarding a major environmental issue.

b. . .measure the candidate's environmental value judgment.

c. . .test examinee's understanding of his responsibilities to the public.

d. . .be machine graded and, commentary . . .philosophies and processes must change and encourage better initial decision to be made. . .competence in *tactical* decision-making is first and most important need. . .

These quotes are consistent with a philosophy of architectural practice that is unrealistic. Architects are often poor tactitians. The architect does not (normally) make strategic decisions for his client. His standard of values concerning the physical development of a given environment are arbitrary and capricious. His responsibilities to the public are clearly set forth in zoning ordinances and building codes, and beyond these legal restrictions, his responsibilities to the public cannot be finitely defined or tested by professional examination.

The special capability of the architect is to synthesize elements of a problem and present his findings in an attractive graphic form, complete with supporting construction documents. To insist that testing for such competence can be done by machine is unrealistic at this point.

Needless to say, I am interested in hearing from the Ohio Board as to their reactions to the convention. We all agreed with Arthur Sidells on incorporating other options to the accredited school requirement as a prerequisite for admission to examination. Can we now agree on a statement relative to the new professional examination?

I can agree with the academicians that architects should develop their capabilities as developers of property, thereby enhancing the possibility of producing a better environment in the event that the more fortunate architects will become owners of property. However, simply changing the examination procedure is not going to change the traditional relationship between the (non-architect) owner and his consulting architect. The ultimate responsibility for making decisions regarding land development rests with *ownership* acting under the constraints of the public interest as interpreted by cognizant levels of government. The architect remains the implementer of his client's decisions.

Howard B. Cain

To: All Members of the Board of Examiners of Architects

Subject: Future Professional Practice of Architecture: Changes Required to Meet Challenges

I agree with many of the points Howard Cain has made. With others I disagree.

Ralph Nader's address to the NCARB Convention in Boston should be heeded, although it had little or no effect on the Convention. The position taken by Mr. Nader was one which fits today's situation but does not project far enough into the future. Since he did not advo-

(Continued on page 11)


The Chamberlin Conference Chair
Soft rolled edges . . . downy, imported top grain leather seat and back cushions . . . a flowing frame of solid cast aluminum . . . finished in high-impact fluidized thermoplastic, either High Gloss Black Ripple or Clear Mirror finishes.
Please write today for an illustrated brochure to Burke-Acton, 5140 North Westmoreland, Dallas, 75247.
BURKE-ACTON
Division Tartan Corporation


CRSI
FOUNDED 1924
Go 60 and Save. 9,000 tons of Grade 60 reinforcing steel support 90,000 cu. yds. of concrete bringing Dallas an exciting, new three-block-long Municipal Administration Center.
GRADE 60 USD
Architects: Associated Architects
I.M. Pei & Partners, New York City/Harper and Kemp, Dallas
Structural Engineers: Terry-Rosenlund & Co., Dallas

YOUR POINT OF VIEW

(Continued from page 6)
cate any change in the traditional client-professional relationship, his view is not for the long term but for the short term. By recommending that a segment of any profession become involved in an advocacy program while the balance of the profession acknowledges its existence and gives it some support is an interim policy only. The obvious conflict will arise when the recommendations of the advocacy group clash directly with the majority opinion of the balance of the profession.

I recommend careful reading of the article (p. 148) in the June 1970 issue of *Progressive Architecture* by Michael Brill, chairman of the Department of Architecture of the new State University of New York at Buffalo. Mr. Brill makes an interesting point that the present direction of the majority of student bodies will create an ever-increasing goal divergence between student and practitioner. This will cause the erosion of professionally generated standards in the schools to the point where the profession can no longer look to the school for preprofessional certification. Since the operation of state boards is based upon the protection of the public health, safety, and welfare, the profession may have to set up new cram schools outside the existing schools of architecture to assure a minimum body of knowledge and competence in the technical aspects of the practice.

It is my strong belief that oversimplification of the role of NCARB is happening. In an attempt to redefine the role of architect as a tactician, NCARB is moving completely away from his continuing role as a technician. He must be both. At least there must be persons who are trained as both, and since everyone with a professional education and training should be designated as an architect, we cannot discard the technician in favor of the tactician. In my view, the term *architect* needs to be applied to everyone in the design and direction or control of the construction of man's environment on earth. We need to enlarge our numbers rather than diminish them.

I am seriously concerned that the search for a new ideal image of the architect is tending toward one of elitism. Only those persons who have come through the door of an accredited school, who are tacticians viewing the total scene rather than technicians who may be highly skilled in specialized fields can don the mantle of the architect. I think we have reached this point through a misunderstanding of the deep-seated desires of the students of architecture, together with their entire age group, to create a better world during their generation. We must accept such goals but insist that technical competence in the subdisciplines in present practice be kept alive.

In Howard Cain's memorandum, the plea is for continuance of the traditional relationship between the owner and the architect. Howard maintains that the ultimate responsibility for making decisions regarding development rests with the owner acting under the constraints of the public interest as interpreted by government. This position does not acknowledge the present strong powers of persuasion exercised by most architects in their relationships with their clients, nor does it accept the swell of public opinion to curb the far reaching control of the individual entrepreneur or developer. We will see a continuing growth of public control of housing, health facilities, schools, and universities, much of it resulting from government encouragement and subsidy such as Operation Breakthrough. Individual ownership will be replaced more and more by nonprofit corporations receiving subsidies, tax reductions, or guaranteed low interest loans.

Perhaps we are all looking for a simple answer to a complex problem. I have been looking forward to Gerry McCue's report on "The Future of the Profession." Now that it has been published I find it is not a clear path to a common goal, rather it is an admonition that many new goals and directions are emerging. The profession of architecture is destined to be fundamentally altered in the next 15 years. We must try to understand and help direct the forces acting on the profession so that we may intelligently adapt and synthesize the demands and goals of students in the schools, faculty, and curriculum of the schools themselves, the diverse abilities of all present and future practitioners and of the new clients who will be imposing the largest building challenge ever faced by our profession. It is not a simple task and we should not be found guilty of coming up with a simple shortsighted answer.

Arthur Sidells
Past President, Ohio State Board of Examiners
Secretary, NAAB
Warren, Ohio

UCLA Pico-Union Project

Dear Editor: As director of the UCLA Pico-Union Project, I want to express my appreciation for the article on our project which appeared in your July issue (p. 35). It represents an excellent summary of our basic purposes and programs. We believe this type of long-term collaboration between a university and a community organization is a unique venture in the field of "urban renewal" and neighborhood redevelopment.

When the question of developing a community-planned park was first broached in 1968, Richard Gutierrez, then a UCLA art major, volunteered to do the overall park design, in cooperation with the residents and Recreation and Parks officials. When actual construction began, a PUNC community coordinator, Danny Montoya, became supervisor of construction, and Gutierrez continued as consultant. Thus, the entire design and construction of the park has been a community responsibility, with technical advice from City agencies and UCLA.

Paul Bullock
Project Director
University of California
Los Angeles, Calif.

Surprise

Dear Editor: I was pleasantly surprised to see the drawing of Tree Growth and Development (P/A, June 1970, p. 174) which was done in a research project under my direction while I was on the faculty at the University of Wisconsin. This tree was not drawn by a computer, but was done to assist in the digitizing of the plant form for later reproduction by a computer plotter. You neglected to mention this at the time it was printed. Thank you for mentioning it now.

Gary O. Robinette
Associate Executive Director
American Society of Landscape Architects
Washington, D.C.

Architects: Frederick Confer & Associates, Concord, Calif.

Breakage resistance and safety

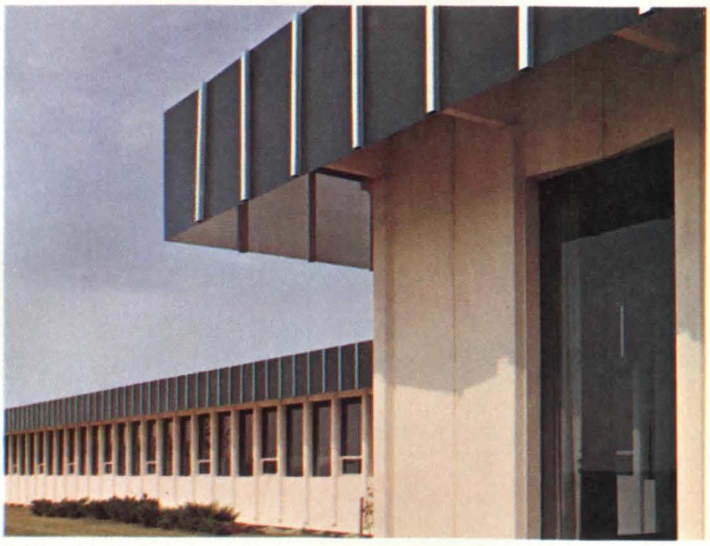
PLEXI

Castle Rock School, Walnut Creek, Calif. (left). Schools, plants, office buildings, and commercial establishments all across the country are putting Plexiglas acrylic sheet to excellent use as safety window glazing. Shatter-resistant Plexiglas sheet drastically reduces breakage and the costs of replacement. Additional advantages of Plexiglas in window glazing are the control of solar heat and glare through the use of gray and bronze tints in the Solar Control Series.

Hilton Inn, Northampton, Mass. (upper right). As no other material can, Plexiglas acrylic plastic captures and controls daylight. Because of its light weight and strength, Plexiglas is a practical and graceful material to use in large dome enclosures. Heat and glare are controlled in such structures through the specification of one of the transparent gray or bronze colors in the Plexiglas Solar Control Series.

Cumberland School, Camp Hill, Pa. (lower right). Effective solar heat and glare control and a distinctive appearance result when Plexiglas sheet is used as sunscreens. Pleasant atmospheres conducive to work, play, or learning are created because Plexiglas sunscreens reduce objectionable glare. Balanced combinations of light transmittance, glare control and solar heat reduction can be achieved by choosing from a range of gray and bronze tints in the Solar Control Series. The light weight of Plexiglas sheet in combination with a wide range of available thicknesses makes possible window and sunscreen clear areas up to 10 feet without intermediate support.

Control of solar heat



Architects and Engineers: Bender Burrell Associates, Camp Hill, Pa.

Daylight without glare

GLAS®

ROHM AND HAAS

PHILADELPHIA, PENNSYLVANIA 19105

In dome enclosures, in sunscreens, and in windows, Plexiglas acrylic plastic gives you a combination of benefits that can't be equaled by any other type of transparent material—toughness, safety, glare and solar heat control, formability and rigidity that make possible large daylight openings that resist wind and snow load. More than a quarter century of successful outdoor use has proved the ability of Plexiglas to retain its clarity, color stability and strength in all environmental conditions.

Investigate in detail the advantages of using Plexiglas sheet in dome enclosures, sunscreens, and window glazing. Use the coupon to request the information you need.

Rohm and Haas Company, Plastics Department
Independence Mall West, Philadelphia, Pa. 19105
Attn: Mr. R. R. Rorke

I am interested in learning more about Plexiglas® acrylic plastic for dome-enclosure, sunscreen, and window-glazing applications. Please send material checked.

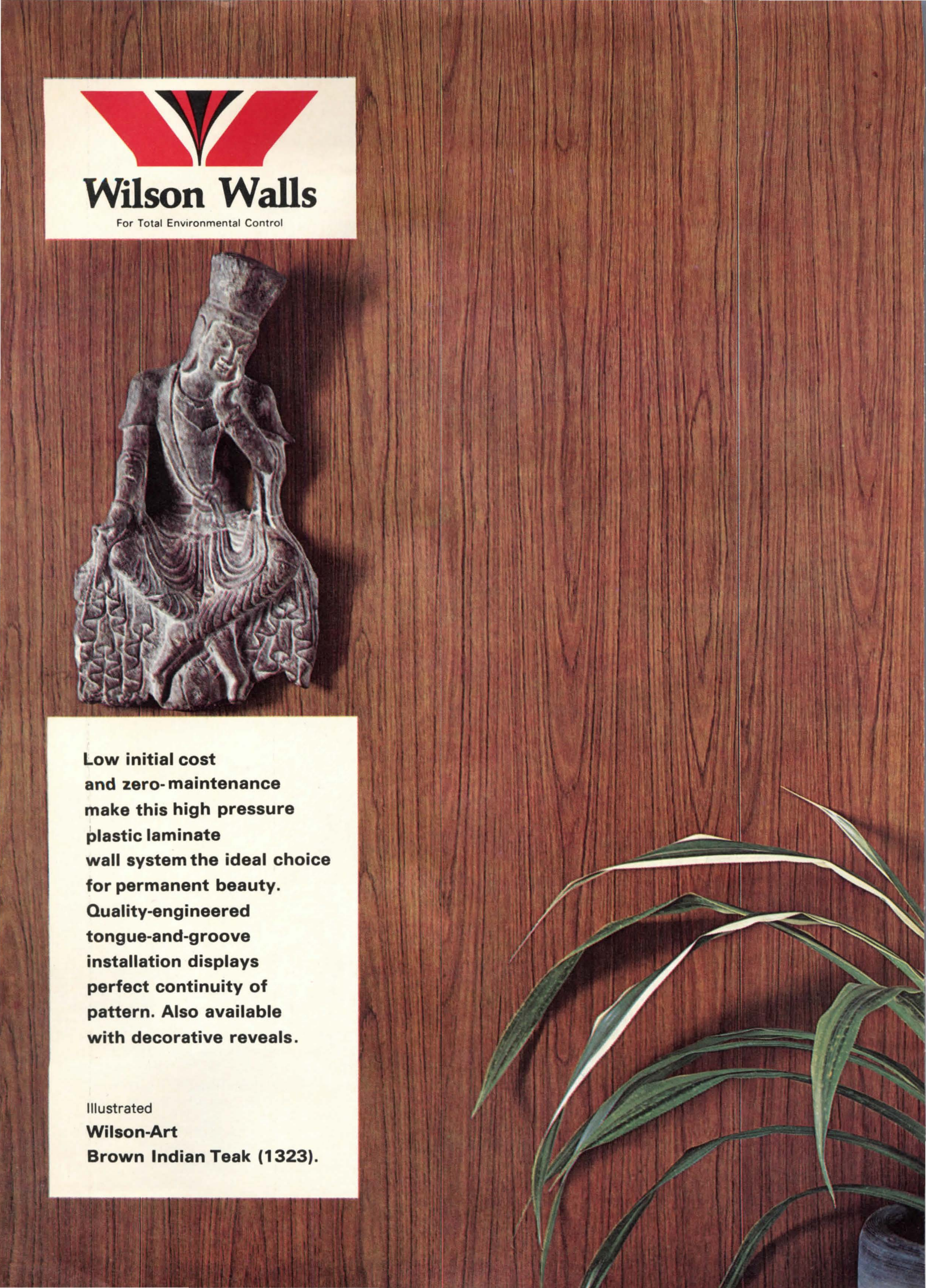
_ Solar Control Series Brochure
_ Window Glazing Brochure
_ Solar Control Series Sample Chips
_ Local Sources of Supply
_ Have local Rohm and Haas Building Products Specialist telephone for appointment.

NAME________

ADDRESS________

COMPANY________

CITY________ STATE________ ZIP________


Wilson Walls
For Total Environmental Control
Low initial cost and zero-maintenance make this high pressure plastic laminate wall system the ideal choice for permanent beauty. Quality-engineered tongue-and-groove installation displays perfect continuity of pattern. Also available with decorative reveals.
Illustrated
Wilson-Art
Brown Indian Teak (1323).

Speaking of beauty <u>and</u> economy, let's talk about Wilson Wall Systems with Wilson-Art plastic laminate.

Wilson Wall Systems provide quiet dignity in the most luxurious office setting, yet are durable enough to maintain their beauty in heavy-traffic commercial areas.

COMPETITIVELY-PRICED Wilson Wall Systems usually cost less initially—always cost less ultimately.

You can forget maintenance costs when you specify Wilson-Art high pressure plastic laminate in new, modular Wilson Walls.

So, whether your primary concern is beauty, durability, or economy, Wilson Wall Systems with Wilson-Art give you all three.

Wilson Wall Systems are composed of high pressure plastic laminate with melamine overlay adhered under pressure to a 43# density particle board with phenolic backing sheet. Available in 8′ and 10′ panels, 15½″ and 24″ widths, Wilson Walls come in the commonly used thickness of 7/16″ (total thickness) in both tongue-and-groove and reveal systems.

To see the complete selection of Wilson Wall Systems with Wilson-Art high pressure plastic laminate, call the Wilson-Art Architectural Design Representative nearest you.

Atlanta: 404-373-2223
Chicago: 312-437-1500; 312-625-7590
Los Angeles: 213-723-8961
Miami: 305-822-5140
New Jersey: 609-662-4747; 215-923-1314
New York: 914-268-6892; 212-933-1035
San Francisco: 415-782-6055
Seattle: 206-228-1300
Temple, Texas: 817-778-2711

For more information, consult Sweet's Catalog or Spec-Data Sheet.

Wilson Art®
PLASTIC LAMINATES

RALPH WILSON PLASTICS COMPANY . . . TEMPLE, TEXAS
ARCHITECTURAL PRODUCTS DIVISION DART INDUSTRIES INC.

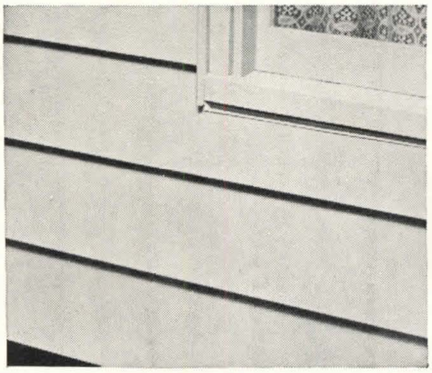
On Reader Service Card, Circle No. 383


Carpeting of Herculon®...because you can't get by on looks alone.
We know that you put carpeting in your homes and apartments mainly because it has greater sales appeal and costs you less than hardwood flooring. That's probably why you put it in your models, too. But we also know that you and your customers need carpeting that can handle traffic, resist stains and clean easily. Carpeting of HERCULON* olefin fiber does a great job. Does it better than anything else. And longer.
For more information, contact Fibers Merchandising, Hercules Incorporated, Wilmington, Delaware 19899.
At Hercules, it's our job to make your job easier.
HERCULES

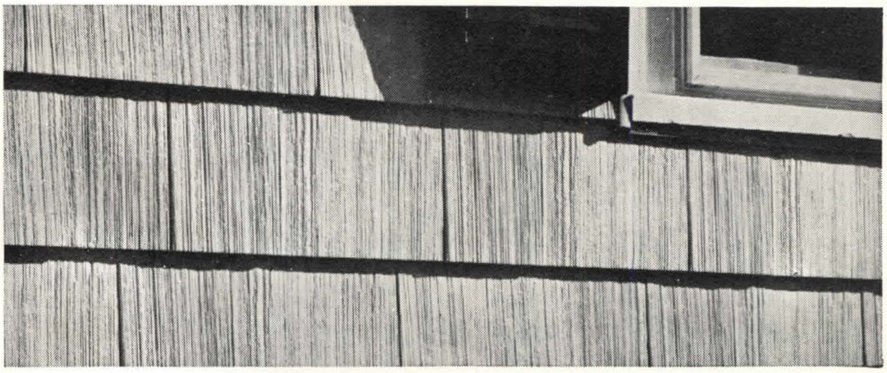
Geon vinyl protects a house from top to bottom and inside and out.

The kind of houses that your customers want. Houses that almost maintain themselves.

Geon vinyl. The tough material. It has what it takes to make:

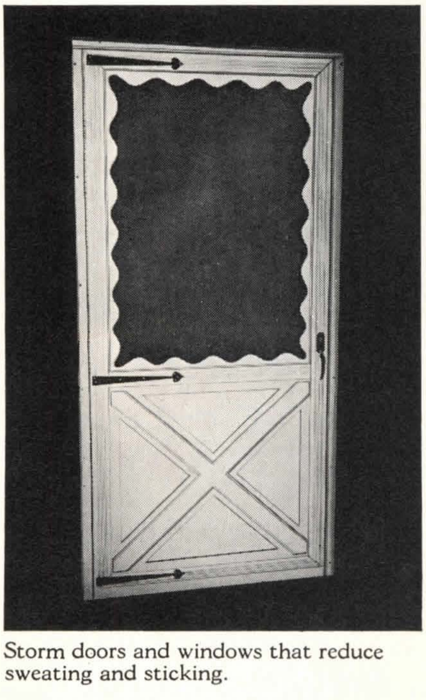


Siding that resists denting . . .

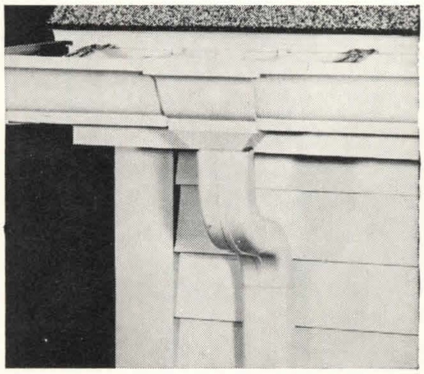


. . . and can look beautifully shake . . .

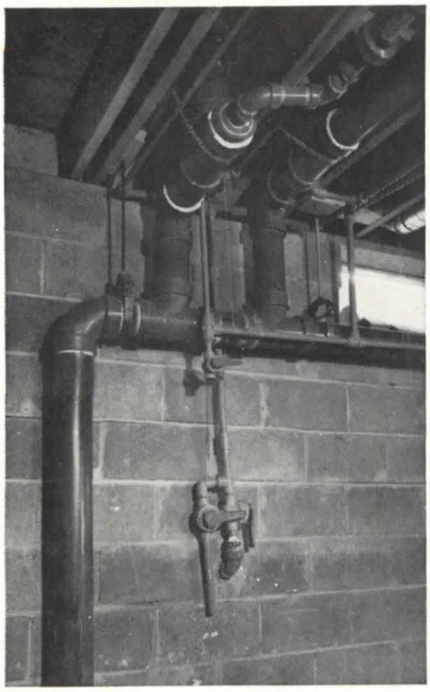
. . . or charmingly stone.



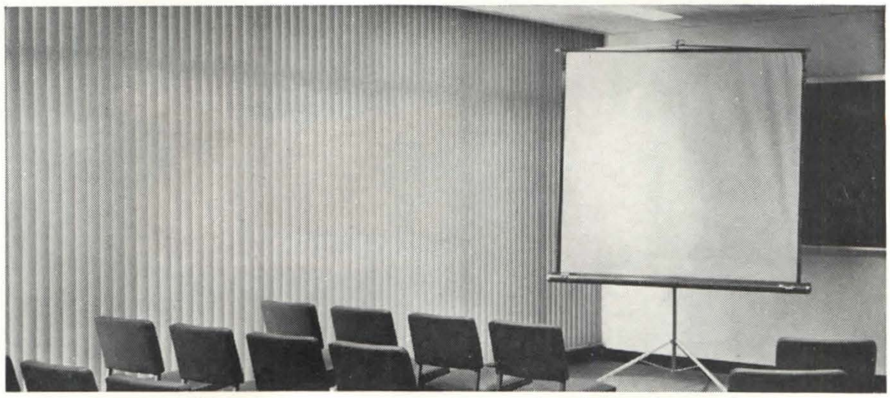
Storm doors and windows that reduce sweating and sticking.



Gutters and downspouts that won't corrode or blister.

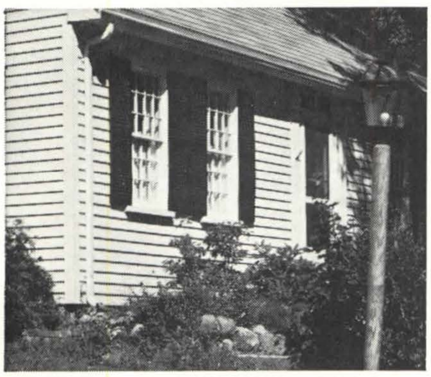


And that makes the difference in selling houses.

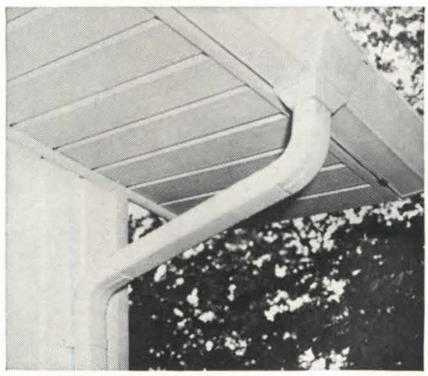


DWV and water supply pipe that resists build-up of hard water deposits and reduces heat loss.

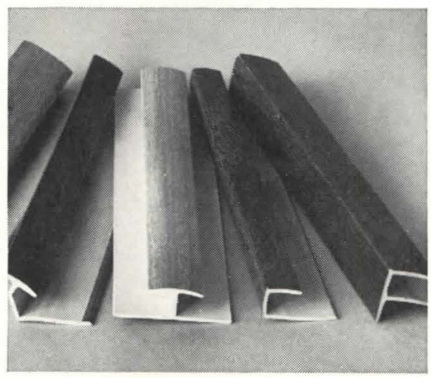
Louvers for vertical blinds that resist twist, warp or bow. That close perfectly from top to bottom.



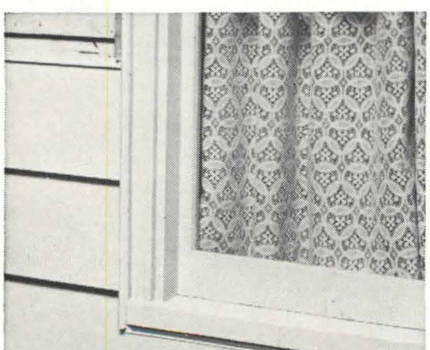
Shutters that don't rot or peel.



Soffit panels that resist warping. Panels that are strong but light and easy to handle and cut.

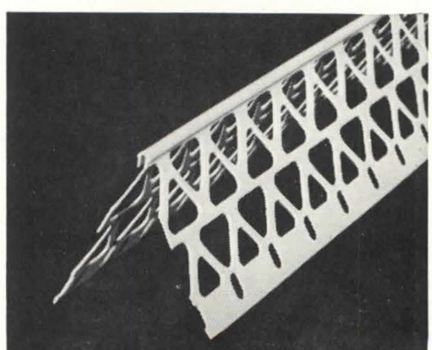


Interior trim that requires no painting.



Vinyl components for windows that reduce sticking, sweating.

Vinyl clad windows that are warm and need no painting.



Solid vinyl corner bead that's tough, won't rust.

These and other products such as awnings, roof edge, baseboard raceways are of solid color that won't rub or wear off. Color the sun can't make peel and moisture can't blister.

We're talking about sense. The kind of sense your customers have when they're looking to buy a house with practically no maintenance.

And that takes B.F. Goodrich Geon vinyl.

Geon vinyl. For detailed information, write to us at B.F. Goodrich Chemical Co., Dept. **P-1,** 3135 Euclid Avenue, Cleveland, Ohio 44115.

B.F. Goodrich Chemical Company
a division of The B.F. Goodrich Company

Geon VINYLS   B.F.Goodrich

On Reader Service Card, Circle No. 396

A golden glass for a sun-drenched state.

The Bartow Savings and Loan Association in Bartow is one of the first buildings in Florida to be glazed with Vari-Tran®/Golden reflective glass. The effect is a golden focal point for a new business district.

Thermopane® insulating glass with Vari-Tran/Golden 208 coating is in the vision areas and Tuf-flex® tempered glass with Vari-Tran/Golden 208 is in the spandrel areas. So the building not only looks great from the outside, but is pleasant and comfortable to be within.

Vari-Tran significantly reduces cost of air-conditioning equipment and its annual operating cost . . . effectively controls glare and solar radiation.

Get the data on L-O-F products with silvery and golden Vari-Tran coatings in six variable heat and light transmittances. Write Architectural Construction Department, Libbey-Owens-Ford Company, Toledo, Ohio 43624.

Vari-Tran® REFLECTIVE GLASS

LOF GLASS

On Reader Service Card, Circle No. 357

ARCHITECT: LESLIE G. PICKETT, BARTOW, FLA.
GENERAL CONTRACTOR: MORRIS PRITCHARD BUILDER, LAKELAND, FLA.
GLAZING CONTRACTOR: CENTRAL GLASS CO. INC., LAKELAND, FLA.
MECHANICAL ENGINEER: H. LYMAN CAUVEL, TAMPA, FLA.

At last...
U. F. C.-Foam*
a foamed-in-place insulation
that makes sense from every viewpoint

- Sound Absorption ■ Thermal Insulation
- Cost ■ Application Ease
- Dimensional Stability ■ Moisture Resistance
- Pest Control ■ Nonflammability

U. F. C.-Foam is a superior foam insulation which on an installed-cost-per-unit-effectiveness basis is less expensive than poured or matted insulation materials

Application

U. F. C.-Foam is applied from a patented gun within which the foaming action takes place. There is no further expansion after the foam leaves the gun. Voids can be completely filled without fear of subsequent pressure build-up. It can be applied in any temperature as easily as spreading shaving cream.

U. F. C.-Foam can be used to fill existing voids through holes as small as 1 inch, can be applied between open frames — floor, wall or ceiling, or can be foamed through metal lathe. Once in place it can be smoothed with a trowel and sheathed over immediately.

A typical between-studs void is completely insulated in less than 2 minutes.

Properties

THERMAL CONDUCTIVITY — k factor nominally .2 at 70°F meah temperature and 0.18 at 35°F mean temperature.

SOUND ABSORPTION — In plaster walls improves sound transmission class (STC) from 37 to 44. In dry walls reduces sound transmission 5 to 7 decibels.

STABILITY — unaffected by heat, cold or moisture.

WATER RESISTANCE — Its permeability to vapors precludes accumulations of moisture, making moisture barriers unnecessary.

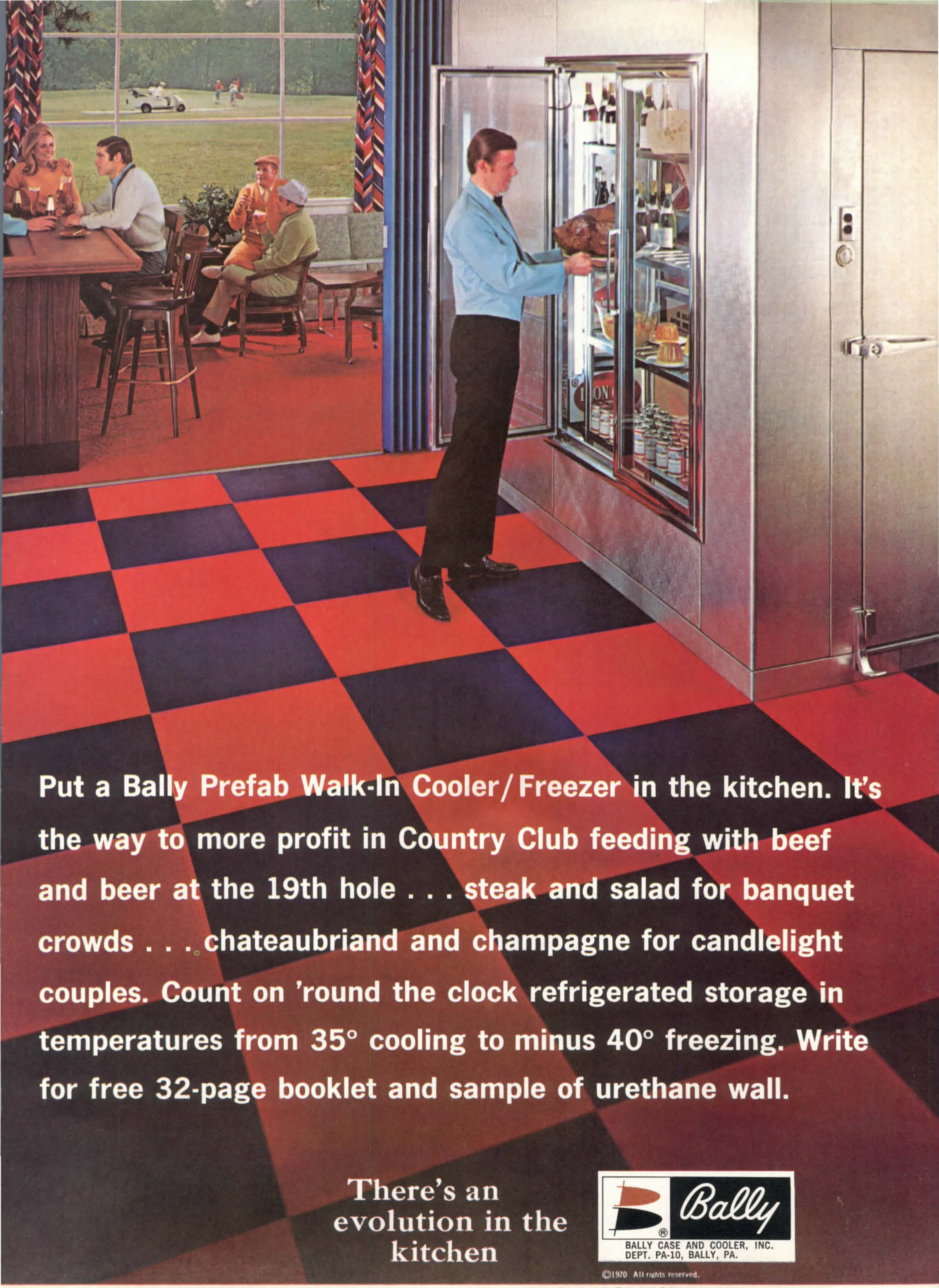
NON TOXIC, GERMICIDAL, MOLD RESISTANT, RODENT & INSECT DETERRENT.

To get the full story on the one modern insulation system, write for this booklet, it's free!

ufc®

U. F. CHEMICAL CORP.
37-20 58th St., Woodside, N.Y. 11377
Phone: (212) 651-0837

*formulated in accordance with the patented Isoschaum process

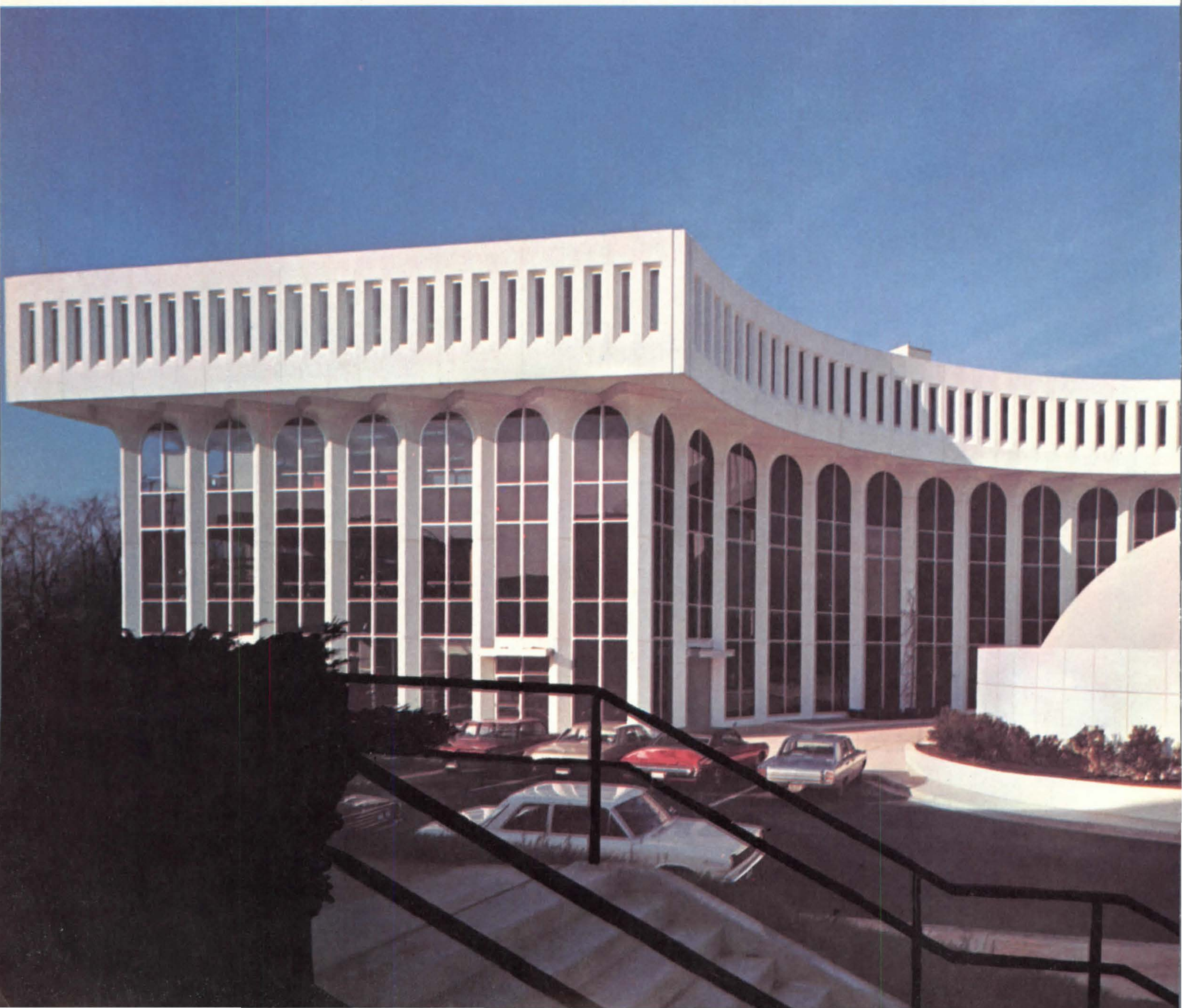


BALLY PREFAB PANELS . . . FIRST TO PASS UNDERWRITERS' LABORATORIES (UL) FIRE TEST!

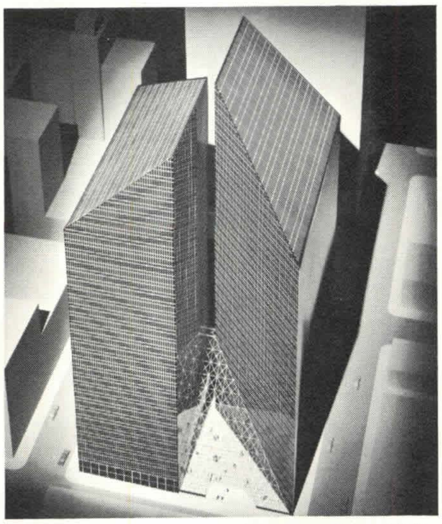
Cost of steel frame lowered

by designing 11 repetitive wedge-shaped sections

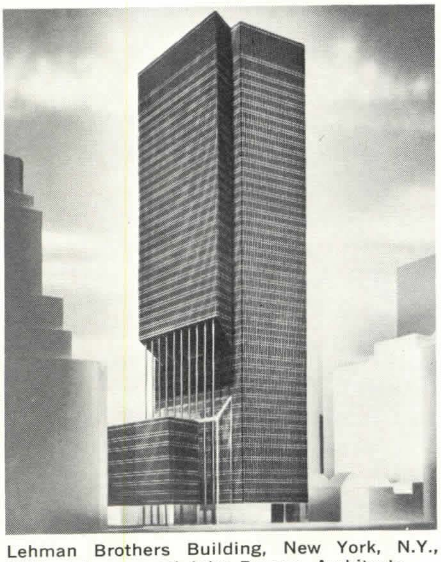
Architects: Ward and Schneider, Cleveland, Ohio. Consulting engineers: Barber & Hoffman, Cleveland. General contractor: Hill and Kimmel, Inc., Silver Spring, Md. Steel fabricator: Arlington Iron Works, Arlington, Va.



P/A NEWS REPORT

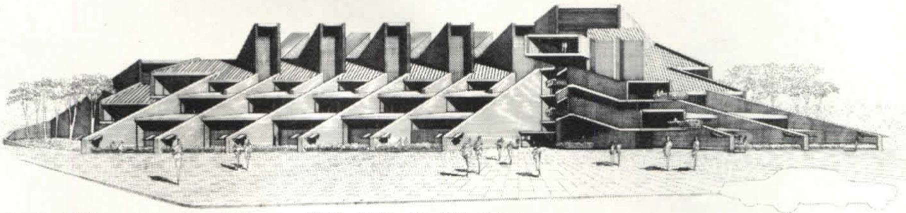


Office Building Project, Houston Tex., Philip Johnson and John Burgee, Architects. Photo: Louis Checkman



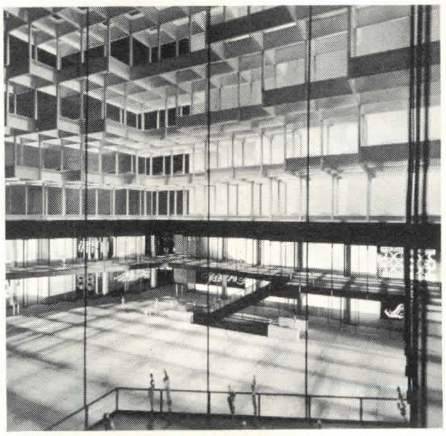
Lehman Brothers Building, New York, N.Y., Philip Johnson and John Burgee, Architects.

United Nations Development Center (Latest redesign), New York, N.Y., Kevin Roche John Dinkeloo & Associates.

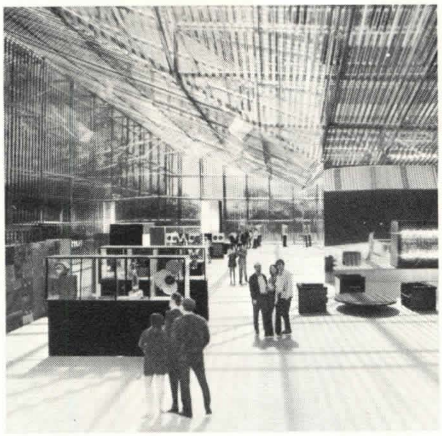


Central Library for city of Niagara Falls, N.Y., Paul Rudolph.
Photos: Courtesy of Museum of Modern Art

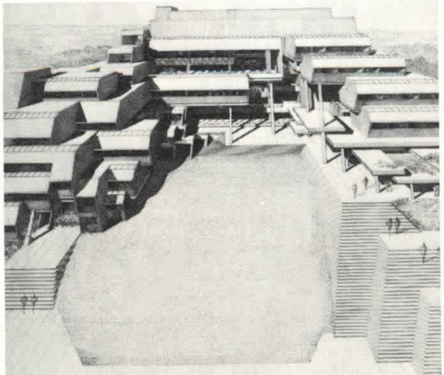
Current Works of Roche, Rudolph and Johnson on View



Enclosed public space, Investors Diversified Services Center, Minneapolis, Minn., Philip Johnson and John Burgee.



Computer Museum Project, Kevin Roche John Dinkeloo & Associates.



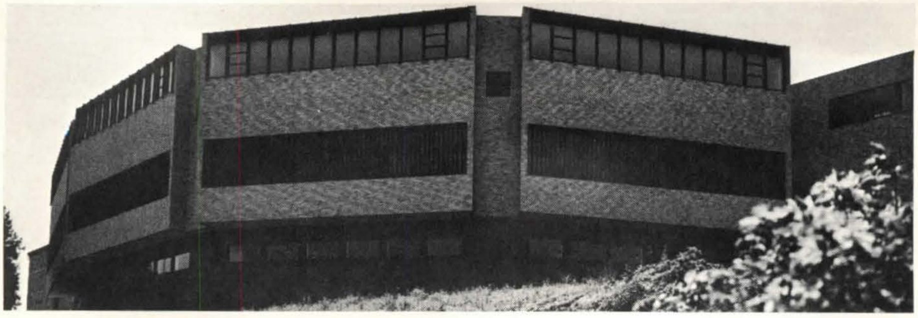
Burroughs Welcome & Co. Inc. Research Triangle Park, N.C., Paul Rudolph.

The first in a series of exhibitions examining works in progress of leading U.S. architects opened September 20 at the Museum of Modern Art in New York. The architects selected for the first exhibition are Kevin Roche, Paul Rudolph, and Philip Johnson; the choice, according to Arthur Drexler, Director of the Department of Architecture and Design, was generated by the scale and scope of the projects these architects are executing. Many of their projects, he explained, will have a substantial impact on the urban milieu because of their size.

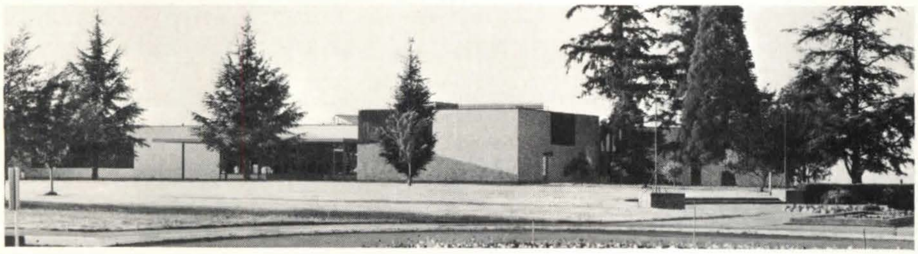
The exhibit, which includes 16 models, will present in detail seven works of Kevin Roche, six projects of Paul Rudolph, and seven of Philip Johnson plus numerous references to other work of the architects. Johnson, Mr. Drexler states, has done a prodigious amount of city planning on paper and illustrates a remarkable sensitivity to urban problems in his current work. These reasons might account for Arthur Drexler's inclusion of Philip Johnson's *oeuvre* in the show, despite the inevitable comments regarding the exhibition of the work of a trustee of the museum.

Regarding the particular grouping of these three architects, Drexler commented on their singularity at present as leaders of the second generation of architects who retain a large amount of design control in their offices. There are also thematic similarities and contrasts in their work: Roche and Johnson show a concern with glass-enclosed public spaces, architecture as landscape, and large scale for the simple structure. Rudolph, on the other hand, breaks down the scale of monumental work with a broad range of detail and incident.

The impact their architecture will have on cities, both visually and environmentally, remains to be seen. At any rate, included here are a number of their projects as yet little known even to the profession.



Northwest elevation of library, (above) South elevation, (below)



Monastery Gets an Aalto

The second building in this country designed by Alvar Aalto has just been completed for a Benedictine Monastery near Portland, Ore. The building, a library for the Mount Angel Abbey, follows 23 years after the design of his Baker House dormitory at MIT. (Aalto also designed a conference room in 1964 for the Institute of International Education in New York.)

The $1.272 million structure, financed by a private donation, is a three-story fan-shaped building. A semicircular double-height space topped by a curving skylight forms the principal portion of the 44,000 sq ft building. Bookstacks on both levels follow the arcing lines and are all in view of the librarian. Materials for the concrete structure are "Aalto woods" of birch, oak, and fir with pale brick facing on the exterior. Associated architects for the project were DeMars & Wells, of Berkeley, California.

Show a Success, but the Backers Walked Out

A retrospective exhibition on the outré work of Morris Lapidus has caused more behind the scenes clamor at the New York Architectural League than the innocent public may realize. Prevalent is the belief that the exhibition will be misunderstood by the public as having the Architectural Profession's implicit approval of this design "approach". Another reaction is that anyone whose work is as pervasive in America's schlock commercial sphere hardly needs an exhibition. Basic to these arguments is the issue of taste, or visual standards; while being all for it, many Leaguers are willing to show what the lack of means as a successful and commonplace phenomenon, while others object to the presumed self-indulgent attitude toward vulgarity. Organizer of the show, John Margolies (who has installed imitation Muzak to complement the exhibition), expressed some puzzlement over the debate. "The Achille's tendon of the profession is nasty ol' aesthetics," he said recently. "We've got to get down to what architecture is all about . . . and come to grips with what it is." And coming to grips is what they are doing: The chairman of the Scholarship Committee recently resigned, and League member Sibyl Moholy-Nagy has reportedly threatened to quit.

L.A. Coming Together?

Los Angeles' Committee for Central City Planning Inc. has announced their selection of a firm assigned the seemingly impossible task of giving the city some sort of plan. Restricting operations to a feasible area comprising the downtown business district, Wallace McHarg Roberts & Todd of Philadelphia will formulate a general development plan over a two-year period. Their results, according to the Committee, will constitute a new type of plan involving the technology of the future and uniquely appropriate to Los Angeles. The firm of Wallace McHarg Roberts & Todd has already achieved recognition for their work on the Lower Manhattan Development plan, The Downtown Business District Plan for Buffalo, N.Y., and Inner Harbor Plan and Urban Renewal Project plan for Baltimore, Md.

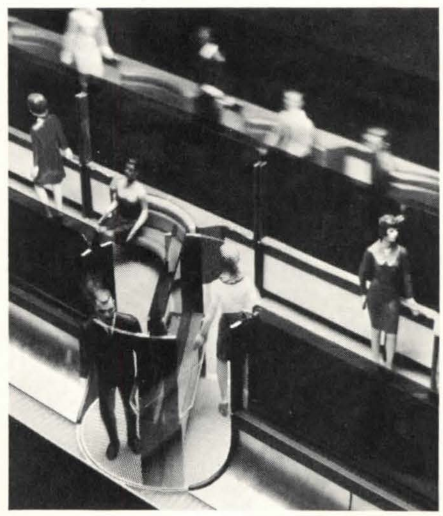


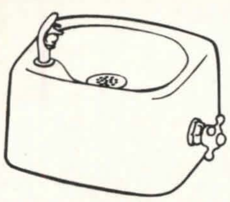
Photo: Courtesy of Alcoa

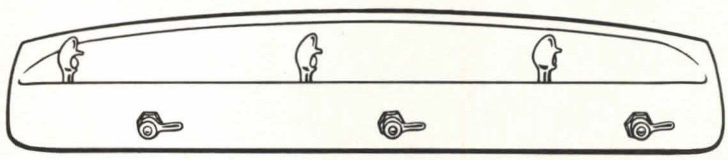
Synchroveyor: A Refinement on the People-Mover

A moving sidewalk of rigid aluminum platform modules has recently been selected for further research in Alcoa's Ventures in Design program. Conceived by industrial designer, Larry Bell, the 8-ft wide platforms with 3-ft high walls are supported by electrically-run roll tables. The train loops operate up to 30 mph and for local trains stop to load and unload every fourth distance of the loop. Transfer is made by semicircular decks that rotate like revolving doors. At one point, the longer-distance express loops, which maintain a continuous speed of 15 to 30 mph, join the local loop. In this instance, passengers transfer via the rotating decks when the local reaches the same speed as the express.


New Primitive...
for a beautiful
handcrafted look.
New Primitive™ ceramic tile has the uneven, handcrafted look that's so prized today. The surface has a natural cleft finish. The shading varies from tile to tile. The effect is rich, rustic, Primitive.
And permanent. Tough, rugged Primitive is solid ceramic. It's the wall-to-wall floor that wears practically forever.
So clients get beauty they won't want to cover up, durability they can clean up with little effort.
Primitive is vitreous, frostproof, and stainproof. In seven glazed colors, one unglazed, and five shapes. Write for your full-color brochure on our newest idea. Primitive. American Olean Tile Company, 1419 Cannon Avenue, Lansdale, Pa. 19446.
Primitive ceramic tile. It's the natural thing to use.
American
Olean
A Division of National Gypsum Company

Model 1405—Polymarble / Model 1425—Fiberglass


Model 1070—Polymarble


Model 1400—Polymarble / Model 1420—Fiberglass

New Polymarble drinking fountains by Haws come in white and five beautiful shades and the color goes all the way through. They're tough, fade resistant, light in weight, perfect for indoor or outdoor use.

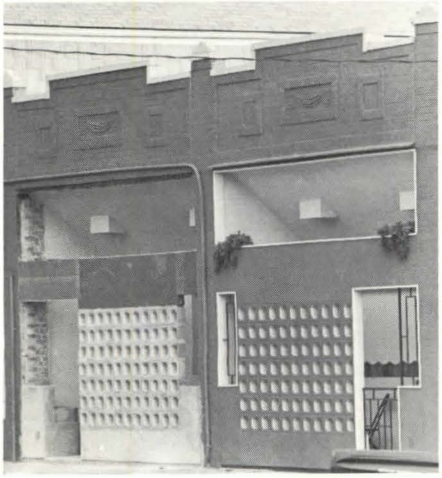
For your next project, let a Haws Polymarble fountain harmonize with your design, in white, yellow mist, tan, gray satin, cerulean blue, or pistachio green. Available with standard or freeze-proof valves.

Models 1400 and 1405 are also available in fiberglass, in white and five attractive colors.

Write for complete details and color samples.

Haws® Since 1909 | **DRINKING FOUNTAINS**

HAWS DRINKING FAUCET CO., 1443 Fourth Street, Berkeley, California 94710.

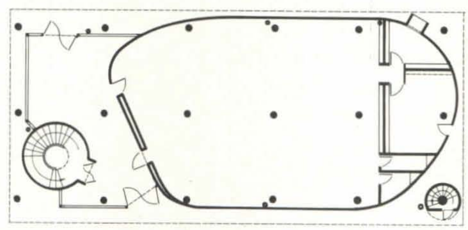


Poor Man's Town House

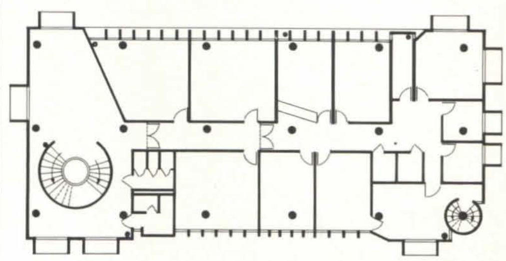
As a city constantly renews itself, not only are treasured landmarks lost, but also scores of "ordinary" buildings that are an expression of a vernacular tradition in America's urban past. An architectural designer, Vincent Colangelo, recently demonstrated how abandoned store buildings in Queens, built during the twenties and thirties, can be revived economically by conversion into town houses. With his father, a retired construction supervisor, and using only 2 x 4's, cement plaster, and homemade concrete grille blocks, designer Colangelo so far has refurbished two of four row houses. He incorporated elements from other vernacular architecture: the front wall is set back to create a patio behind the concrete grille screen. Inside the house, an ample one-level floor through, an outdoor atrium (one for every two houses), and kitchen separate sleeping areas in the rear from dining, living areas in the front.

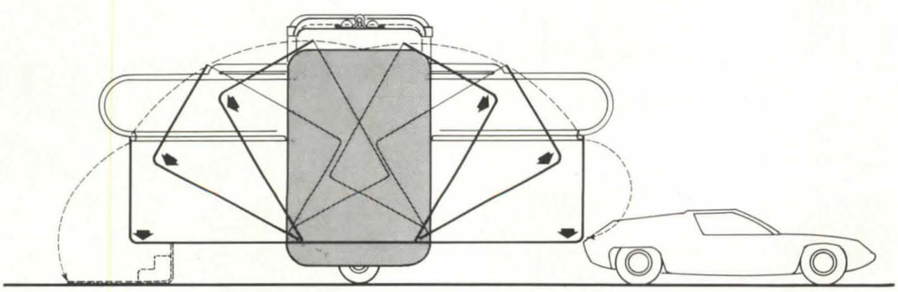
Thai Design for the English

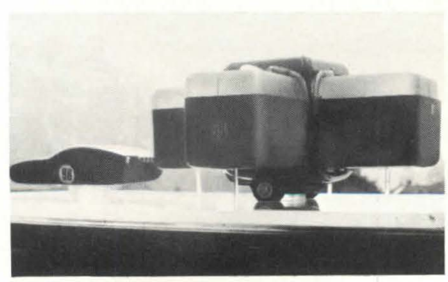
The British have eschewed any supposed stuffiness in one notable architectural instance: the British Council Building in Bangkok. When they decided to build the office structure on a low budget ($150,000) and a 10-month start-to-finish schedule, they commissioned a young Thai architect, Sumet Jumsai, of the office of DEC Consultant. The architect has expressed the various elements in the three-level structure so clearly that the buildings look as if they were constructed from a toy assembling kit. The central mass of the building is finished in gray mosaic on the second and roof levels; it is wrapped around two massive red stair towers which appear to be carrying the first and third floors. Colors inside are primary, with a grid of red and blue columns placed with nonchalant reference to other elements, such as doors, windows, partitions.



Ground floor plan (above); curved wall encloses library within volume of building. Second flood plan (below); offices and classrooms feed off double-loaded corridor.
Third floor (not shown) contains an auditorium for 200 persons.







Fold-up Home for Easy Travel

Before too long, roads in Europe may be dotted with mobile homes — but hardly the cumbersome models Americans know. A Viennese architect, Gernot Nalbach, has designed a plastic mobile home that can be folded up for traveling, unfolding to approximately four times its size when parked. The modular units also fit together to form apartments (which still fold to a quarter of the new size). The vacuum-molded reinforced glass-fiber unit, replete with plastic bath and kitchen, rests in an aluminum frame, with a roof cover that lifts pneumatically when the unit is being folded. This design has outstanding possibilities for stacked housing complexes, since the units can be folded for travel to site and placement by elevator in frame.

Design Alternatives Analyzed

Last August P/A's Editor Forrest Wilson spent two weeks in Cuernavaca, Mexico helping architect-designer Sascha Illich and a group of participants lay the groundwork for a series of courses to be given this spring. Under the auspices of the innovative *Centro Intercultural de Documentacion* (CIDOC) an "anti-school" founded by the unorthodox educational thinker, Ivan Illich (Sascha's brother), the special term of courses in February and March will be entitled "Alternatives in Design of Physical Environments." Its goal is to "deal with themes related to the development of a language for defining fundamental alternatives in long-range planning of artificial environments especially in Latin America."

The Alternatives in Design term is a part of the Institute for Contemporary Latin American Studies division of the *Centro* where those who guide the educational process ("teachers") name the subject, choose the participants ("students"), and define the discipline and method.

At the August session, daily discussion revolved around issues presented by Sascha Illich and Forrest Wilson, the outcome of which was the concretization of the concepts for the spring study. Sascha Illich, like his brother Ivan, is concerned with the change of present forms of our institutions; in the affluent society he points out, "Design is another process which has become institutionalized; these institutional forms must change if they are to reflect changing social conditions and needs." "Man-made physical environments," he has stated, "rationally planned for specific functional performance, are progressively increasing pollution and social polarization while restricting personal liberty and sensuous participation."

Mr. Wilson's introductory speech highlighted several other points: "Building, like education, can be learned outside school rooms and outside the rigid guidelines the trades have set down for their own protection. By assuming that the only way people can have the products of technology is through the channel of mass manufacture deprives the masses of our technological benefits as well as limiting the nature and capabilities of our technologies."

Out of the August session developed the following ideas for courses proposed by participants: "Old and New Spatial Patterns in Villages of Morelos," proposed by Valente Quinto Espinosa (in participation with other students of the University of Morelos and supported by its Director Francisco Ramirez Badillo); "Autogenerated Rural Housing," by Robert Chavez; "Mexican Social History as Reflected in Architecture," by Eduardo Langange; and "The Design Process and Its Institutional Forms," by Sascha Illich. Eduardo Terrazas, coordinator of design for the Olympics in Mexico City was present at the session and also will teach during the spring term, as will Reverend James Morton of Chicago's Urban Training Center.

A number of other Americans also were invited to teach, including economists, entrepreneurs, engineers, as well as architects and designers.

Photos: John Eckert

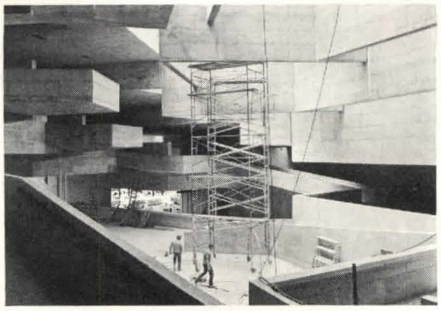
Sascha Illich

Forrest Wilson

New Publisher for Progressive Architecture

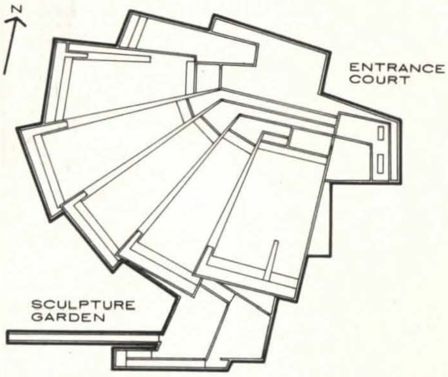
Philip H. Hubbard, Jr., President of Reinhold Publishing Corp., has announced the appointment of Harrington A. Rose as publisher of PROGRESSIVE ARCHITECTURE.

Mr. Rose joined the staff of P/A in 1962, and was appointed associate publisher in January of this year. Before joining P/A he was senior sales engineer at Blaw-Knox, Buffalo, N.Y. and was with Stone and Webster Service Corporation for over 14 years where his engineering assignments included the Transcontinental Gas Pipe Line Corp. Mr. Rose attended Syracuse University, where he studied chemical engineering, and Worcester Academy, Worcester, Mass. Mr. Rose is married and has two daughters.



Fan Shaped Museum Nears Completion

Construction is nearing completion for the new University Art Museum at the University of California at Berkeley. Designed by competition winner Mario Ciampi of San Francisco, the fan-shaped poured concrete structure will provide a total exhibition space of 31,050 sq ft and a sculpture garden of 36,800 sq ft. Lighting is a combination of natural (through skylights and floor to ceiling windows) and artificial (fixtures on tracks). Flooring is brick tile or colored concrete, and carpeted in some areas. The gallery, scheduled to open next month, will include in its permanent collection 45 paintings by Abstract Expressionist Hans Hofmann. The $4.85 million building is financed totally without state funds.



P/A Has New Managing Editor

The appointment of Rita R. Robison as Managing Editor of PROGRESSIVE ARCHITECTURE has been announced by Forrest Wilson, Editor. Mrs. Robison was formerly Managing Editor of Architectural & Engineering News and most recently was an associate with Weld Coxe, Communications Consultant, Philadelphia. Mrs. Robison attended Monticello College, Alton, Ill. and graduated from the University of Colorado with a B.A. in journalism.

We make a lot of different ceilings to do a lot of different things.

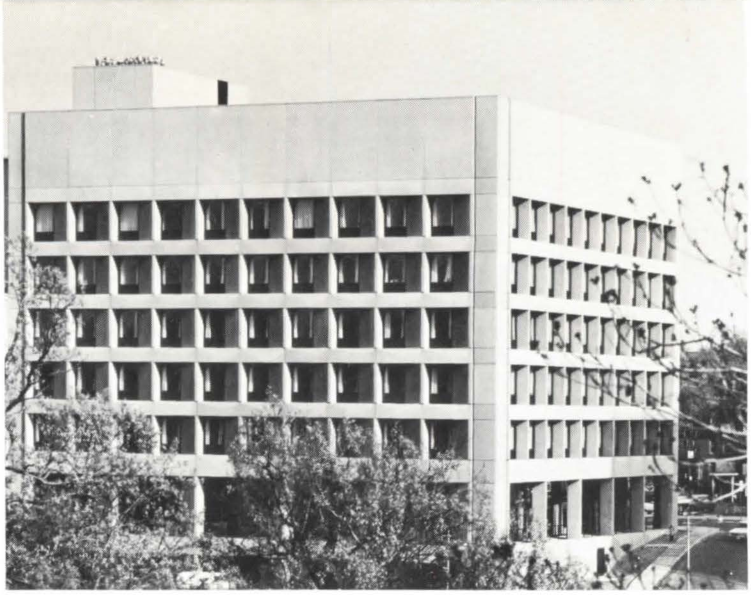
This one's thing is complete adaptability.

With this Armstrong Luminaire Ceiling System, *you can match the size* of the ceiling module to the size of the planning module of the building. Both the length and the width of the Luminaire Custom/Module are variable. This provides a range of module sizes from a minimum of 24″ x 38″ to a maximum of 60″ x 72″. Whatever customized dimensions you come up with, you get the standard benefits of *all* Armstrong Luminaire Systems—totally integrated ceiling systems that combine the functions of lighting, air handling, and acoustical control—plus partition and sprinkler head adaptability. An Armstrong representative is in the best position to tell you more about the Luminaire Custom/Module and the wide range of other Armstrong Ceiling Systems. For his name and a copy of our Ceiling Systems folio, please write: Armstrong, 4210 Watson St., Lancaster, Pa. 17604.

Armstrong CEILING SYSTEMS THAT WORK

Or on Readers' Service Card circle No. 300.

Battelle-Northwest Technical Center, Richland, Wash.

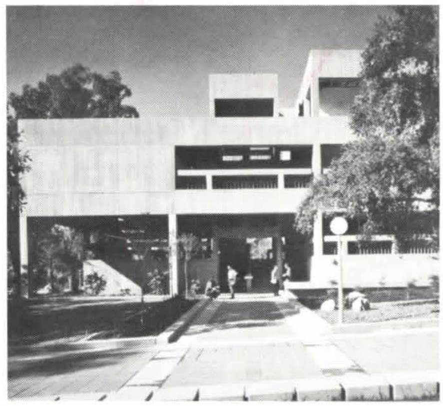


Shaw & Begg Limited Office Building, Toronto, Can.

Concrete Awards Announced

Nine buildings of over 200 entries have been named winners of the 1970 Prestressed Concrete Institute Awards program, at PCI's recent convention in Minneapolis. Winning entries included: The Stamford Hospital, Stamford, Conn., **E. Todd Wheeler** and the **Perkins & Will Partnership,** with associate architects, **The SMS Partnership,** (engineers **Garfinkel Marenberg & Associates**); Physical Sciences Complex, University of Guelph, Guelph, Ontario, Can., **Craig, Zeidler & Strong,** (structural engineer, **J. Maryon & Partners**); Stephen Leacock Collegiate Institute, Borough of Scarborough, Ontario, Can., **A.M. Ingleson, Architects,** (structural engineer, **Robert Halsall & Associates Limited**); Four College Science Building, Claremont College, Claremont, Calif., **Caudill Rowlett Scott,** and associated architect **Everett L. Tozier,** landscape architect, **James A. Cooper,** (structural engineer, **Kariotis & Kesler**); Shaw & Begg Limited Office Building, Toronto, Ontario, Can., **Parkin Architects Engineers Planners**; Water Street and State Street Parking Facilities, Binghamton, N.Y., **Mowry Teitsch & Surine,** (structural engineer, **DeLeuw, Cather & Associates**); Cowlitz River Bridge, Lewis County, Wash., **Howard, Needles, Tammen & Bergendoff, Engineers;** Battelle-Northwest Technical Center, Richland, Wash., **Naramore, Bain, Brady & Johanson,** (structural engineer, **Skilling, Helle, Christiansen, Robertson**); CRS Office Building, Houston, Tex., architect-engineer, **Caudill Rowlett Scott.** Serving on the jury led by **Rex Whitaker Allen** were **Harry C. Simrall, PE,** president, National Society of Professional Engineers; **Thomas M. Niles,** president, American Society of Civil Engineers; **Louis A. Rossetti, AIA,** Rosetti Associates Inc.; **Norman H. McMurrich, FRAIC,** Somerville, McMurrich & Oxley (Can.).

Stephen Leacock Collegiate Institute, Scarborough, Can.



Four College Science Building, Claremont College, Claremont, Calif.

School in the Streets

A high school principal and an architect have developed a new type of school for the streets of Philadelphia's Mantua section. The school literally takes to the streets. With the residents' permission, several streets will be closed and prefabricated portable classroom units placed in them. Each unit will house teaching machines and other equipment for eight pupils. A plexiglas all-weather dome, supported on columns attached to renovated house façades, will be placed over the units.

The plan proposes as many as 15 "cells" under the dome, with vacant lots and back alleys used for necessary service access and parking. The only permanent new structure on each site would be a group center, (the domed octagonal structure in photo). Thus, according to the principal, Forest Adams, and the architect, Merle Lynn Easton, the cost of the 120-student "mini-school" could be reduced to $7 to $10 per sq ft instead of the usual $21 to $30 per sq ft typical of this area. The dome would cost $300,000.

The teacher-to-pupil ratio could be 1 to 40, a ratio found unsupportable in the normal classroom situation. Since the street school would be breaking down the students into small groups, and occupying them with the teaching machines, one teacher could be responsible for five units. While the school board is interested in the proposal, according to its proponents, the street school would not be built until the community approves the idea and it is requested by a block organization. They would then be encouraged to form a corporation to supervise construction of the school.

The Pella look is the look of inspired design and expert craftsmanship.

If you like the look of PELLA Wood Double-Hung Windows, wait 'til you see how much comfort, convenience and economy they offer!

Exclusive spring-loaded sash slides permit PELLA Double-Hung Window sash to pivot so the outside can be washed, painted or reglazed from inside quickly and easily.

Wood, the best natural insulator, keeps out heat and cold, minimizes condensation problems. Exclusive stainless steel and woven pile weatherstripping seal out drafts and moisture. Heating and cooling are more economical.

Storm panels stay inside sash year 'round. Insulating glass is optional. Aluminum outside full or half screens. Removable muntin bars come in horizontal, rectangular or diamond patterns. All exterior surfaces are factory-primed. Where large fixed units are used, PELLA Pivot Windows solve the washing problem.

For more information on PELLA products, mail card below, or phone your PELLA Distributor (look under WINDOWS in the Yellow Pages), or see SWEET'S Architectural or Light Construction File.

ROLSCREEN COMPANY, PELLA, IOWA 50219

PELLA MAKES QUALITY WOOD WINDOWS, WOOD FOLDING DOORS & PARTITIONS AND WOOD SLIDING GLASS DOORS

PELLA

WOOD DOUBLE-HUNG WINDOWS

Architect: Glenn O. Haubrock & Assoc., A.I.A. • Builder: Gil Volz

Designer: William German • Builder: Darling & Darling Co.

Yes, via first class mail, rush me more color photos and information about the following PELLA wood products:

Pella

Windows: ☐ Double-Hung ☐ Casement ☐ Awning
☐ Sliding Glass Doors
☐ Folding Doors and Partitions

Name ______________________

Firm ______________________

Address ______________________

City ____________ State ____________ Zip ____________

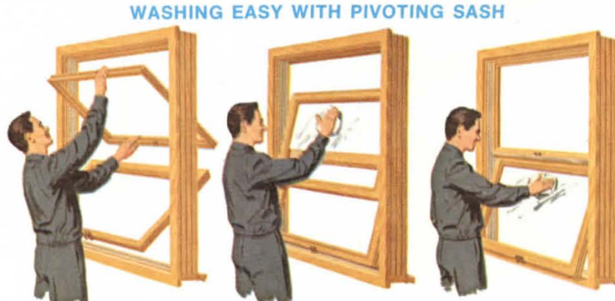
Telephone: ______________________

Also available throughout Canada.

Printed in U.S.A.

MM-123

WASHING EASY WITH PIVOTING SASH



Rotate Sash **Wash Windows** **Return to Normal**

MAIL CARD TODAY
Answered within 24 hours

"PMT" is now the big news in drafting rooms!

PMT in use at Western Electric Company drafting operations.

"PMT"
preventive maintenance technique based on daily use of the KOH-I-NOOR Rapidograph Ultrasonic Cleaner for technical fountain pens

Speed up drafting operations with Koh-I-Noor's preventive maintenance technique. An occasional dip of your technical fountain pen into Koh-I-Noor's Rapidograph Ultrasonic Cleaner gives you immediate pen cleaning, flushes away accumulating drafting-surface particles and other unseen trouble-starters.

You don't have to take apart your Rapidograph Technical Fountain Pen for on-the-spot ultrasonic cleaning. You don't even have to remove the ink. Just dip your Rapidograph pocket model pen or drawing point section up to the cap threads on the barrel, and millions of energized bubbles—generated by 50,000 cycle ultrasonic action—carry cleaning solution into the smallest openings, "scrubbing" your pen points inside and out. Koh-I-Noor's prescribed PMT based on daily use of the Rapidograph Ultrasonic Cleaner is fast—10 to 30 seconds per cleaning. And PMT saves money because time spent at washbasins for general and corrective pen cleaning is time lost.

See your Koh-I-Noor dealer, or write for descriptive literature. Koh-I-Noor, Inc., 107 North St., Bloomsbury, N.J. 08804. In Canada: Koh-I-Noor/Canada/Ltd., 4180 Ave. de Courtrai, Montreal 249, Quebec.

3069 USC2. *5" x 5" x 5"cast aluminum housing. Stainless steel tank. Completely transistorized solid state circuitry. No moving parts. Suggested retail price \$66.00, including 3/4 oz. plastic bottle of cleaning concentrate and small-parts cup with strainer.*

YOU GET MORE FROM KOH-I-NOOR

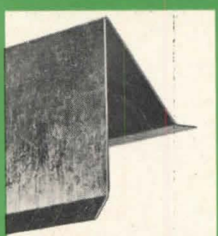
On Reader Service Card, Circle No. 355

Do a roof a favor.

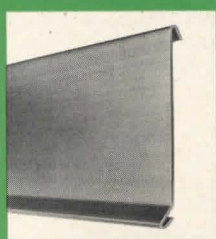
It's simple. All you have to do is specify the original gravel stop system: Hickman.

Hickman is a *total* system. And as such, it remains effective against water damage, cracked felts, leaks, and tar drippage years beyond any other system on the market. No other gravel stop grips the felts positively, permanently. Only one—Hickman.

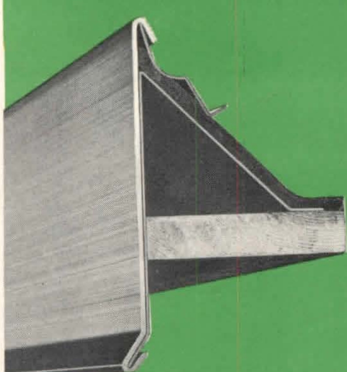
It works like this:

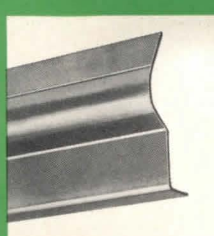


Galvanized water dam is thermally compatible with the felts. Means no separations or cracks. Ever.



Extruded aluminum fascia is free-floating. Joint covers are concealed. Variety of sizes and finishes.





Patented compression clamp is key to Hickman's lasting quality. Locks down felts, locks out water. No perimeter leaks.

And for a pleasant change, the best doesn't cost the most. Our installed cost is actually *lower* than ordinary extruded gravel stops. And, we can prove it.

Think about it this way. You're helping a roof do a better job by specifying Hickman. But you're also making sure your building will stay beautiful.

See Hickman Gravel Stop, Roof Expansion Joint and Fascia Panel Systems in SPEC-DATA 7 and SWEET'S Architectural File.

HICKMAN

W. P. Hickman Company, Inc.
2520 Industrial Row Troy, Michigan 48084
Phone: (313) 549-8484

On Reader Service Card, Circle No. 348

Roma Barocca:
The History of an Architectonic Culture
by Paolo Portoghesi
translated by Barbara Luigia La Penta
Roma Barocca comprises a complete illustrated history of building activity in Rome from about 1600 to 1750. But it acquires a far broader interest because of its critical examination of the cultural process as it developed in one of the key periods and centers in the history of architecture and urbanism.
$25.00

Beyond Habitat
by Moshe Safdie
Beyond Habitat is a highly personal statement—almost a diary—covering the author's life and career before Habitat, his struggle to transform Habitat from a "design solution" on paper to a living reality, and his more recent architectural work and his general ideas on housing and other matters since its completion. The book is illustrated with halftones of his buildings.
$10.00

Russia: An Architecture for World Revolution
by El Lissitzky
translated by Eric Dluhosch
Between the October Revolution of 1917 and the imposition of the rigid doctrines of "Soclialist Realism" under Stalin in the early thirties, the arts, architecture among them, were developing with great freedom of invention and expression in the Soviet Union. El Lissitzky, a leading proponent of socially oriented architecture, here reviews the achievements of his postrevolutionary compatriots and outlines his own program for future action.
$10.00

The MIT Press Cambridge, Massachusetts 02142

OLD WORLD NEW WORLD

PISTOL AND RIFLE RANGES

SEI designs and manufactures electronically controlled pistol and rifle ranges; automatic target transport, turning and hit sensitive systems; bullet traps, shooting stalls, and protective baffle systems. Free planning recommendations.

Shooting Equipment, Inc.

2001 NORTH PARKSIDE AVENUE • 312/889-6200
CHICAGO, ILLINOIS 60639

On Reader Service Card, Circle No. 369

FULLSPACE

Lundia

PREFABRICATED ADJUSTABLE SHELVING

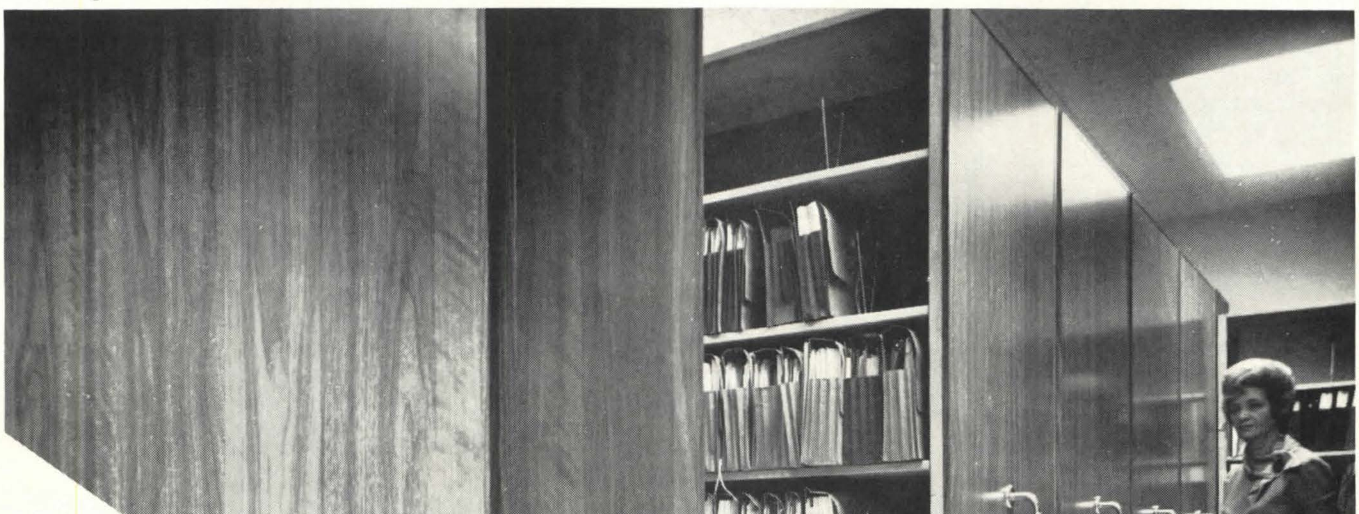
LOGICAL STORAGE SYSTEMS FOR SEEMINGLY ILLOGICAL SPACE PROBLEMS

Miss Vicki Mulcahy, Records Supervisor, "was literally climbing the walls in the old system" which was crowded, depressing and dusty. With FULLSPACE, "Not only is there so much more space, but it is easy to get to the proper shelf whenever I have to. I stay in one area and the file is brought to me, in a manner of speaking. It is just like an office rather than a back room reserved for storage...livable, attractive and cheerful."

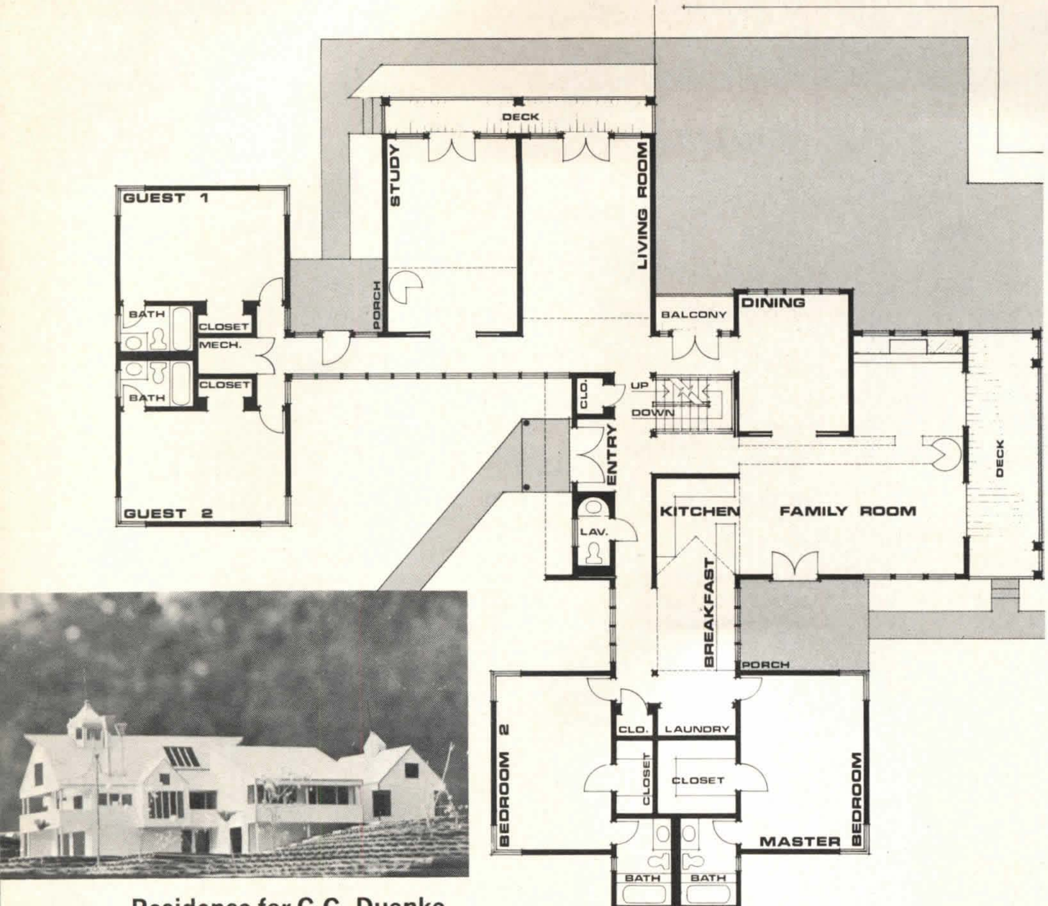
Large Law Firm handles a case against storage problems and wins a victory

It was a case of moving—or doing something drastic about the problem of records storage at the law offices of Gibson, Dunn & Crutcher. The law firm is one of the largest of its kind in the U. S., with offices in L. A., Beverly Hills and Newport, Calif., and Paris, France.

Mr. Herbert S. Schwab, Director of Administration, said, "Legal terminology always manages to cover endless sheets of paper to clarify a point of law or an issue, so when we finish some cases, we have an entire bookcase filled with legal folders." The firm's offices were literally being devoured by space-hungry storage shelves crammed with records, undergoing their own population explosion. "Fortunately," Mr. Schwab continued, "we saw the LUNDIA system in another attorney's office and recognized the tremendous potential. We would be able to double our storage space in existing areas without moving. The results have been nothing short of exciting. We now have used only 1/3 of the space we had for *all* our files. We still have 2/3 of this space left, and estimate that means at least three years before we have to think of expansion."



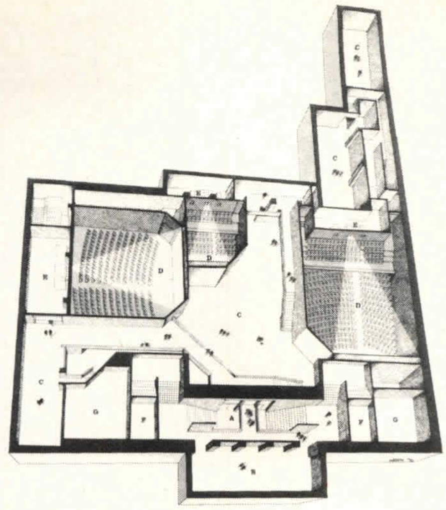
On Reader Service Card, Circle No. 359



Residence for C.G. Duenke

Dutzow, Missouri
Hohman and Meyer, Architects

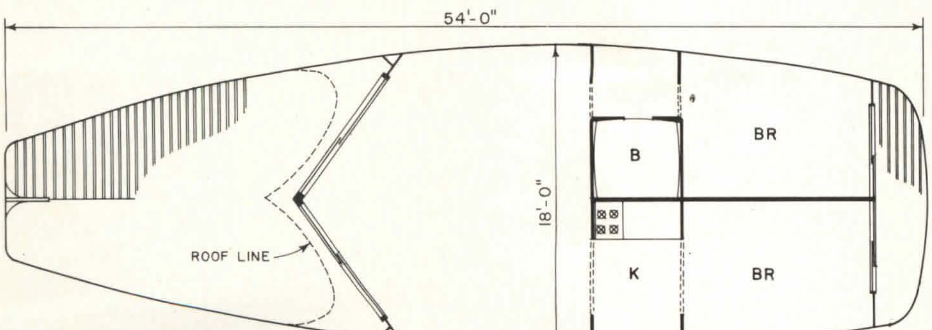
Traditional forms are modified to satisfy clients' tastes and achieve what the architects describe as a *plasticelectricrustic* character. The clients, a married couple with grown children, wanted a traditional looking house with most living areas on one level, the flexibility to accommodate guests and to entertain both formally and informally. They got a comfortable sprawling farm house of wood frame construction with cedar siding and a terne metal roof — and idiosyncratic features included here and there. All living is on the second level (a garage and laboratory wing are at grade) where a quartered parti allows spaces to progress from guest wing to formal living to informal to master bedroom wing. Balconies and sitting rooms overlook the double height study, living and family rooms. These areas are connected by captain's walks and bridges, and link to a stair spiralling from the family room to the dome of the main cupola.



City Center Cinemathèque

New York, New York
Oppenheimer, Brady & Associates, Architects

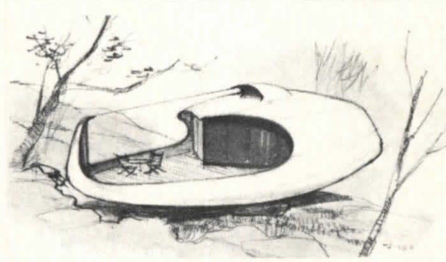
By next March the basement of the New York City Center will be transformed into New York's first cinemuseum. The former Masonic Temple ballroom dating from the twenties will be drastically altered to provide facilities for three simultaneous film showings, permanent and temporary exhibit areas. Two auditoriums seat 299 persons each; the third, for film shorts, will seat 90. The architects plan to remove the ballroom ceiling, leaving the structural elements, lighting grid, and mechanical equipment exposed in the two-level exhibit area. The auditoriums will have acoustically treated hung ceilings. Stairs and platforms are concrete, and in places where old Masonic neo-Moorish decor exists, it will be retained. Victor Vaserely, friend of the new cinemathèque's patron saint, Henri Langlois (of Paris' Cinemathèque fame), will design wall murals.



Puerto Rican Vacation House, Prototype

Isabella, Puerto Rico
Arthur Cotton Moore, Architect

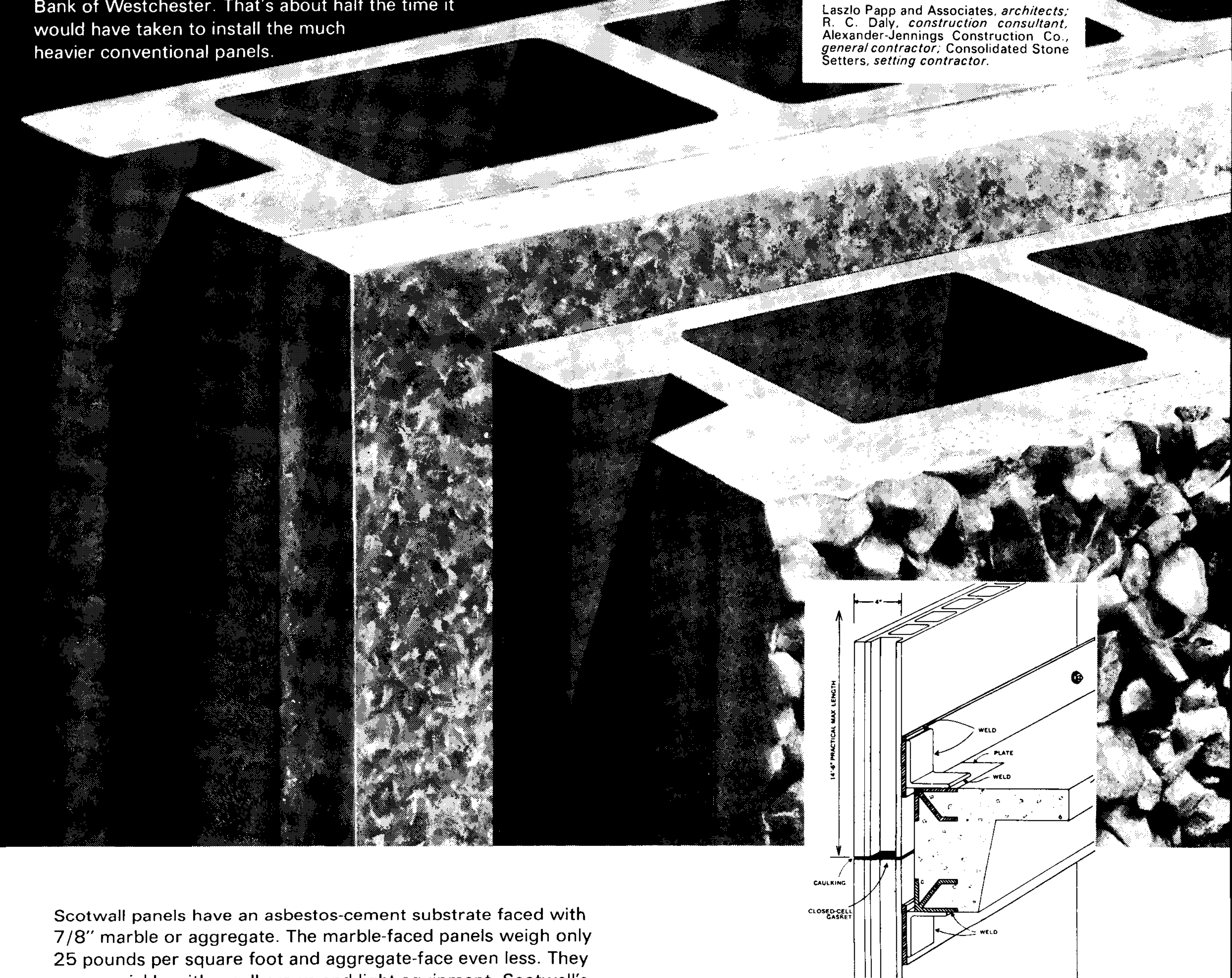
A plastic house to cost $7000 maximum, is being developed for a rugged site in Puerto Rico. The material, a mixture of polyvinyl chloride and acrylic (Kydex), is finished on two sides. It can be formed with double curvatures, great strength, and high corrosion resistance, but at present can be produced only in strips 4 ft wide. Thus, the curved stackable strips will be imported to the site, riveted together over a tubular metal frame and supported on a pedestal. The mechanical system is simple: rainwater is collected through the deck, toilets are chemical, and the house comes equipped with a small generator. Stock glass sliding doors and a stock molded fiberglass bathroom are to be used.



Scotwall Saved 500 Man Hours Here!

It took a five man crew 14 working days to set the 220 marble-faced Scotwall spandrel panels on the National Bank of Westchester. That's about half the time it would have taken to install the much heavier conventional panels.

Laszlo Papp and Associates, *architects;* R. C. Daly, *construction consultant,* Alexander-Jennings Construction Co., *general contractor;* Consolidated Stone Setters, *setting contractor.*



Scotwall panels have an asbestos-cement substrate faced with 7/8" marble or aggregate. The marble-faced panels weigh only 25 pounds per square foot and aggregate-face even less. They go up quickly with small crews and light equipment. Scotwall's combination of strength, stability and light weight permits a much lighter supporting structure and far greater design freedom.

The new Scotwall Panel System will give your buildings the beauty of marble or aggregate cladding for an in-place cost below that of many less desirable materials. Let us show you.

WRITE FOR YOUR COPY OF THE NEW SCOTWALL BROCHURE

THE INNOVATORS IN STONE PRODUCTS

Georgia Marble Company

11 PRYOR STREET, S.W., ATLANTA, GEORGIA 30303
A subsidiary of Jim Walter Corporation

MARBLE INSTITUTE OF AMERICA

COAST-TO-COAST CONSULTING SERVICE—Our engineers stand ready to assist you any time anywhere on any project involving marble or limestone. A phone call will put one of our men across the desk from you in a matter of hours. Phone 404/688-2861.

On Reader Service Card, Circle No. 343

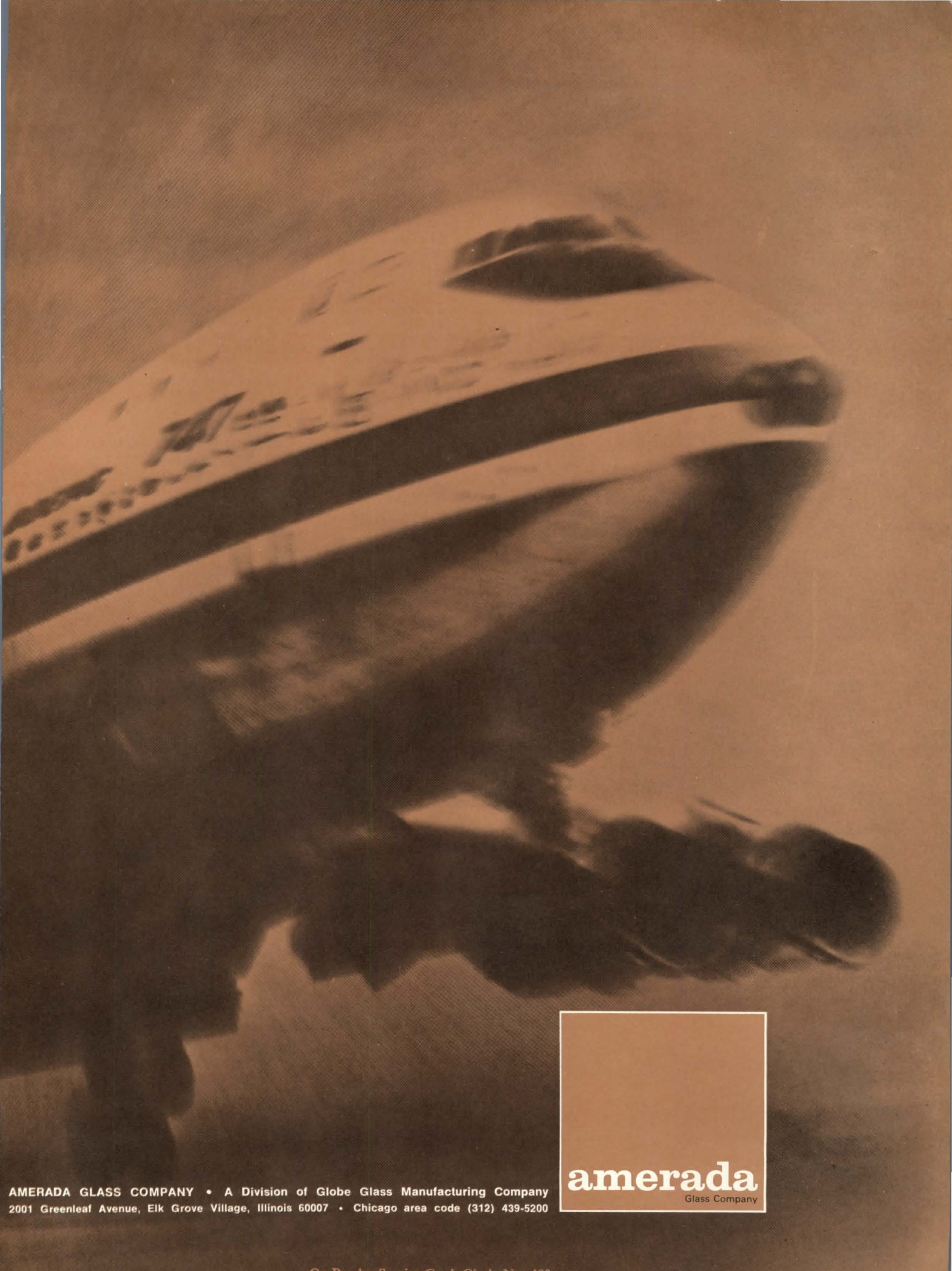
ACOUSTA-PANE®...
for things that should be seen ...but not heard.

Huge, luxurious, the ultimate in flying. But if you're planning a building near one, you'd better keep it quiet.

Amerada Acousta-Pane turns off the noise. In terminal buildings. In hotels and motels. In schools. In offices. Any kind of noise, anywhere you need to keep it quiet.

Acousta-Pane is a laminated safety glass—both pleasing and protecting. And while it turns off noise, it can also reduce heat and glare and protect from ultraviolet fading.

The ultimate in functional glass, write for complete details.


amerada
Glass Company
AMERADA GLASS COMPANY • A Division of Globe Glass Manufacturing Company
2001 Greenleaf Avenue, Elk Grove Village, Illinois 60007 • Chicago area code (312) 439-5200

Harbour City

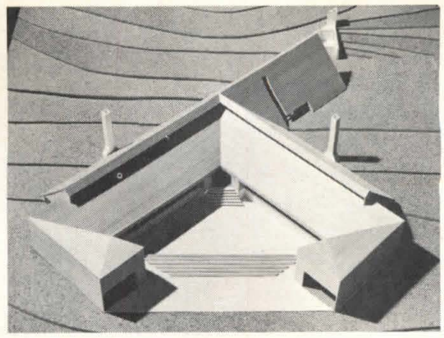
Toronto, Canada
Craig, Zeidler and Strong, Architects

Unlike some American port cities, Canada has taken steps toward making its waterfront areas accessible to the public. Latest is the plan to build a Venice-like park and island city for 60,000 people in Toronto's Lake Ontario. The low-rise community, to be built of a flexible-use concrete system still being developed, will provide townhouses, garden apartments, commercial and recreational facilities. The community, new parklands (280 acres), and waterways will cover a total of 1120 acres, 900 of which are to be created by dredging and landfill. It is expected that the creation of landfill for development rather than land purchase will reduce final cost of the project.

San Bernardino City Hall

San Bernardino, California
Gruen Associates, Architects
Armstrong-Ulmer, Associate Architects

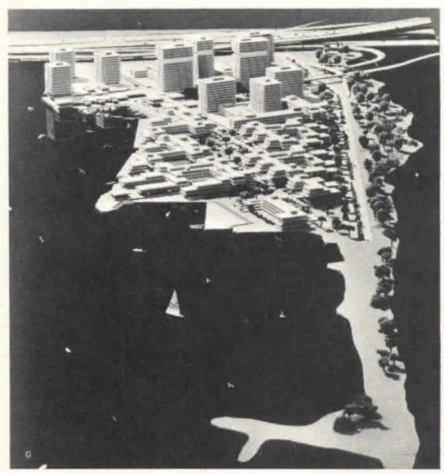
Construction of a city hall is the first phase in the development of a civic center that will include an apartment office tower, hotel, theater, and two bank office towers. Also to go into immediate construction is a below-grade exhibit center in one portion of the plaza adjoining the city hall. The concrete-framed and solar bronze and spandrelite glass structure will cost $6 million, and is being financed by "bond anticipation notes" for an early start.



Girl Scout Dining Hall

Camp Tohikanee, Pennsylvania
Frank Schlesinger, Architect

A Girl Scout dining hall need not have the institutional character usually found in organizational encampments. To alleviate "messhall" scale and noise, the architect created two wings that wrap around an open-air amphitheater. These wings serve as summertime screened porches but for winter use can be closed off by side-operating partitions. For wintertime camping, one wing can be turned into sleeping quarters. Emphasizing the orthogonal grid of the design, and introducing added light to the interior is a clerestory window running the length of the roof truss. Four-inch tongue and groove wood planks spanning perimeter plates to central trusses will be covered with wood shingles, as will the rest of the masonry and wood-framed structure.



Watergate Apartments

San Francisco, California
Wurster, Bernardi, Emmons, Architects

The first phase of a $100 million 60-acre complex of offices, housing, and shopping facilities will include 903 low-rise apartments. The housing, grouped in five tiered buildings, is sited on 22 acres of a peninsula projecting into San Francisco Bay. On-grade parking will be contained in concrete structures forming the base for the three-story complexes, elevated plazas, and recreation areas. Apartment buildings themselves are wood-framed and cement plaster.

Washington News About the Profession

by E.E. Halmos

Franzen Accepts Craftsman Award

Hailing the long association of the architect and the building craftsman, Ulrich Franzen, FAIA, on August 31 accepted the first "Thomas Jefferson Award for Architecture" from the Bricklayers, Masons & Plasterers' International Union and made a precedent-setting gesture:

Franzen announced, at the end of his acceptance speech, that he would donate the $5000 prize to the "Outreach" program of the A. Philip Randolph Institute, for use in helping black youths enter apprentice training courses in building trades.

Presentation of the award to Franzen was made by Thomas F. Murphy, BMPIU president. The acceptance speech was followed by an address by Bayard Rustin, Executive Secretary of the Randolph Institute, who said that his group is now spending $2 million a year, in 21 cities, to train black youths for the construction trades.

Recent Legislation Weak

With Congress apparently heading for a "lame duck" session after the November elections, very little major legislative action, beyond passage of remaining funding bills, can be expected.

An example is in the field of environmental control — where all of the excitement of the session's early days has simmered down to a very few real actions — mostly concerned with continuing existing programs at a somewhat accelerated pace. (Congress actually had given up hope of any major breakthroughs, and settled for tucking $1.5 billion for loans and grants for water pollution control into the $5.3 billion annual public works bill, which also contains $1.3 billion for the Corps of Engineers, $301 million for Bureau of Reclamation.)

The final highway bill was also a major compromise that made nobody very happy: It permits some further tapping of the Trust Fund, extends time limits not as far as the Administration wanted; doesn't change the key apportionment formula. The "taps," over the heated objections of highway-oriented groups, will include funds for forest and public lands roads, for housing (as a last resort) for persons displaced by roadbuilding, for support of mass transit schemes under some circumstances, for "beautification." Most satisfactory action will permit elimination of certain segments of the Interstate system that are "unwanted or controversial" (thus the less than 200 miles within major metropolitan areas that have been rallying points for anti-freeway forces). Overall program is extended through 1977.

The lawmakers approved an "Emergency Home Finance" act, to pump another $1.2 billion into the housing market in the fond hope that this would spur construction of perhaps two million homes a year for middle-income families. But that marked almost the only real legislative help in this area.

And still on the books as Congress approached elections were schemes to reorganize scattered areas of the Housing and Urban Development department — to reduce substantially the number of semi-independent operations; other reorganization plans in other federal departments.

CSI Introduces New Payments

Payment bonds posted by owners in favor of architects, engineers, and contractors, were recommended to the newly formed Construction Industry Foundation by a special panel of bank officials. Such bonds would assure all concerned of payment for services — much as contractors must now post performance bonds.

Other ideas: total funds for a project should be deposited with a third party for disbursement; establishment of some method by which owner (or agent) would make one final, total payment, after work has been completed.

Construction Trend Up Slightly

There were some signs, finally, of steadying in the construction industry: In June, volume of activity was at a seasonally adjusted rate of $88.8 billion — up very slightly from May although well under 1969 rates. Significant point: It was the first time this year that the rate climbed over the preceding month.

Part of the reason for the upturn was housing, which showed a rate of 1.358 million units in June, up substantially from May's 1.225 million annual rate (though again well under the previous year). Nobody was prepared to say that this was anything but normal summer surge, but the outlook was cautiously optimistic.

Costs and labor problems didn't slacken, however. The Interior Department's index of sewer and sewer plant construction costs jumped a whopping 3.22 points in August; strikes in the industry had more than doubled, a total of 420 in 1970, *vs* 205 in the same period of 1969.

Experimental "Bidding" at DOD

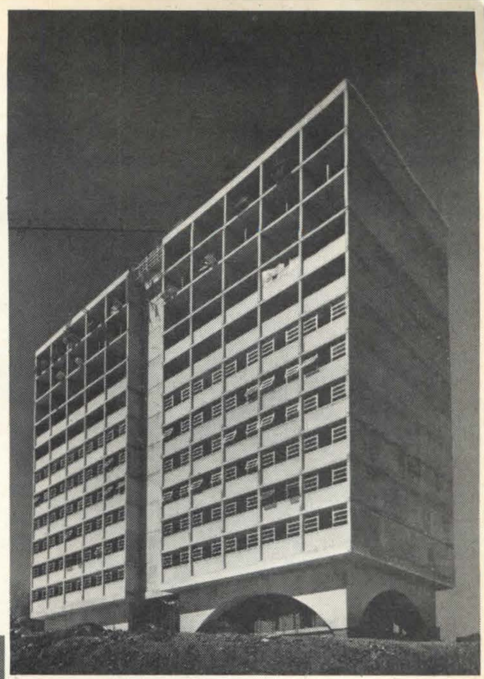
A sharp change — labeled as "experimental" — in armed services methods for procuring services of Architect-Engineers seems to be exactly what some professionals feared as a reaction to their attempts to obtain legislation outlawing any kind of price consideration.

The change could mean a real setback for the legislation itself (HR 16443), although the bill had progressed to the House Rules Committee in early September.

Here's the new procedure — already initiated in the Army's Sacramento Engineer District and the Navy's Southern Division, under directives from the Defense Department's Assistant Secretary for Installations and Logistics: (a) Technical proposals are solicited from qualified A-E firms; (b) these proposals must be accompanied — in separate, sealed envelopes — by lump-sum estimated prices; (c) district or division evaluation boards consider the technical proposals, assign rankings for negotiations; (d) the sealed price estimates are then opened; (e) if the selection board decides to do so, it may make changes in the earlier rankings of the A–E firms, and (f) then proceed with negotiations looking to award of a contract.

DOD went to a lot of trouble in announcing the plan to argue that the procedure isn't "bidding." It said the action was a result of studies it started early in the year aimed at "enhancing technical competition"; and it added, in discussing possible changes of ranking by the evaluation board, that "it is not anticipated that price estimates play a predominant role" in selection, but that the selection boards "may determine that pricing considerations warrant a change in the relative rankings" of A–E firms.

THOROSEAL PLASTER MIX spray-on finish was applied to the entire exterior and some interior poured-in place concrete surfaces of this new men's residence hall in Texas. An interesting, rough texture was achieved, which gives added character to the attractive appearance. It was decided that best results could be obtained by an applied cement-base finish that would also waterproof at the same time. Again THOROSEAL PLASTER MIX has lived up to its reputation as an outstanding protective-decorative, lifelong finish.



STOP RUBBING CONCRETE!

THORO PRODUCTS waterproof-finish concrete economically

Jackson Hall, Southwest Texas State College, San Marcos, Texas. Arch.: Harvey P. Smith & Assoc., San Antonio. Contr.: Citadel Const.

STANDARD DRY WALL PRODUCTS, INC

DEPT. 70-PA-3 • **7800 N.W. 38TH ST., MIAMI, FLA. 33166**

SDW 139

On Reader Service Card, Circle No. 372

STAMP OUT DRAFTING

I'M FREE

Send for our free 1969 catalog. Brand new drawings of trees, people, cars, arrows, trucks, etc. A stamp of our gorgeous "Bikini Belle" (shown here) is free with minimum order.

Also available: transfer sheets and tracing guides. Dealer inquiries welcomed.

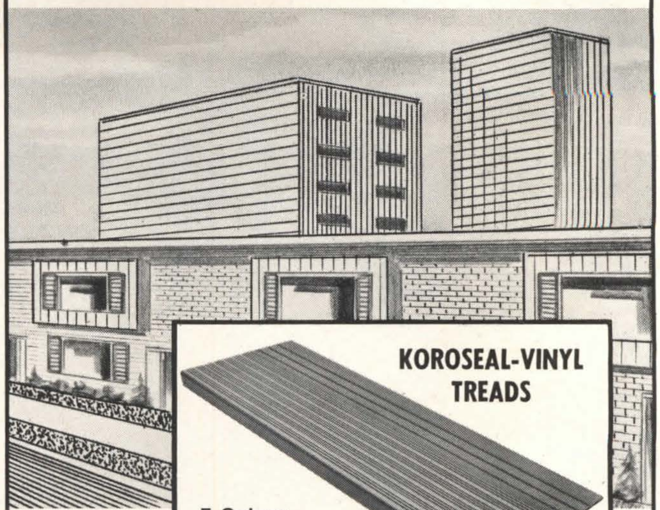
instant landscape

1115 Embarcadero • Sacramento, California 95814 ®

(916) 443-3459

On Reader Service Card, Circle No. 349

MUSSON TREADS FOR APARTMENTS



KOROSEAL-VINYL TREADS

5 Colors
8 Sizes
Safety Design
Matching Coved Risers

Model No. 400

For Economy, Safety and Beauty

Architects favor Musson KOROSEAL-VINYL treads for many multi-family complexes; also factories, shops, stores, theaters, etc. These treads are easily cut to fit, resist oil and grease, are easy to clean, low cost, non-porous and durable.

Write For Catalog and Prices

THE R. C. MUSSON RUBBER CO.

1320 Archwood Ave. **Akron, Ohio 44306**

On Reader Service Card, Circle No. 391

FREE!

DEEP LONGSPAN STEEL JOIST SPECIFICATIONS

Depths from 52" to 72" Clear spans up to 144 feet.

FIRST Edition

A new help to structural designers . . . the *first* standard specifications for deep longspan joists—DLJ and DLH-Series . . . adopted by the Steel Joist Institute. Covers materials (36,000 psi and 50,000 psi), connections, camber, painting, application, bridging, erection—and all pertinent design information, including Standard Load Tables.

to STEEL JOIST INSTITUTE
Suite 707-B
2001 Jefferson Davis Hwy.
Arlington, Va. 22202

Please send me a copy of the new Deep Longspan Steel Joist Catalog to

NAME__________

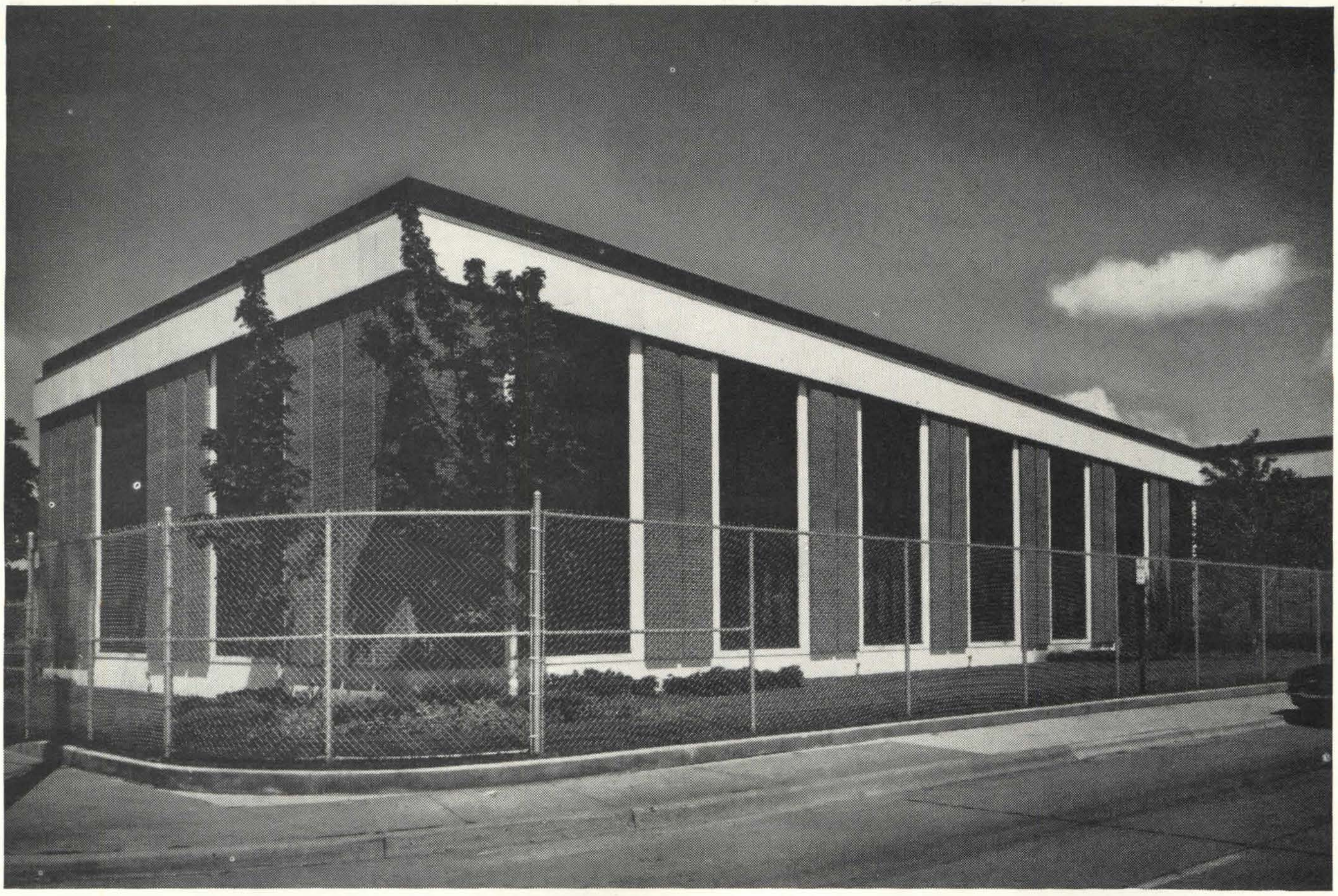
ADDRESS__________

CITY______ STATE______ ZIP______

Send for your free copy today!

7005

On Reader Service Card, Circle No. 373



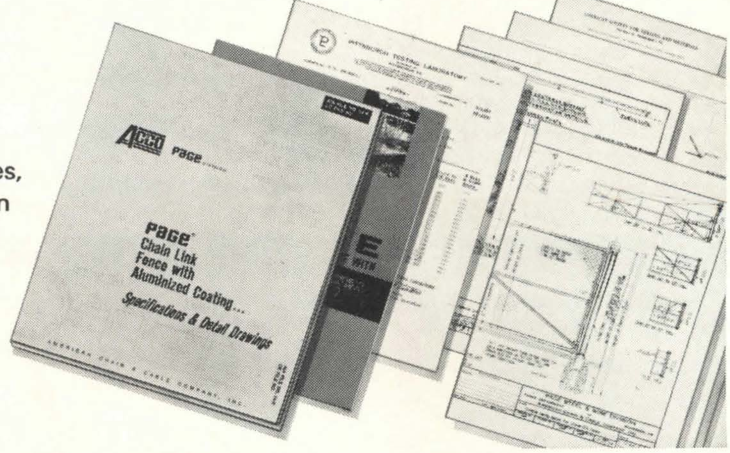
PAGE® fence
keeps its good looking weatherability years longer

Low maintenance cost and high protection are combined in *Page* Aluminized chain link fence fabric and barbed wire. The aluminum coating prolongs life before maintenance up to 3 to 5 times longer than the best hot-dipped galvanized products.

Used on a framework of smooth round posts with no foothold bevel edge bands makes *Page* fence less climbable—over-all appearance is smooth, clean and unobtrusive. When you specify *Page* Aluminized fence fabric you can forget about painting and corrosion-caused replacement costs—even in tough industrial atmospheres.

Save design time with the industry's most complete fence spec kit

It contains data and drawings on styles, wire gages, gates, back stops, framework, ASTM Specification A491-63T, lab reports and work sheets. For your spec kit write: Page Fence Division of Acco (American Chain & Cable Co.), P. O. Box 279, Monessen, Pa. 15062.



ACCO PAGE FENCE DIVISION

NEWS REPORT

Personalities

Adam Yarmolinsky, Professor of Law at Harvard University will be the chief executive officer of the Welfare Island Development Corp., the newly created subsidiary of UDC which is developing the $250 million new community on Welfare Island in the East River. . . . **Sidney L. Katz** has been appointed Acting Dean of the Pratt Institute School of Architecture.

Calendar

The International Symposium on Low Cost Housing Problems related to Urban Renewal and Development: University of Missouri-Rolla, Oct. 8, 9. . . . **The American Institute of Planners Annual Conference:** Minneapolis, Minn., Oct. 17–21. Highlights: addresses by Ralph Nader and Hubert H. Humphrey; presentation of HUD's 1970 design awards. . . . **The Annual and National Environmental Engineering Meeting of the American Society of Civil Engineers:** Statler Hilton Hotel, New York, N.Y., Oct 19–22. . . . **The Annual Meeting of the Industrial Designers Society of America:** Pocono Manor Inn, Pocono Manor, Pa., Oct. 22–25. . . . **The Annual Meeting of Automated Procedures for Engineering Consultants:** Las Vegas, Nev., Nov. 4–6. . . . A reunion of the Atelier members of 1926–1927 of the **T-Square Atelier of Philadelphia,** the oldest architectural society in the U.S.: Engineers' Club of Philadelphia, Nov. 7. . . . Conference and workshop on Tri-state air pollution (New York, New Jersey, Conn.) sponsored by **American Institute of Chemical Engineers and Environmental Technology Seminar:** Hofstra University, Hempstead, N.Y., Nov. 20, 21.

Competitions

The Foreign Area Fellowship Program is offering **Ph.D. research opportunities and professional internships in urban studies for Latin America and the Caribbean.** Foreign Area Fellowship Program, 110 East 59th St., New York, N.Y. 10022, due by Nov. 30, 1970. . . . The 1970–71 **Design in Steel Award Program** will offer two awards in each of four structures categories: best design in steel; best engineering in steel. Structures categories include housing, high- and low-rise and public works construction. Director, Design in Steel Award Program, 201 East 42 St., New York, N.Y. 10017.


Reflections
More than 35,000 times a day someone may enter or exit from these back-to-back doors. Safe, reliable door control is essential. So is the unblemished contemporary design of this magnificent exhibition center. Here, no compromise has been made. Door control is by Rixson*, of course.
101
*More than 160 Rixson fully concealed floor closers; The Rivergate, Port of New Orleans Exhibition Center.
Rixson's No. 28 Series; center hung, with exclusive full control panel adjustments and a reputation unsurpassed. Details? Just ask.
Architects: Curtis & Davis; Edward Silverstein; Mathes - Bergman and Associates
Hardware: Woodward, Wight & Co., Ltd., New Orleans, La.
RIXSON CLOSERS
A Division of Rixson Inc., Franklin Park, Illinois 60131, In Canada: Rixson of Canada, Ltd.
CENTURY 2000

Holophane

The IES* is establishing new lighting practices for tomorrow's schools.

That's good news for tomorrow's students.

Holophane has the new lighting system that conforms to those practices today.

That's good news for you.

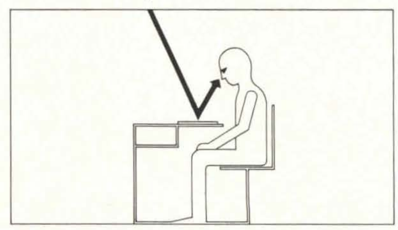
*Illuminating Engineering Society

The beginning of a new era in lighting. The end of the veiling reflections problem.

"Veiling reflections" is the term used to describe the glare that reflects from a printed page and makes it hard to read.

Percepta, a new precision, prismatic optical assembly by Holophane, is designed to eliminate that glare.

Percepta's specialized photometric distribution projects the light sideways, in a unique twin-beam pattern, rather than downward, as in conventional lighting. This means that veiling reflections (reflected glare) are directed away from the viewer's eyes, thus permitting optimum visual performance.



Conventional lighting subjects reader to veiling reflections.

This means that reflected glare caused by overhead lights is minimized, and useful sideward light is maximized.

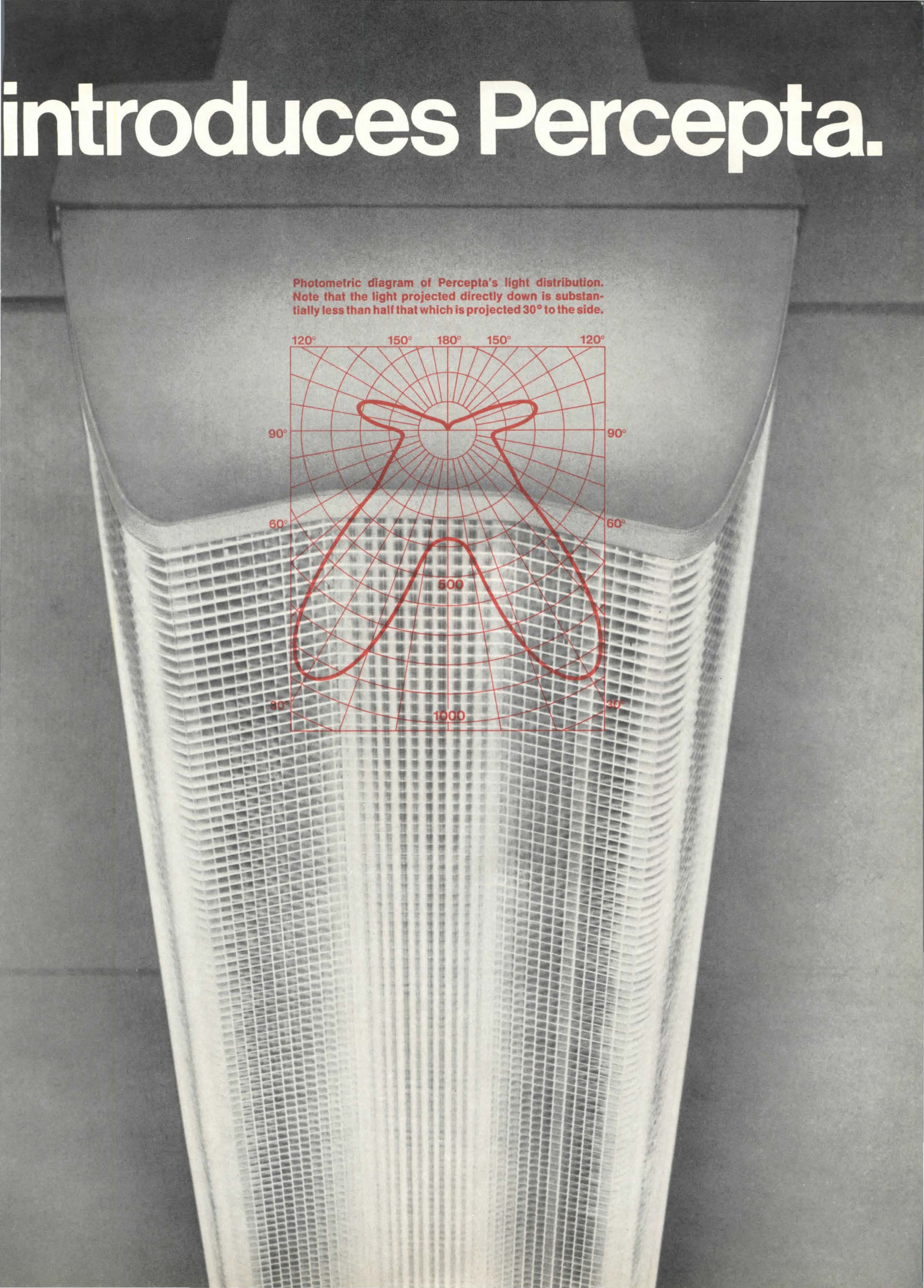
How much of a problem are veiling reflections? Enough that the new Illuminating Engineering Society recommendations state that their effects (loss of contrast) are to be considered in future evaluation of lighting systems.

What's new about the new IES practices?

In June 1970, the IES adopted new guidelines for footcandle evaluation, as applied to task illumination measurement.

Whereas the "classical footcandle" measures light delivered to a given area, regardless of its glare-producing effects, the new standard of "effective footcandles" evalu-

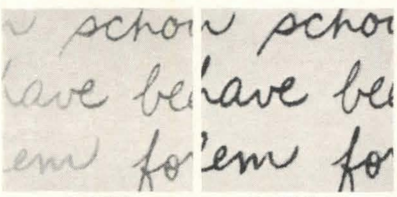
(continued overleaf)


introduces Percepta.
Photometric diagram of Percepta's light distribution. Note that the light projected directly down is substantially less than half that which is projected 30° to the side.
120° 150° 180° 150° 120°
90° 90°
60° 60°
500
30° 30°
1000

Holophane introduces Percepta. (continued)

ates the visual effectiveness of the light, as well as its quantity, and is related to the results obtained with a scientific reference standard, the illuminating sphere.

These two photographs show handwriting samples in the presence of veiling reflections and in their absence.



A. With veiling reflections. B. Without veiling reflections.

Photograph A shows a student's-eye view of the handwriting as it would be seen if his desk were struck by light from directly overhead and forward. What happens, of course, is that the pencil line glints when light strikes it at such an angle, almost as though tiny mirrors were placed on the paper. The result is loss of contrast, and therefore, loss of see-ability.

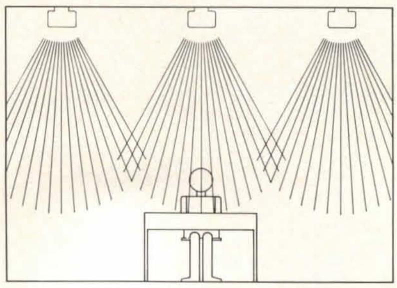
In Photograph B, the handwriting sample was struck by the same amount of light from the side, thus directing the veiling reflections away from the student's eyes, resulting in substantially improved contrast, and hence, better see-ability.

As you can see, it is loss of contrast that decreases visual performance, even though the amount of incident light in each case is the same. By defining illumination requirements in terms of effective footcandles, the IES has taken a major step forward in improving seeing conditions for students and office workers alike.

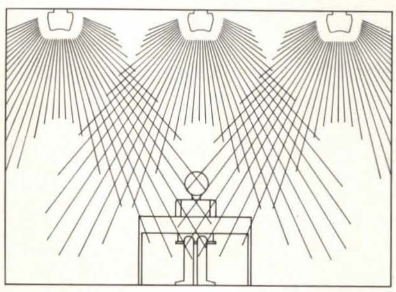
And it has exposed the villain of this piece—veiling reflections.

How does Percepta minimize veiling reflections?

As we have seen, veiling reflections are caused by overhead lighting, striking reading matter from a forward position. Merely moving desks to the side of the light fixtures, however, is not necessarily a workable solution—for this would result in a serious loss of usable floor space.



C. Conventional lighting distribution.



D. Percepta's lighting distribution.

Percepta's twin-beam light distribution, however, is sideward. Its maximum intensity is directed outward at angles greater than 20°. So a student sitting to the right or left of the light source will receive full illumination on his reading matter, and veiling reflections will be directed away from his eyes.

But what happens if, for one reason or another, a student winds up sitting directly under a row of Percepta fixtures?

No problem.

Because the light falling directly downward is such a small percentage of the total light that the veiling reflected glare will fail to materialize. The majority of this student's light will come from adjacent rows of fixtures, not the one directly overhead. So he'll be able to see his notes and textbooks better.

And if Percepta's going to become a best seller, it will be because of that: it makes for good reading.

What about costs?

Depending on various classroom space geometries, Percepta, because of its extremely high efficiency and unique design, will meet or exceed IES standards by using 4, 5 or 6 foot spacing on centers.

The initial purchase price may be more than that of the lighting we have known up to now. But you'll more than make up for the difference in the long run.

Because Percepta was designed to minimize not only veiling reflections, but installation and maintenance costs as well.

First of all, surface-attached Percepta enables you to avoid the installation costs associated with recessed fixtures. (The fact that Percepta can be surface-attached also makes it easy to install as replacement lighting in older schools and offices.)

Secondly, it uses only one fluorescent lamp per fixture, instead of two or more. This cuts lamp replacement costs.

And because Percepta uses fewer lamps and less wattage than conventional lighting, you wind up with a lower electric bill.

Finally, you also wind up with less heat from the lights and less heat from the ballasts. So you even save on air conditioning. (Or, if you don't have air conditioning, your rooms stay cooler.)

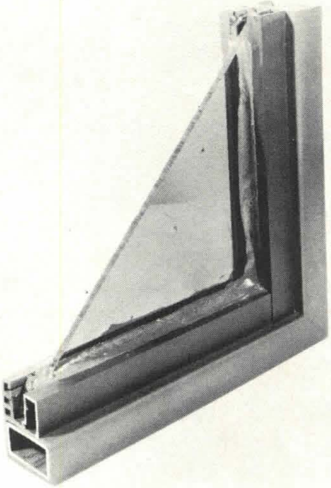
But there's one thing no one can put a price on. The improved visual performance—and indeed the healthy eyesight—of students or office workers.

And that's where Percepta will prove to be the best bargain of all.

For complete technical data write to:
Holophane Company, Inc.,
Dept. B-10,
1120 Avenue
of the Americas,
New York, N.Y. 10036.

HOLOPHANE

PRODUCTS & LITERATURE



PVC Windows

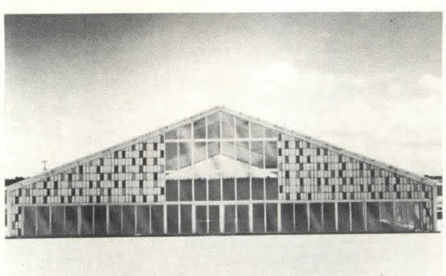
Cores of aluminum or steel are now available in Compro windows which are completely encased in polyvinyl chloride. The hardware is recessed in the aluminum core and a vertically pivoted sash allows for safe cleaning. PVC is corrosion-resistant, a thermal insulator, and acts as a vibration and sound dampener. Compro Division of Alumiline Corp.
Circle 101 on Reader Service Card

Plastic-Topped Atriums

A new light on the subject of atriums. Topped by a bubbled skylight of Plexiglas acrylic plastic, which admits plenty of light, the properties of the tinted Plexiglas control heat and sun glare. Encased in a ¼″-thick aluminum frame, the dome is breakage- and weather-resistant. Skylights by Naturalite, Inc. Plexiglas is a trademark of Rohm and Haas Co.
Circle 102 on Reader Service Card

Going Up

The coat of arms proclaims the prestigious first use of this commercial plastic elevator cab. The first structural plastic approved by New York City's building code, it is tradenamed Nalite, and is a laminated 3/16″-thick sheet reinforced with Owens-Corning Fiberglas. Lightweight, easy to maintain, and — a major influence in its acceptance — flame-retardant, the cab holds 20-25 passengers, is 7′ wide x 5′ deep. National Elevator Cab & Door Corp.
Circle 103 on Reader Service Card

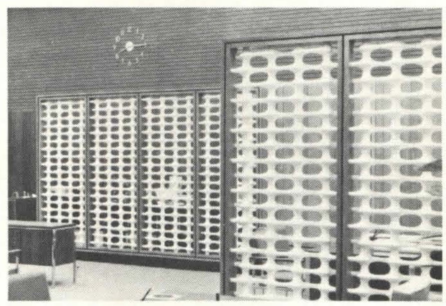


In the Swim Year Round

The Skywall Natatorium provides for year-round swimming — outdoors in summer, indoors in winter. Structural members are extruded box beam anodized aluminum sections. The electrically powered roof of fiberglass-reinforced acrylic modified polyester sheet, permanently bonded to an aluminum grid core, opens almost 50 percent; two-thirds of the insulated tempered glass walls slide open. Can be used to cover an existing pool — is said to offer cost savings over building interior pools. Paddock Structures, Inc.
Circle 104 on Reader Service Card

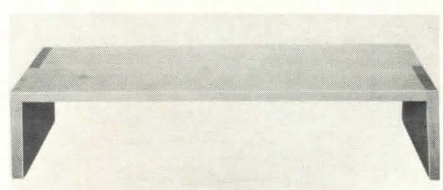
See-Through Swivel

No secrets here. Clear acrylic chairs turn on a memory swivel base of polished stainless steel or aluminum. Plump foam cushions. Designed by I.M. Rosen for the Pace Collection.
Circle 105 on Reader Service Card



Plastic Grillework

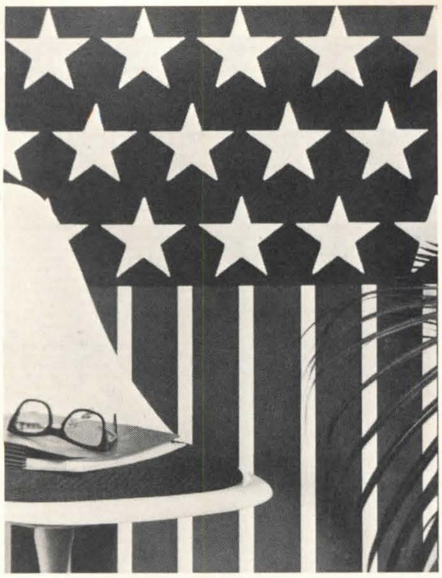
Original sculpture designs are the basis for Sculpta-Grille, a series of panels composed of tough, impact- and corrosion-resistant plastic units of hollow, heavy-walled construction. Exterior façade application or interior divider or decorative use. Harvey Design Workshop, Inc.
Circle 106 on Reader Service Card



Not for the Butcher

A butcher block table, protected by layers of polyurethane, is suitable for institutional, campus, or commercial use as a dining or lounge table. Sizes from 18″ to 60″. Thompson Manufacturing Co., Inc.
Circle 107 on Reader Service Card
(More products on page 56)

(Continued from page 55)



The Look Is Vinyl

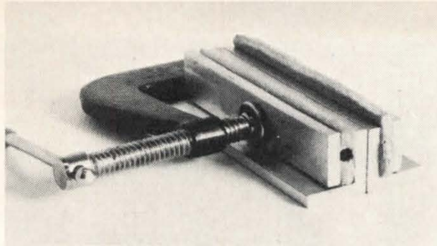
Vinyl featuring deep embossed textures and "with it" styles comprises "The Look" wallcovering collection. A special "Perma-Boss" process, used for the first time in the United States, achieves extremely deep permanent embossing. Designs include this flock stripe. The Birge Co., Inc.
Circle 108 on Reader Service Card

Stain for Wood

An acrylic exterior wood stain, WoodGuard, has a flat finish, dries in an hour or less, offers water washup, fade resistance, and adhesion. 12 colors. National Paint & Varnish Co.
Circle 109 on Reader Service Card

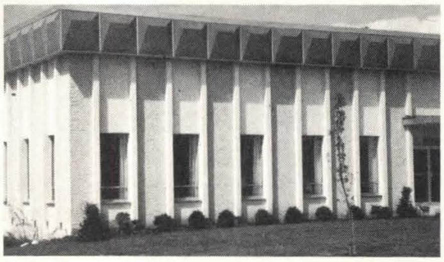
Liquid Bonding Agent

Cement mixes prepared with ACRYL 60 — a liquid bonding agent of acrylic polymers and modifiers — are suitable for exterior and interior use, are hard, tough, and fast curing, and possess resistance to many common chemicals. Standard Dry Wall Products, Inc.
Circle 110 on Reader Service Card



Pre-Shimmed Tape

Pre-shimmed polyisobutylene-butyl tape incorporates a 50 Shore "A" rubber rod with a central fiberglass core. Designed for a variety of bedding and sealing applications, the tape is highly adhesive, retains its elasticity at a wide temperature range, and is said to be impervious to ultra-violet rays. The Tremco Manufacturing Co.
Circle 111 on Reader Service Card

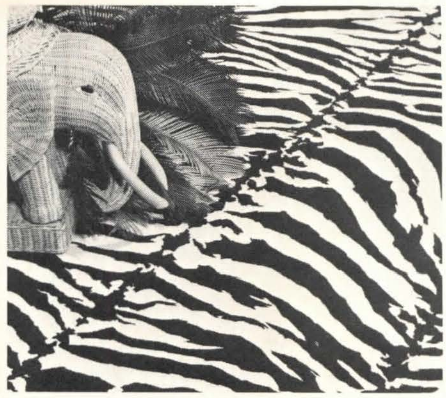


Let's Face It

Building facings with lucite acrylic plastic are weather resistant, have greater impact strength than glass, are lightweight, and have strong chemical resistance. Custom design if existing panels do not meet design needs. A new booklet is available. E.I. duPont de Nemours & Co., Inc.
Circle 112 on Reader Service Card

Lighter Letters

They look like metal sign/display letters. They're made from Cycolac brand ABS — a lightweight, durable, impact-resistant thermoplastic. Chromium plated, gold, or stainless steel finish. Wide size range. Thermoplastic from the Marbon Division, Borg-Warner Corp.
Circle 113 on Reader Service Card

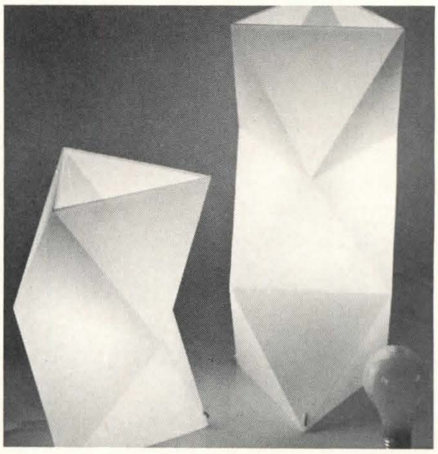


Safari

Changing floors with the season is the new approach with nonadhesive vinyl floorings. This "Shinyl Vinyl" demands no waxing — the zebra pattern gives the effect of the real thing — without disturbing the jungle. Congoleum Industries, Inc.
Circle 114 on Reader Service Card

Dyeing for Carpet

Residential and contract carpets can be custom dyed in runs as small as 350 yds in 15 carpet grades. Another technique allows runs up to 10,000 yards to be dyed uniformly. Available in wool, Monsanto Acrilan, acrylic and Cadon nylon, Dupont nylon, Kodel polyester, Herculon olefin and Antron nylon. Roxbury Carpet.
Circle 115 on Reader Service Card



Folded Light

The ancient art of paper folding has been applied to plastics — white vinyl and clear acetate are scored, folded, and joined by hand for transparent or opaque white shades. Shades hang, sit directly on a table, or on a stem and base. Bases in marble, wood, or acrylic. db Design.
Circle 116 on Reader Service Card

(More products on page 58)

Powerbond.® Like a raincoat for floors.

The backing for Powerbond pile vinyl has a closed-cell construction which means water—or anything else—can't penetrate. Unlike sponge rubber, it can't deteriorate. Matter of fact, it's the only material that flushes back water.

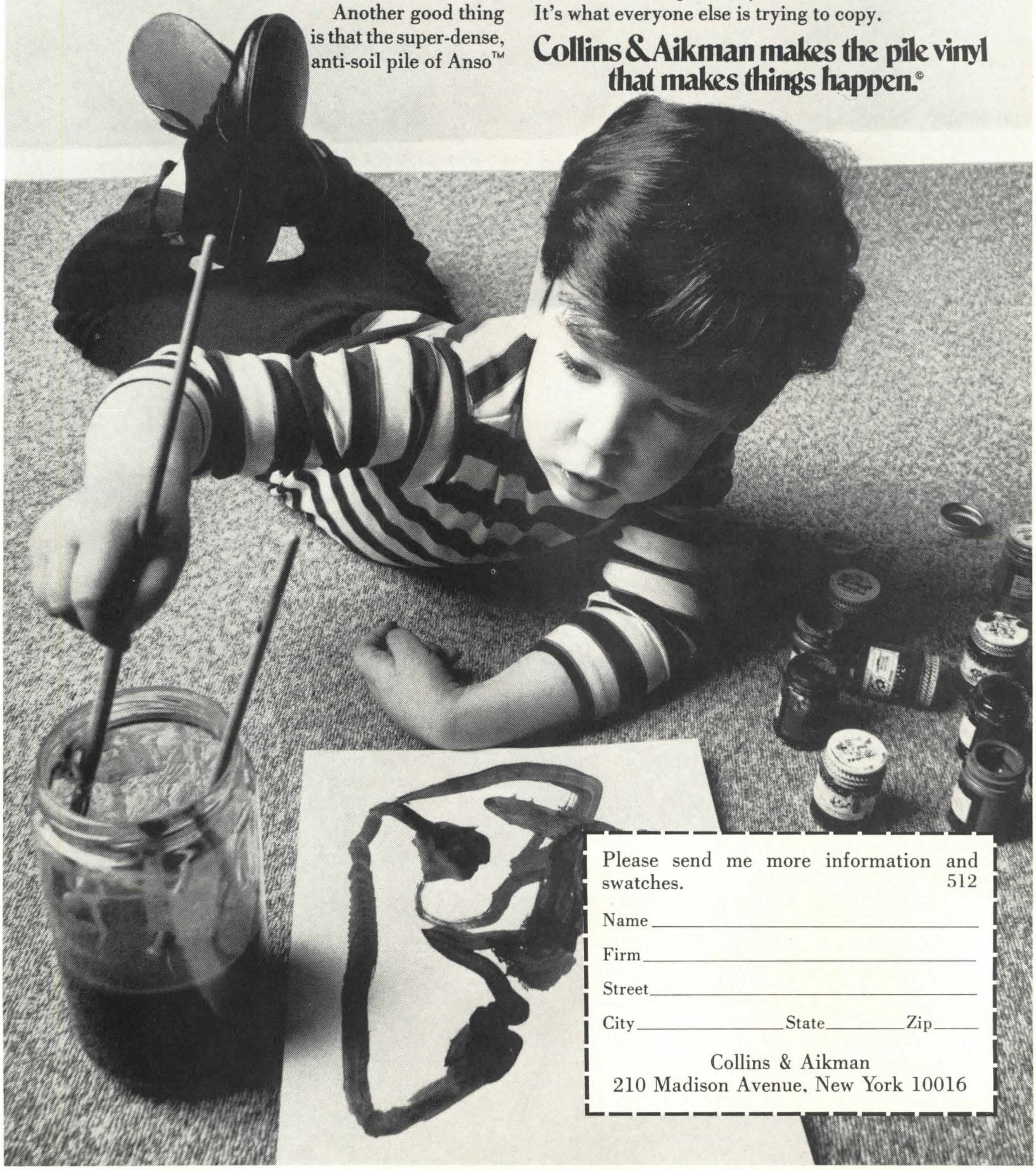
Another good thing is that the super-dense, anti-soil pile of Anso™ nylon by Allied Chemical holds dust and dirt on the surface. That makes cleaning easy.

Powerbond is extraordinarily rugged, abrasion resistant, resilient. And has excellent sound deadening properties.

Deliveries are from 3 to 4 weeks from day of order. And we offer unusual guarantees against excessive wear.

Powerbond pile vinyl. In 24 colors. 3 textures. It's what everyone else is trying to copy.

Collins & Aikman makes the pile vinyl that makes things happen.©



Please send me more information and swatches. 512

Name__________

Firm__________

Street__________

City__________ State________ Zip_____

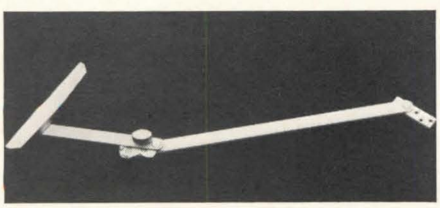
Collins & Aikman
210 Madison Avenue, New York 10016

On Reader Service Card, Circle No. 389

(Continued from page 56)

Shell of Steel

In 128 man-hours the steel shell of a typical 1800-sq-ft house complete with windows, doors, stuccolike finish, and garage is up and ready. The Rusco System consists of 16" flanged steel panels that are bolted together for roof, floors and all exterior walls, plus steel cross braces, ridge frame, windows, and doors. It also can be used for apartments. Fire-proof, termite-proof, and rot-proof. Rusco Industries, Inc.
Circle 117 on Reader Service Card

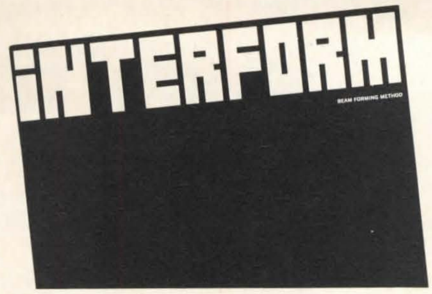


Open Door Policy

This medium traffic door holder and stop for interior single acting doors (surface mounting style) and for single or double-acting doors (concealed style) uses a nylon-filled slide block that offers extreme shock absorbing capabilities, requires no lubrication, and will not rust, chip, or peel. The 3 Series, bronze arm with bronze or steel channel; the 5 Series, steel arm and channel; the 8 Series for use on interior and exterior doors, heavy and medium traffic. Checkmate, Division of Rixson, Inc.
Circle 118 on Reader Service Card

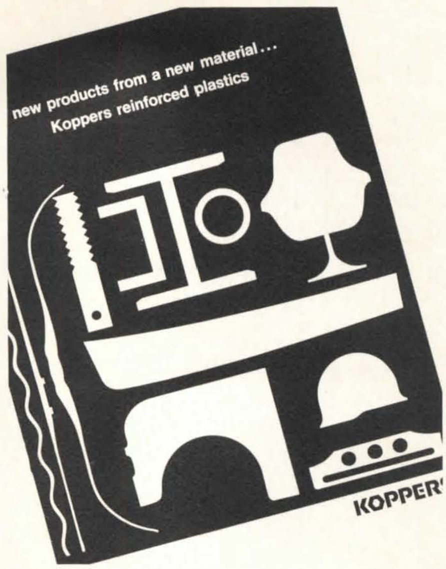
Duraform

A 17-page booklet defines the composition and application possibilities of Duraform, an asbestos-PVC alloy for exterior facing and structural panels. Kaykor, a division of Continental Oil Co.
Circle 119 on Reader Service Card



Beam Forming Method

Beam and slab forming equipment now available on a rental basis is described in this brochure, which features beams to 60" in one piece. All types of forms are described: curved, twisted beams, wall and beam intersections, spandrel, and those for use in fireproofing steel buildings. Interform.
Circle 120 on Reader Service Card

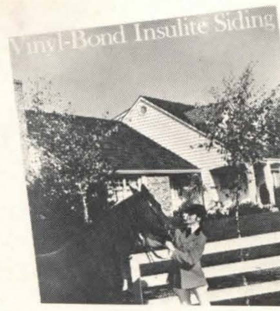


Protective Coatings

Protective coatings for the petroleum, gas, water, and electrical industries are presented in a 16-page color brochure, including bitumastic enamels and cold-applied coal tar coatings as well as a complete line of color coatings. Organic Material Division, Koppers Co., Inc.
Circle 121 on Reader Service Card

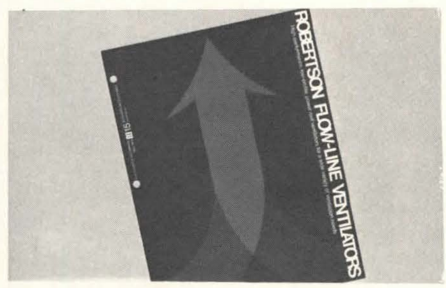
Hook-on Partitions

A "hook-on" method of installing vinyl-surfaced gypsum panels is described in this color brochure. The movable partition system — KW 500 — has sound control ratings up to 46 STC; a one-hour fire rating. Kaiser Gypsum Co., Inc.
Circle 122 on Reader Service Card



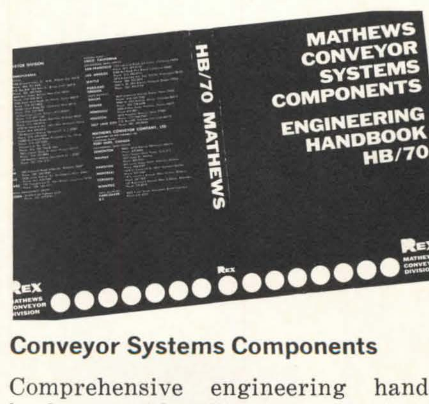
Vinyl-Bond Siding

A six-page color brochure illustrates the use of Vinyl-Bond Insulite Siding — protected by a vinyl coating of thermosetting acrylic on the face, edges, and ends. Reversible weather-drip edges reduce waste. Boise Cascade Building Products.
Circle 123 on Reader Service Card



Power Roof Ventilators

Ways and means to solve a variety of ventilation needs are described in the Flow-Line Ventilator product data brochure. Both belt-driven and direct-drive, these exhaust ventilators are suitable for light industrial and commercial use. H. H. Robertson Co.
Circle 124 on Reader Service Card



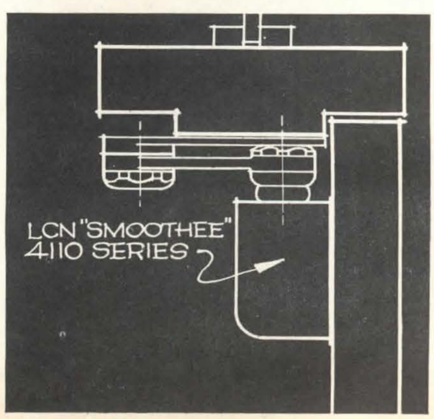
Conveyor Systems Components

Comprehensive engineering handbook on unit handling conveying contains section descriptions, drawings, and selection procedures. It covers the design and application of components to make up conveyors as well as assembled gravity and power conveyors. New $8\frac{1}{2}$" x 11" size. Mathews Conveyor Division.
Circle 125 on Reader Service Card

South Senior High School, Minneapolis, Minn.; The Cerny Associates—Caudill-Rowlett & Scott, Associated Architects.

Can there ever be a perfect school doorway?

Until there is we recommend the one in the picture. The remarkable elegance is achieved with a simplicity and honesty that invites outright imitation. The closers are LCN Smoothees®, stop-face mounted, 4110 Series. Your Hardware Consultant knows all about them. Ask him, or write LCN Closers, Princeton, Illinois 61356.



On Reader Service Card, Circle No. 356

Wimsley, Bosch & Bruber, A. I. A.

Thanks for making our restroom what it is today!

Us girls love those dual-vend dispensers with both Kotex® napkins and Kotex tampons. Not like the restrooms in our old office building. Now every gal has the kind of protection she wants.

One out of two women today use tampons. So restrooms need both tampons and napkins. Bobrick Dispensers, Inc. makes a number of excellent dual-vend dispensers. We'll be happy to send you a free catalogue. Or see Bobrick, in Sweet's.

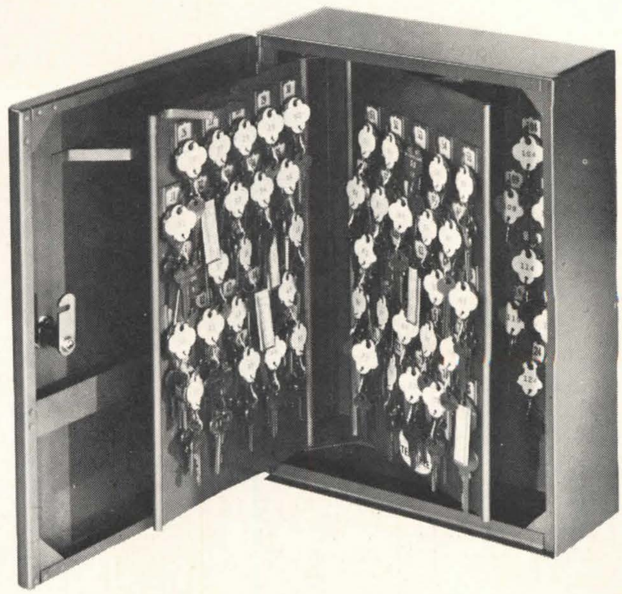
As usual, the architects' names aren't for real. But the gals' needs are.

Kimberly-Clark Corporation
Commercial Department Neenah, Wisconsin

KTX-189

On Reader Service Card, Circle No. 354

Take your pick



We hope you specified TelKee Key Control systems to your client—or else he'll be picking locks.

If he must account for 25 keys or more, it will pay him to use TelKee. So it will pay you to specify it.

The reasons are as important as those he has for keeping some people *out* . . . and letting other people *in.*

And the wish *you* have to protect his interests.

Write today for complete TelKee catalog. Dept. 1070

TelKee INCORPORATED

A subsidiary of Sunroc Corporation
Glen Riddle, Pennsylvania 19037 • Phone (215) 459-1100

SOLD NATIONALLY BY DEALERS AND PINKERTON'S, INC.
On Reader Service Card, Circle No. 374

Let's face it, Malaysian meranti doors impress people.

And that's a very good reason for spending the few extra dollars it costs to carve them.

These doors give your prospective buyer an impression of luxury from the moment he walks into your house.

It's not only that they're exquisitely carved. That's impressive enough.

But the big thing is, they're made of an exotic hardwood.

It's Malaysian meranti.

And that's very impressive. Because Malaysian meranti is basically a furniture wood. And looks a lot like its cousin, mahogany.

So these doors can give just the touch of elegance that often helps close a sale.

But, frankly speaking, we think Malaysian meranti is better than mahogany in many ways.

It's lighter in color. So it's easier to finish. Especially if you want to use a light stain.

Of course, the style shown here is just one of the many St. Regis door styles. We'll be glad to send you the catalog on all our Malaysian meranti and other fine doors.

And if you don't see what you want, we'll custom-build it for you. Impressed? Write us at Box 1593, Tacoma, Washington 98401.

FOREST PRODUCTS ST REGIS

On Reader Service Card, Circle No. 366

PROGRESSIVE ARCHITECTURE
OCTOBER 1970

EDITORIAL

"The correct appellation of a man capable of conceiving and building a structure is 'architect' " — Pier Luigi Nervi.

When building a structure was the architect's sole concern, registration that acknowledged his competence to provide for public health, safety, and welfare within that structure was a satisfactory cornerstone upon which to build professionalism in architecture. It is not that we must redefine the need for registration, or even to question its value. Its importance is obvious. But, we must rethink the concept that only the registered architect is an environmental professional.

When the majority of architecture school graduates do not choose to be registered yet work in the field of environmental design; when the definition of architecture no longer is limited to the art of building and hence to being "capable of conceiving and building a structure"; and when, as Mike Brill pointed out in P/A June 1970, the profession may have to set up special schools outside the existing schools of architecture to prepare the architecture student to pass his examination, based upon the protection of public health, safety, and welfare; then it seems that we need to question the meaning and place of the "registered architect" as the sole arbiter of "quality of environment."

Brill suggests that registration procedures will have to be enlarged and changed to include an increasing number of men who will not be registered in the traditional sense yet are vitally concerned with the quality and the materials of the environment.

He is not alone in his concern. Arthur F. Sidells, secretary of the NAAB and past president of the Ohio State Board of Examiners, states in his letter (p 6, YOUR POINT OF VIEW): "Everyone with a professional education and training should be designated as an architect . . . In my view the term architect needs to be applied to everyone in the design and direction or control of the construction of man's environment."

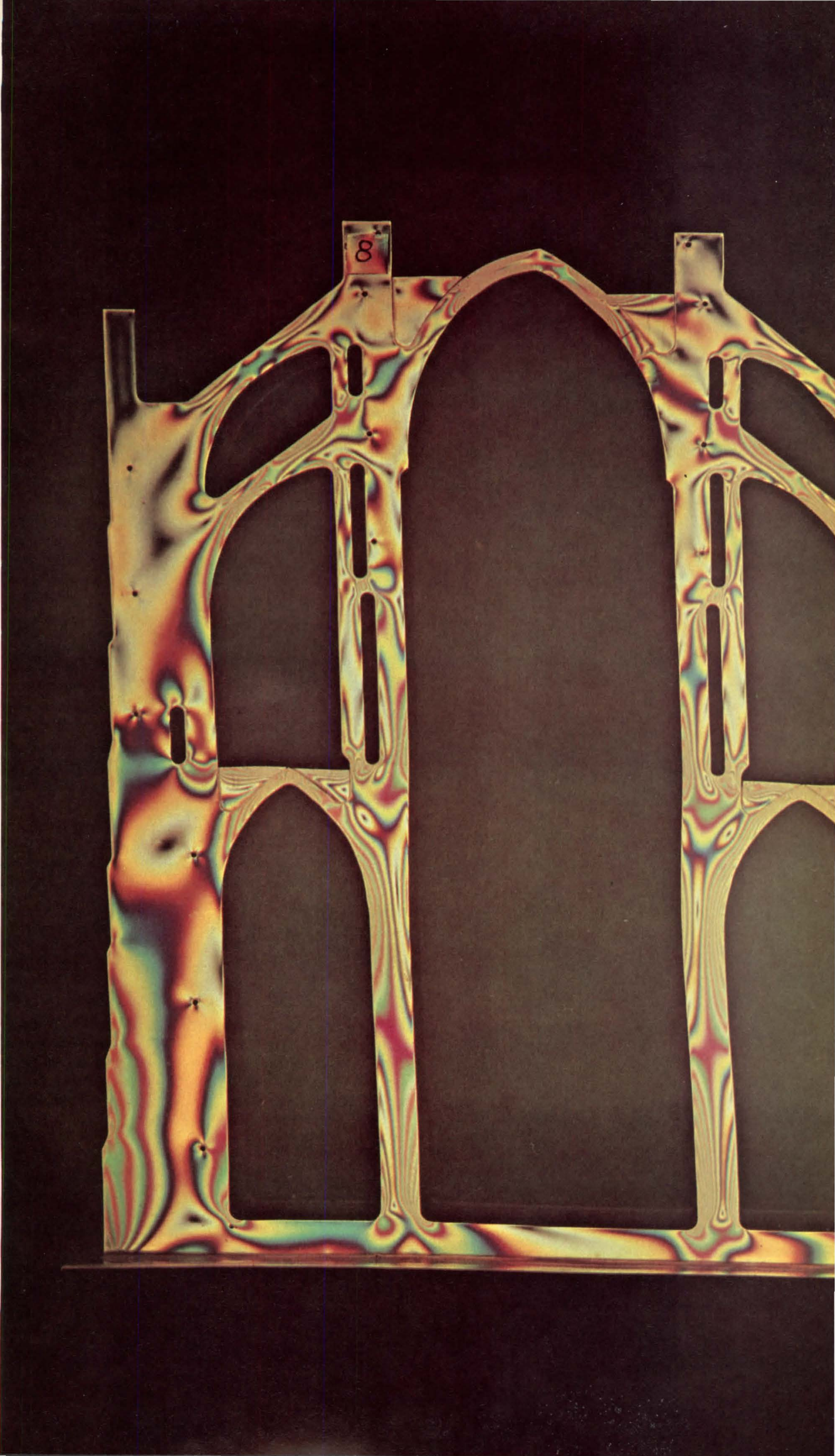
Under the dictionary definition everyone who designs a structure with taste, specifies its materials, and sees that it is built, is an architect. Registration denotes responsibility and culpability within a limited but essential range of responsibilities dealing with public health, welfare, and safety as applied to the building of structures.

We at P/A have long recognized the validity of the accredited architect, registered or not. The profession has broadened from the single building to the total environment. An architect conceivably could satisfy his registration responsibilities in the design of antisocial structures such as segregated, environmental polluting, or perceptually damaging facilities. It is, therefore, not a sufficient guideline to satisfy the standards of today's architect who demands an ethical commitment on the part of the profession greater and more binding than the obligation of public health, safety, and welfare.

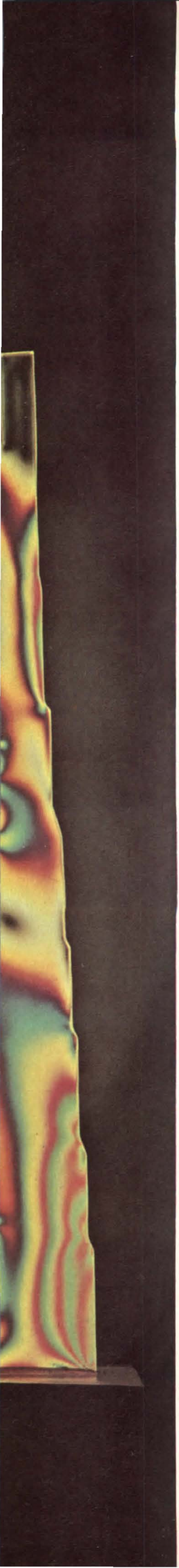
We agree with the statement of Sidells, "We need to enlarge our numbers rather than diminish them." The need is to include not exclude. Registered architects, accredited architects, interior architects, specifying architects, scientific architects, architect architects, and architects with funny hats, all 200-plus classifications of environmental designer delineated by the Princeton report on education and, perhaps, a few more have a place.

Instead of a few registered men responsible for public health, safety, and welfare, we believe the vast number of accredited architecture graduates dedicated to the quality of the environment should be recognized. If we expect these ever increasing numbers of people involved in our built environment to be professionally responsible for its quality, it is illogical to refuse them the title of professionals.

Forrest Wilson



Plastic model of Amiens Cathedral as viewed through special filters. Colored swirls indicate stress patterns. Photo: Fritz Goro-LIFE Magazine© Time Inc.



Ten years ago, when the editors of P/A developed their last major review of the man-made plastic *materials*, they believed that architecture was about to enter the age of plastics. Although the volume of this material used annually in building construction has increased substantially, we have not experienced the many exciting and innovative uses of plastics that were expected. However, there have been notable refinements in design and construction techniques, just as there continue to be misapplications and unabashedly obtuse designs. In the preparation of this current review, the editors sought the counsel of Professor Albert G.H. Dietz — of the School of Architecture and Planning at MIT — in developing an overall report on the state of plastics in architecture today. Professor Dietz contributed the introductory discussion as well as the look at the future revelation that concludes the issue. Armand Winfield, Plastics Specialist and contributor of the plastic house case study, was also a valuable consultant.

Plastics: A Decade of Progress

Plastics have come far in building since the time when they were used mainly as knobs for hardware and as small components for electrical switches. Growth of plastics in building has paralleled the growth of plastics in general, which has increase from 100-million pounds per year in 1940 to 18-billion pounds in 1969. For a good many years, the percentage of plastics output in construction has remained quite steady at approximately 20 to 25 percent. Although this amounts to perhaps 2 percent of the total present construction outlay, it represents rapid growth from practically zero in 1940.

Applications in building today may be conveniently classed as nonstructural, structural, and semistructural, and as auxiliaries to other materials, although these categories overlap to some extent.

Nonstructural Applications

Nonstructural uses make up the largest category in volume and number of applications. They are too numerous to be discussed in detail, but a few may be cited to illustrate their characteristics.

Illumination: Much of contemporary indoor and outdoor illumination is based upon the clarity, colorability, formability, lightness, and resistance to breakage of plastics — such as acrylics, polystyrene, and polycarbonate. Large luminous ceilings, large troffers and diffusers, and many varieties of shaped light sources are readily made of plastics. The vacuum-formed bubble skylight has become standard. Many of the large luminous signs, now so common, would be difficult to produce except in plastics. Breakage-resistant street lights and school windows are increasingly being provided by plastics. More such uses can be expected.

Piping: The chemical industry has long employed plastics to contain a variety of solvents and corrosive liquids. Not all plastics can handle all liquids, but frequently one can be found to resist attack by specific materials. For water supply, vents, and waste disposal in buildings and service lines, the use is growing as building codes and other constraints give way. Waste and vent lines are already commonly fabricated of plastics. Plastic water lines, especially hot water, have come along more slowly. Nevertheless, many successful installations exist. The principal problems facing plastic piping appear to be nontechnical, such as codes.

Insulation: Most plastics can be foamed, and many are used for thermal insulation, upholstery, packaging, and numerous other applications. For thermal insulation in buildings, plastics may be either prefoamed or foamed-in-place. Foamed-in-place plastics are most useful in irregular and hard-to-get-at spaces.

Floors: Plastic materials are standard for resilient floors. Polyvinyl chloride compositions are commonly employed as sheets and tiles, frequently with a thin foam backing for added resilience and comfort. Hard surfaces are provided by plastic-based terrazzo and other cast or troweled materials, which can be thinner than standard terazzo or granolithic surfaces.

Walls: For resistance to wear, tear, and soiling, plastic-based wall coverings, rigid or flexible, are commonly employed. Rigid materials are exemplified by the decorative high-pressure laminates whose integral melamine-formaldehyde surface is harder than conventional varnishes or lacquers. Flexible polyvinyl chloride film, textured and colored, or laminated to a printed sheet, and often backed with a fibrous or floc layer to promote adhesion, is commonly applied to plaster or wallboard; the latter often prefinished in the factory.

These are but a few of the many and growing uses of plastics in nonstructural building applications. Others include moisture barriers, electrical components and insulation, window frames and sash, hardware parts, and many others.

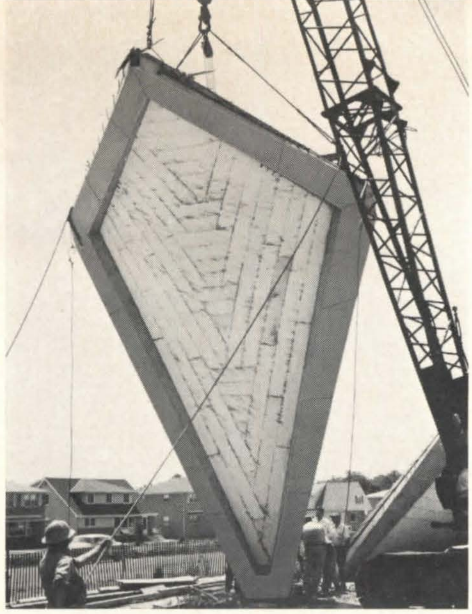
Structural/Semistructural Uses

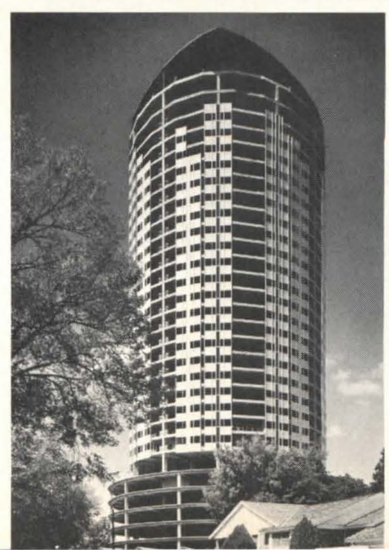
For structural and semistructural applications unmodified plastics are moderately strong but often distressingly lacking in stiffness. They must be combined with other materials of higher strength and stiffness into composite materials having properties superior to the constituents acting alone. Glass fiber, finer than human hair, is 100 to 200 times stronger than massive glass such as window glass, far in excess of the strength of structural steel, at one-third the weight. The fibers by themselves, however, are much too slender to be used to carry loads except as rope or cable. They must be stabilized, held in position somehow, if they are to be used structurally. Neither plastics alone, nor glass fibers alone, therefore, are of much use for load-bearing structures.

When the two are combined, with glass fibers embedded in a continuous matrix of plastic, the picture is changed drastically. The plastic matrix holds the fibers in position and allows their strength to be realized in compression as well as tension, the combination resists shear, and the fiber-reinforced plastic composite provides excellent structural behavior at a strength-to-weight ratio attractive for space vehicles. The composite material provides a combined behavior unattainable by the constituents acting alone.

These glass-fiber-reinforced plastics have found and are finding increasing use in building. Two examples, one almost historic by now, and one contemporary, may illustrate.

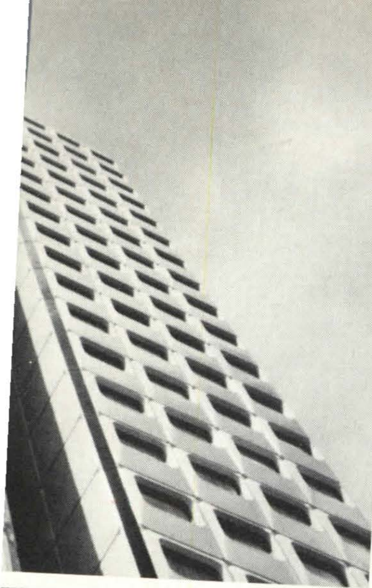
The "House of the Future" built approximately 15





Curtain walls of this apartment building are sandwiches with polyurethane foam cores and thin aluminum facings. Exterior aluminum is faced with polyvinyl fluoride sheet for weather resistance. Internal aluminum sheets are faced with polyvinyl chloride for color, texture, and wear-resistance.

Plastic pipe is light in weight.
(Photo: courtesy B.F. Goodrich)



Precast building section has polystyrene foam boards acting as portion of form and remaining in place as insulation and plaster base in finished building (far left). (Photo: courtesy Dow)

Outside wall cladding of high-rise flats for the Greater London Council are sandwich structures with outside facing of glass fiber-reinforced polyester coated with baked-on polyurethane finish, lightweight foamed concrete bonded to the facing with flexible epoxy bond, and interior facing of reinforced gypsum bonded to the core with bitumen acting as vapor barrier. Panels met all the performance requirements.

Brine-carrying plastic pipe is laid down for skating rink. (Photo: courtesy du Pont)

years ago in Disneyland, consisted of thin shells (approximately 0.3 in. thick) of glass-fiber woven-fabric-reinforced polyester, molded into an efficient structural shape and combined with floor sandwiches into a projecting monocoque "wing."

This lightweight building was visited by 20 million people during its 10-year life, was buffeted by 90 mph winds, and withstood several moderate earthquakes, for all of which it was originally designed. When it was finally removed to make room for another building, the building wrecker had great difficulty in tearing apart the adhesive bonded structure.

In London, the Greater London Council has recently completed several high-rise flats in which the idea of composite structures is carried still further. For the outside walls, instead of specifying explicitly the materials to be employed, it specified performance, i.e., resistance to wind, insulation against heat loss, acoustical behavior, fire resistance, minimum weight/thickness, and maintenance. The result was a composite panel with an outside shell of glass-fiber-reinforced plastic heavily loaded with mineral filler and given a baked-on outside finish, a core of foamed concrete adhesively bonded to the shell, and an inner layer of reinforced gypsum bonded to the core with bitumen. The panel met all test requirements, weighed 15 to 20 percent as much as standard construction, and was one-third as thick.

Plastics as Auxiliaries

Plastics are used as auxiliaries to other materials in a variety of ways, among them coatings, adhesives, and sealants.

Protective and decorative coatings are experiencing something of a revolution with the advent of plastics-based materials. Latex paints supplant conventional paints in many applications, lacquers are extended in usefulness and variety by the introduction of a number of plastic film-formers, synthetic resins and vehicles increase the range of properties available with varnishes, and coatings generally, baked or air-hardening, are being given increased durability and decorative possibilities.

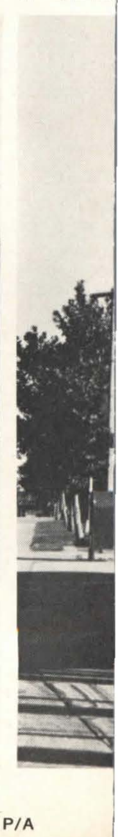
High-strength durable adhesives based upon synthetic resins have made possible the great increase in waterproof plywood, large laminated timbers for exposed locations, and other bonded wood applications. Similarly, strong engineering adhesives for metal, glass, and other hard impervious surfaces are based upon these polymeric materials. As more is learned about the principles of adhesion, greater use of adhesives in building, as well as in other fields, may be expected.

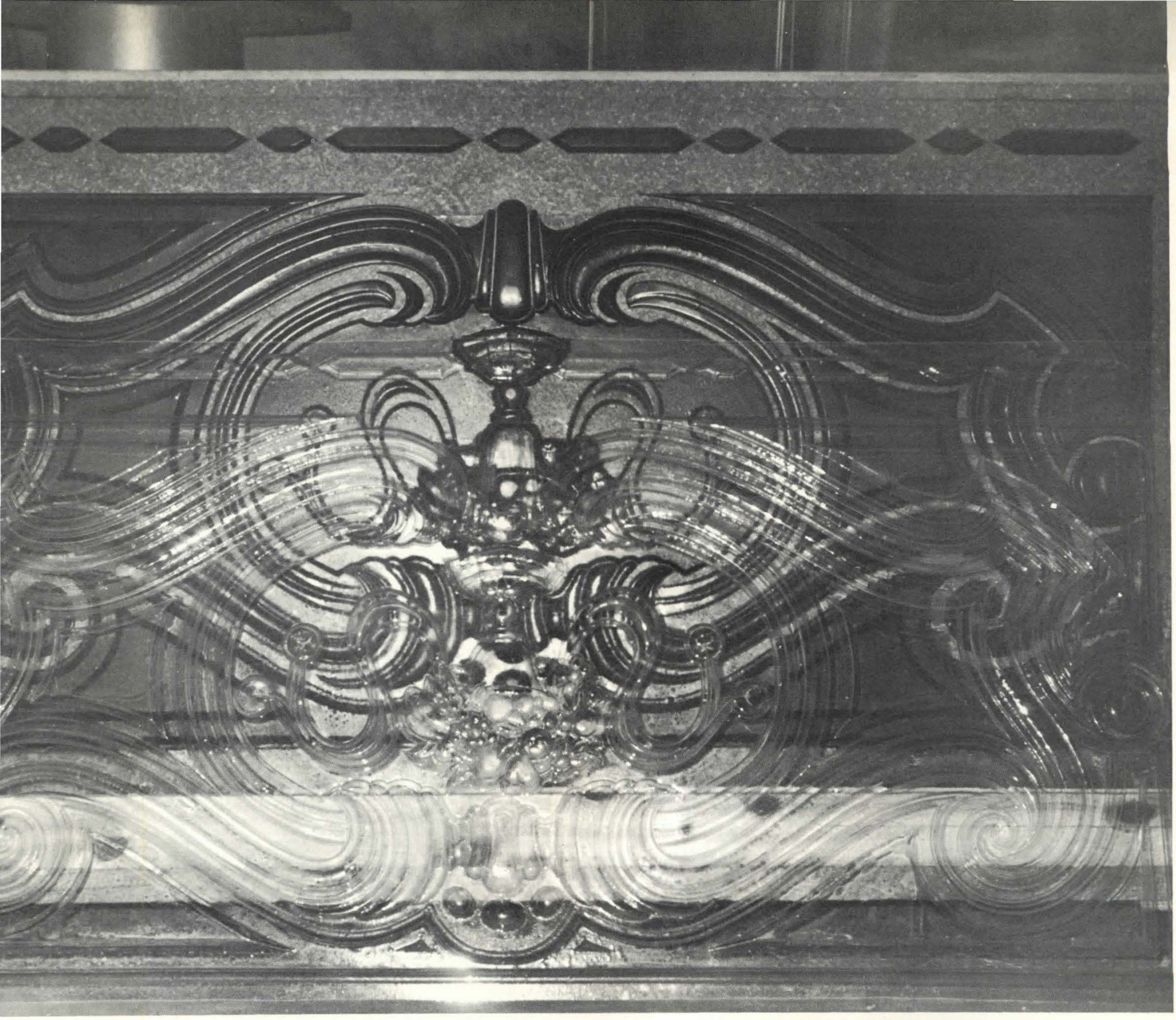
Sealants and gaskets for such exacting applications as large glass lights in metal frames, or concrete openings, are based largely upon synthetic elastomers. Joints between shop-fabricated panels are largely dependent upon similar sealants and gaskets for weathertightness.

Increasing familiarity with plastics on the part of the building fraternity, and building needs on the part of the plastics industry, should enhance the sound uses of plastics in the future, and add them to the palette of established materials of construction in the buildings of the future.

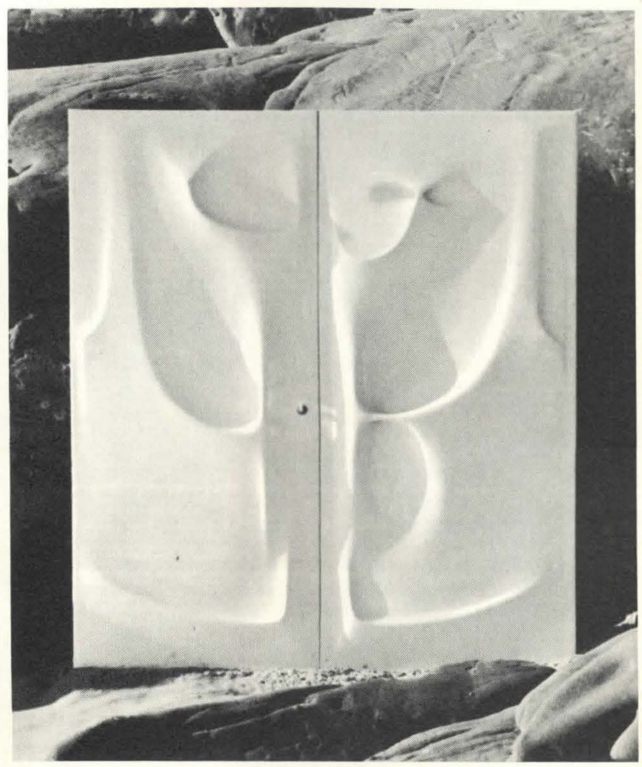
Pop art plastics turn up in everything from snack bars to bus stops. Plastic sign, above, also serves as the roof, while stone-patterned plastic sheets from the same sign company, Ad-Art, Inc., form the walls. Right, a vacuum-formed clear butyrate sheet is used to simulate the sharp definition of a neo-classic cut glass panel, used as part of the Edwardian conservatory movie set for "Hello Dolly." Below, is a bus shelter manufactured by Architectural Fiberglass Corp., while below, right, is one of 50 bus shelters manufactured by ABC Pre-Fabricated Structures Co. and erected throughout New York City in a test of the plastic for weather resistance and vandalism. Door, far right, is polyurethane foam with a fiberglass finish over a hardwood frame, designed by Svetozar Radakavich.

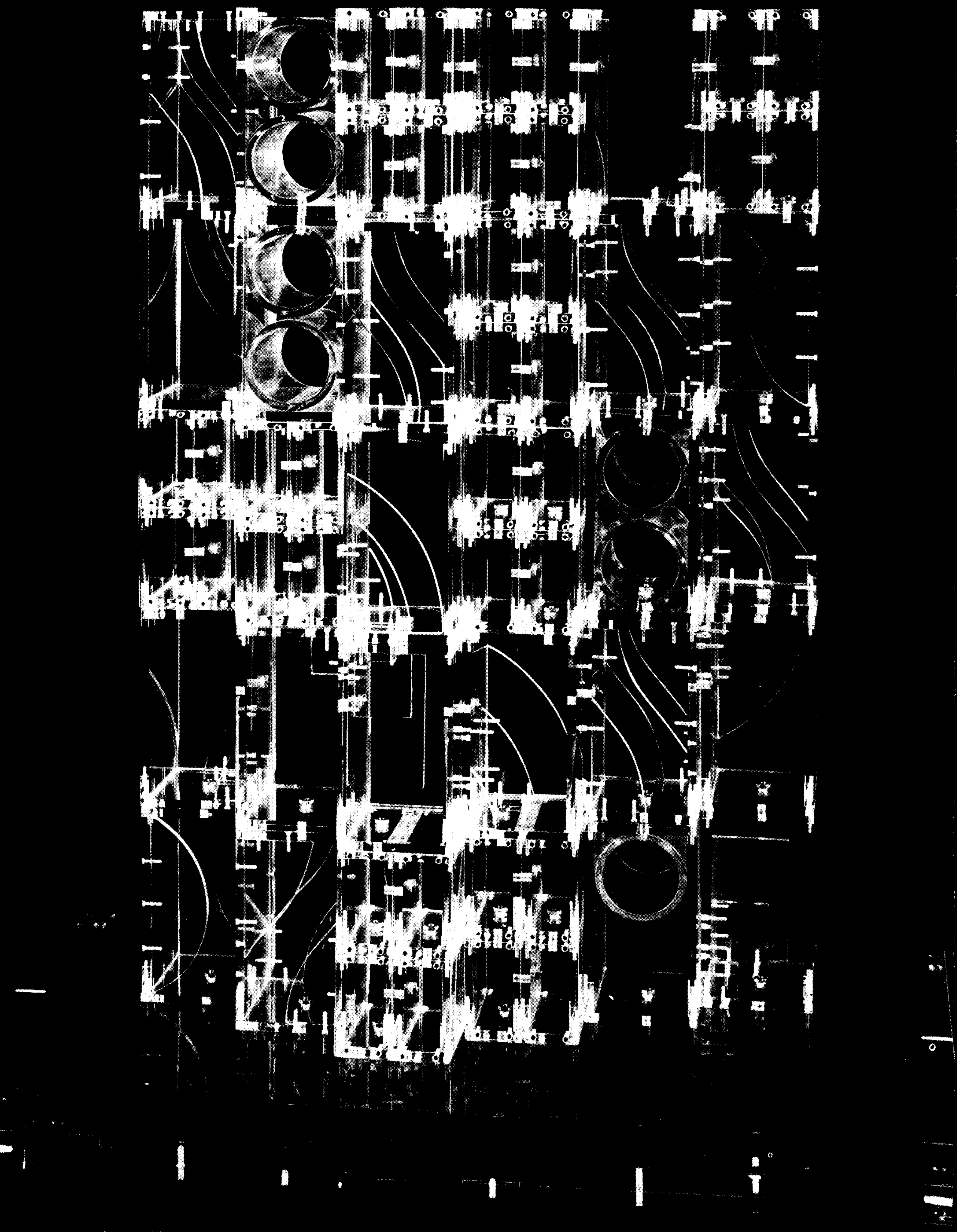
Photo below: courtesy Architectural Fiberglass
Photo far right below: courtesy Museum of Contemporary Crafts
Photos except as noted: courtesy Eastman Chemical Products, Inc.






44 TO 165 ST TERM-JAMAICA
68-272





Plastics: Properties and Potentials

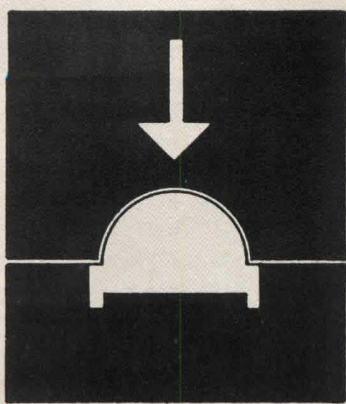
PROPERTIES OF 10 PLASTICS

Property	ABS Acrylonitrile-Butadiene-Styrene	EP Epoxies	PC Poly-carbonate	Polyesters	PE Polyethylene	PS, SAN, SBP, SRP Polystyrene	SI Silicones	UF Urea-Form-aldehyde	UP Urethanes	PVAc, PVAl, PVB, PVC, PVCAc, PVFM
Tensile Strength, psi	4000-8000	4000-30,000	8000-20,000	800-50,000	1000-5500	1500-20,000	800-35,000	5500-13,000	175-10,000	500-9000
Elongation, per cent	2-300	0.5-70	0.9-1.30	0.5-310	15-1000	0.75-80	— to 100	0.5-1.0	10-1000	2-450
Tensile Modulus, 10^6 psi	0.23-1.03	0.001-3.04	0.35-1.85	0.3-2.0	0.014-0.18	0.15-1.4	0.0009-3.0	1.0-1.5	0.01-1.0	0.05-0.6
Compressive Strength, psi	7000-22,000	1000-40,000	12,500-19,000	12,000-50,000	— to 5500	4000-22,000	100-18,000	25,000-45,000	20,000	1000-22,000
Compressive Modulus, 10^6 psi	0.17-0.39	—	0.3-0.45	—	— to 0.15	— to 0.53	—	—	0.004-0.1	— to 0.6
Flexural Yield Strength, psi	5000-27,000	1000-60,000	13,500-30,000	8000-80,000	— to 7000	5000-26,000	— to 35,000	10,000-18,000	— to 9000	— to 17,000
Flexural Modulus, 10^6 psi	0.20-1.30	—	0.34-1.20	— to 2.0	— to 0.35	— to 1.8	—	1.3-1.6	0.01-0.35	— to 0.4
Hardness, Rockwell	R75-M100	M80-M120	M70-R118	60(Barcol)-E98	D30(Shore)-R15	R50-E60	40(Shore)-M95	M110-M120	20A(Shore)-M28	10A(Shore)-M85
Impact Strength. ft-lb/in. notch	0.2-10	1.0-10	1.2-17.5	0.2-16.0	0.5-2.0 to no break	0.25-11.0	— to 15	0.25-0.40	5 to flexible	0.4-20 Impact strength varies with type and amount of plasticizer
Thermal Conductivity	1.3-2.3	1.2-8.7	0.7-1.5	1.2-7.2	2.3-3.6	0.3-1.0	1.0-3.8	2.0-2.9	0.5-2.1	0.9-20
Thermal Conductivity, Btu/ft²/in./hr/°F	39-73	3-55	10-37	7-56	56-195	19-117	4-167	12-20	56-112	28-195
Resistance to Heat, Continuous, °F	140-230	200-550	250-275	250-450	180-275	140-220	400- 600	170	190-250	120-210
Burning Rate, in./min	slow to self-extinguishing	slow to non-burning	self-extin-guishing	slow to non-burning	slow to self-extinguishing	slow to non-burning	none to slow	self-extin-guishing	slow to self-extinguishing	slow to self-extinguishing
Effect of Sunlight	none to slight yellowing	none to slight	slight color change	none to slight yellowing, embrittlement	unprotected crazes fast, weather resis-tance avail-able	slight yellowing	none to slight	pastels, gray	none to yellowing	slight
Clarity	translucent to opaque	transparent to opaque	transparent to opaque	transparent to opaque	transparent to opaque	excellent to opaque	clear to opaque	transparent to opaque	clear to opaque	transparent to opaque
Machining Qualities	good to excellent	poor to excellent	fair to excellent	poor to excellent	fair to excellent	fair to good	fair to good	fair	fair to excellent	poor to excellent
24-hr Water Absorption, ⅛-in. thickness per cent	0.2-0.45	0.08-4.0	0.07-0.20	0.01-1.0	0.01-0.06	0.03-0.6	— to 0.2	0.4-0.8	0.02-1.5	0.02-3.0

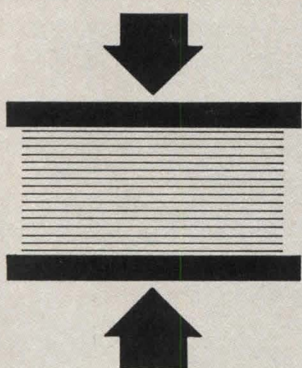
Many of the more ingenious architectural uses of plastics have been conceived by industrial designers who are more familiar with plastic materials and their fabrication processes than are architects. However, some changes within the architectural profession are indicated by the intense interest in plastics expressed by an increasing number of architects and architecture students who have a feeling for this material.

For plastics to come into their own as a material, architects must first educate themselves to the special properties and forming techniques of the 20 or more plastic families that now have architectural potential as shown in the accompanying chart.

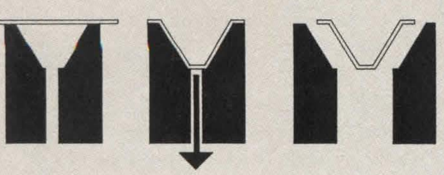
Also, a knowledge of the 14 processing techniques used with plastics would allow the designer more freedom in the application of plastics to architecture. Many of these 14 have



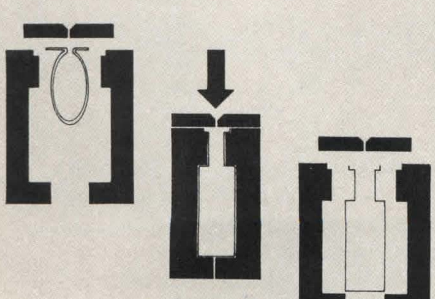
Compression



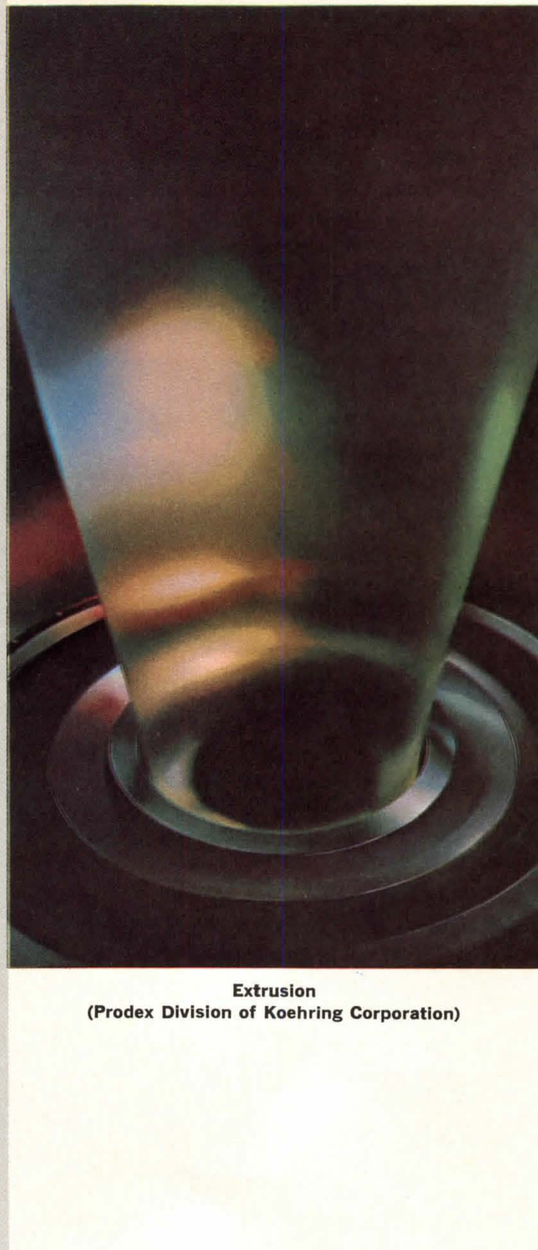
Laminating



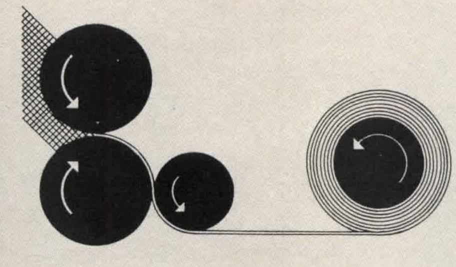
Vacuum Forming



Blow Molding

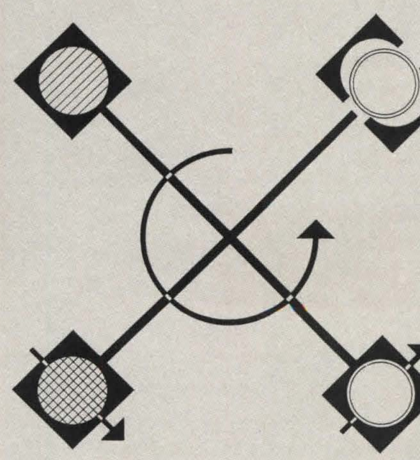


Extrusion
(Prodex Division of Koehring Corporation)

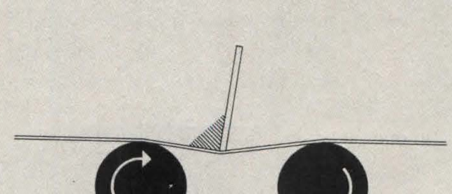


Calendering

Injection



Rotational Molding



Coating

Drawings by Forrest Wilson, *Interior Design* been familiar to us for years; a few require explanation.

Injection molding: Heated thermoplastics are forced into a cold mold.

Compression molding: Cold or preheated thermosetting plastics are placed in a hot pressure mold.

Laminating: A method of combining impregnated substrates into a solid integral sheet of either thermoplastic or thermoset plastic.

Calendering: Thermoplastic compounds are converted to film or sheet form, plain or textured, by pressing them between a series of warm, revolving rollers.

Hand lay-up: Room-temperature-curing thermoset polyesters and epoxies in association with glass or other fiber reinforcements are sprayed, brushed, or spatulated onto or into a mold.

Extrusion: Molten thermoplastics are forced through a shaped die at the end of a heating chamber.

Casting: Either thermoset or thermoplastics can be cast.

Coating: Thermosets and thermoplastics can be used as coatings.

Vacuum forming: Heated thermoplastic sheets are drawn over a mold by a vacuum from below.

Blow molding: A method for molding hollow thermoplastic items. A hollow tube, known as a parison, is extruded down into an opened, two-sided hollow cold mold. The mold is immediately closed around the hot, semimolten parison, nipping it closed at the top and bottom. An air jet is then blown into the parison, expanding it to the configuration of the mold.

Rotational molding: A relatively new molding process for thermoplastics. The molding machine consists of two or three arms extended outward, like spokes from a carousel. These arms are moved consecutively from a loading/unloading chamber to a heat chamber, then to a cooling chamber. As an arm enters each of these chambers, the mold attached to the arm is rotated. The thermoplastic adheres to the walls of the mold, forming a hollow object without internal stress, because the mold has no single orientation.

Fabricating: All plastics can be fabricated by one or more of the following methods: machine operations, heat sealing, cementing, welding, or spin welding.

Filament winding: A new method for producing glass fiber-reinforced thermoplastics (page 104 for discussion and illustrations).

Finishing: All plastics can be finished by at least one of these methods: polishing, texturing, embossing, sand blasting, vapor honing, acid etching, printing, silk screening, painting, spraying, roll coating, branding, vacuum metallizing, electroless plating, or combinations of these techniques.

Recent Plastics Applications

Although many new architectural applications of plastics have been found during the 10 years since P/A last did a plastics issue (June 1960), no new families of plastics with architectural potential have been introduced. Great advances, however, have been made in the applications of polycarbonate, polyvinyl chloride, urea-formaldehyde, and plastic additives to concrete.

Polycarbonate: This plastic is giving acrylics a run for the money. A tough, shatter- and wear-resistant material, not so hard as glass, with good transparency (87 percent light transmission), it is available in colored or clear sheets. One of its interesting properties is that it can be cold formed, retaining whatever shape it is bent to. It also can be vacuum formed. Presently, its primary use is as a glazing material.

Polyvinyl chloride: In sales volume, this is the fastest growing plastic in the building products industry. More building applications have been found for it than for any other plastic. Because of its excellent weatherability and high compressive, tensile, and flexural strengths, it has many uses as soffits, fascia panels, siding, flooring, window frames, and cold-liquid piping. Because its strength is quickly lost in heat, it is used in lighting fixtures that are designed to fall out and expose the sprinkler system in case of fire. One company is experimenting with making hollow bricks of this material for low cost, quickly erected housing. Polyvinyl chloride can be molded by any of the thermoplastic processes.

Urea-formaldehyde: An old material first used in this country in 1929, it has recently been introduced as a foamed-in-place insulation (P/A Aug. 1968, p. 52) with excellent thermal and sound insulation qualities. It can flow into odd-shaped spaces, around wires and piping, and can be troweled before setting. There is no further expansion after the material leaves the applicator gun.

Plastic mortars: A combination of epoxy, resin, a hardener, polymeric emulsion, and portland cement, this mortar exceeds the tensile and compressive strengths of concrete. It bonds concrete, clay tile, or brick so that the joint becomes stronger than the material itself. Manufacturers of the mortar claim its use can effect cost savings up to 30 percent in masonry wall construction.

Plastic impregnated concrete: Recently developed at the Brookhaven National Laboratories, this plastic, irradiated concrete is said to be four times as strong as concrete, with double the life span.

Because it is impermeable to water it is better able to withstand freezing and thawing. Called concrete-polymer, it weighs 7 percent more than ordinary concrete, and at present costs about twice as much. It is manufactured by soaking a 28-day cured, heated concrete slab in a liquid resin additive, while the slab is in a vacuum chamber. Taken out, the soaked slab is cured by irradiating it with Cobalt 60. Currently the material is being field-tested in a California irrigation system, but eventually it could be put to many uses in the building industry.

These materials hold much promise for the future, but without architects to apply them to new uses they will be either insufficiently used, or used merely as substitutes for other materials. However, many ideas for potential, creative uses of plastics in architecture are around; few have yet been realized.

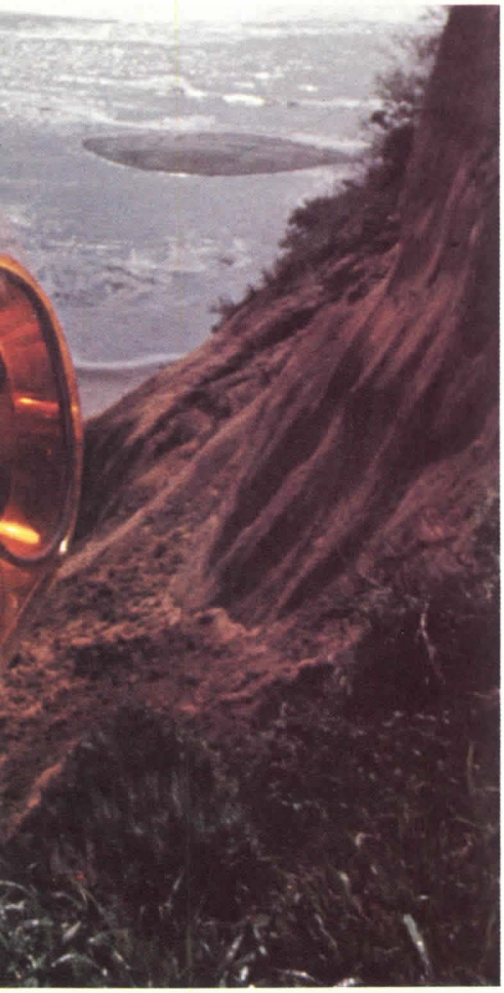
1

See-Through Shell House

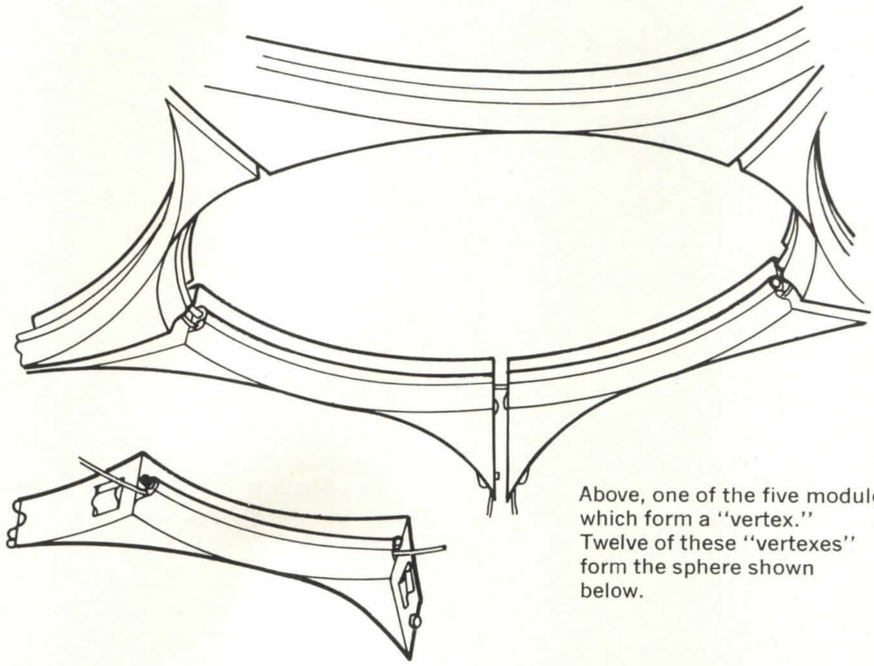
The lightweight plastic house, mounted on a single concrete column, is adaptable to almost any site (photo above). Circular floors provide a total of 1900 sq ft.

Photos: David Duffin

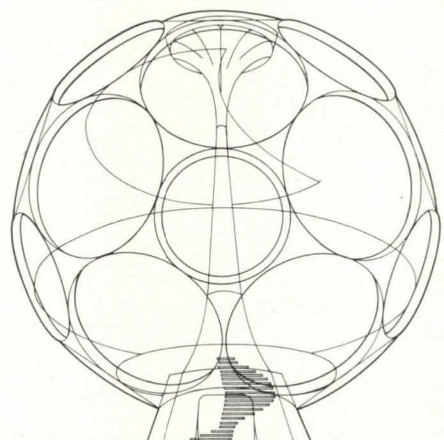
Plastics: Four Steps to the Future



Shown on the following pages are four projects that use plastics as plastics.



Above, one of the five modules which form a "vertex." Twelve of these "vertexes" form the sphere shown below.



This plastic structure by Philo Farnsworth III is modularized so that a complete sphere can be built with 60 identical modules as shown on the accompanying drawing. The modules are either filament wound or stress-jig woven fiberglass. Five modules form a "vertex" (drawing), and 12 vertexes comprise a sphere.

The round spaces between the assembled modules are filled with "lense assemblies" that are fabricated from two polyester-film discs bonded at their periphery to a wire cable. Once sealed in place between the modules with epoxy adhesives these balloon-like components are pressurized, stretching the plastic to a smooth lense shape. As these lense assemblies inflate, the peripheral cables are put in tension, binding the whole structure together. The hollow modules are then filled with foam.

The completed structure is supported by a central column of filament-wound fiberglass "barrel" modules held in a stack with compression rings. The foundation is cast-in-place concrete. Through the central column flow all mechanical functions.

Within the sphere, floors are cantilevered from the column. Ten pie-shaped modules form each floor. These modules are supported by plastic beams circular in cross-section. A special panel system has been developed for use as partitions.

Spatially, the house is 36 ft in diameter. The utility floor is 22 ft in diameter, while the primary floors are 32 ft across — allowing a total floor area of 1900 sq ft. Entry is through the core. Present cost estimates run about $2.50 per sq ft.

Major attributes of this house are low cost, excellent thermal characteristics (because of a silvered exterior surface), good acoustic isolation, rapid erection, and shipability of the small modules.

2

Single-Module System

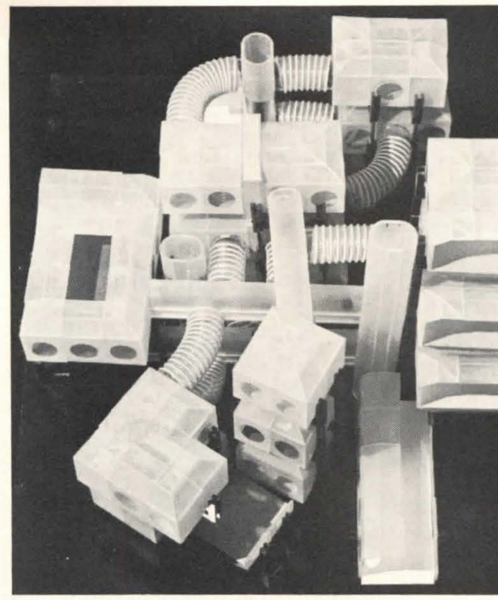
Architect Sam Davis' system is constructed of fiberglass and polyurethane sandwich panels. This allows one C-shaped element to act as part of the floor, wall, and ceiling. All enclosure components are made from this "C"; therefore, only one molding process is required. If extended-length rooms are desired, a U-shaped element is added to the modular repertoire.

Four units bolted together form a soft-edged box. If other shapes are desired, the "C" is cut at the factory to make either interior or exterior corners. On the site, doors and windows are cut into the rooms at the user's discretion. Once the punctures have been made, a vinyl gasket secures the acrylic window and provides weatherstripping.

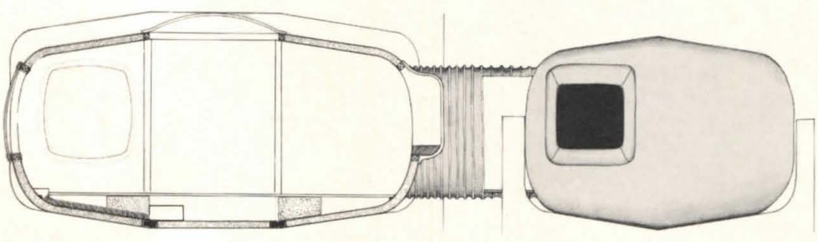
In production, two molds are used; one for the outside and one for the inside skin. The outside skin has a slight wave in it for rigidity. The space between the two skins is filled with a low density polyurethane foam. Present cost projections figure at approximately $4 per sq ft for the completed room unit.

Each room of a dwelling is connected to the others by flexible hallways. By reconnecting hallways and rooms, many spatial variations are possible. The fixed elements are the stairs and mechanical cores which carry services vertically. Horizontally, electric services run through the units' subfloors and the hallways.

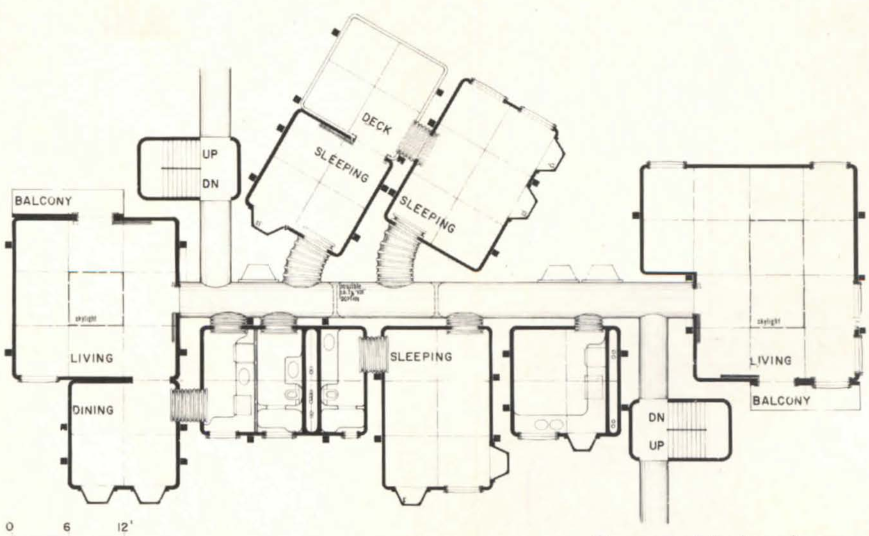
To facilitate shipping, the "C" elements stack easily.



Flexible corridors carrying all mechanical systems connect boxes formed by bolting together four C-shaped modules.
Photo: Sam Davis

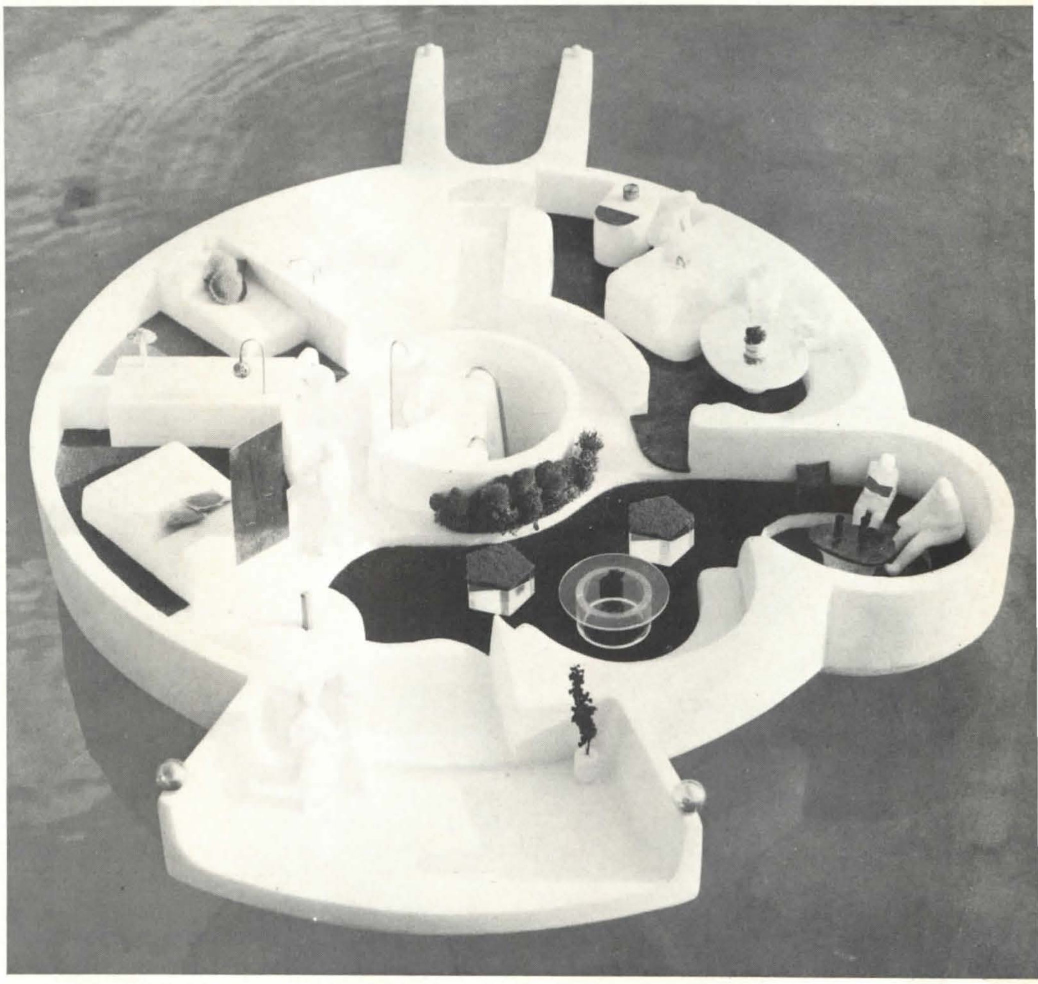


One possible floor plan.



One possible housing complex.

3
Floating House



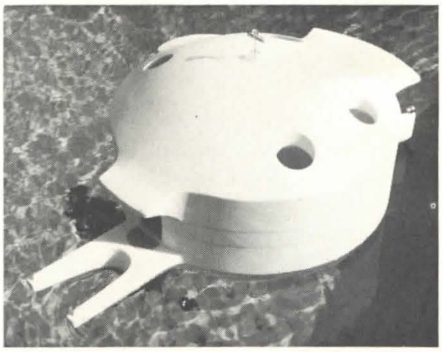


Photo above shows bottom half of house; complete form appears in photo at left.

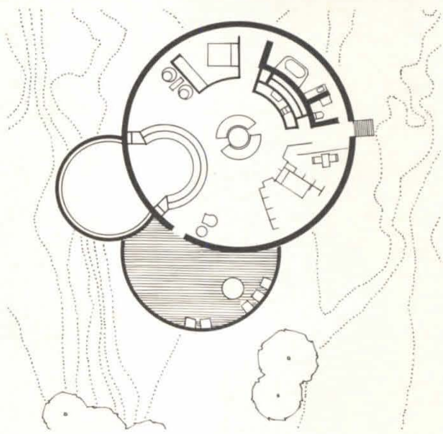
Unlike houseboats, rigid urethane, amphibious structures will not be restricted to the limitations of either house or boat building. Rigid urethane permits shapes, forms, structural units, and integrated concepts not presently feasible with the major materials. It is a flotation material impervious to the elements, and it is an insulation material which can be formed in many densities for construction of architectural shapes of varying stresses.

An amphibious structure such as the one shown, designed by Domenico Mortellito, could be constructed with molding, extruding, and casting processes incorporating insulation, acoustical, lighting, and structural factors. Formed in two molds — one for the top, the other for the bottom — the two sections could be bolted together.

The material itself has few drawbacks. It can be made fire retardant. It is strong, lightweight, resistant to temperature, has no grain, and is translucent in thin sections. When exposed to sunlight, it turns from white to amber without degrading. It can bond with itself, and be finished in many textures and colors, or it can be coated with another material.

Even if the future migrations of man are not into the seas, the strength, weatherability, and lightness of rigid urethane make it an excellent material for use on land.

4 Experimental Plastic House



For a Swedish group that wanted to explore the residential uses of plastics for industrial production, Architect Staffan Berglund designed an experimental house that utilizes plastics in as many discoverable ways as seemed economically possible. The client group ultimately expanded its minimal goal, and when they built the house as a vacation retreat on the island of Torö, they added a swimming pool.

Architect Berglund feels strongly that "in a time when automobiles and mobile homes are made with the maximum use of industrialization, the building industry is medieval." He therefore took the opportunity to explore systematic planning for and the functioning of various lifestyles. He hoped for a synthesis that would make industrialization of residential components easier in the future.

The ultimate objective was a small, lightweight house that could be produced as a single volume, would sit straight on the ground, and would simply have holes cut into it for doors and windows. However, the largest achievable plastic unit was a separate, domed roof, which covers about 2000 sq ft. It is composed of 20 pie-shaped plastic wedges, which, in section, have one 1/16-in. thick layer of textured, glass fiber, reinforcd plastic on each side of a 4-in. core of hard-foamed PVC plastic.

At the periphery of the dome, both the amount of glass fiber reinforcement and the density of the core are increased. At the center is a double layered, acrylic dome skylight above a compression ring. No materials other than plastics are used in the dome construction. The wedges are designed simply to lock together and be sealed with a plastic coating.

The pie-shaped roof units were manufactured at a plastics factory, stacked, trucked to the site, and folded out, like a flash-bulb reflector. Dimensions of the mold were determined by the transportation regulations of how large a unit could be trucked. Professor Thorkild Rand of the Division of Aircraft Structures at Sweden's Royal Institute of Technology was the consultant on the dome structure.

To support this plastic roof, steel columns on the perimeter are embedded in a concrete slab. Both to cut the size of the columns and to avoid glare and reflections in the glass, the steel columns and the enclosing glass wall are raked.

Within the house, Architect Berglund has arranged several different gradations of separation or rooms-within-rooms as the concept of the interior planning. At the open end of this range, the conversation pit in the living area is symbolic. At the most closed end of this scale are several completely separated capsules — with plastic walls and roofs — which sit secluded within the dome for use as bedrooms and bathrooms. The complete separation controls scents, heat, and humidity for each area. The bedroom, which the architect calls "an overdimensioned bed box," can be opened up to the major space by means of wide doors.

Separation of another degree is used in the kitchen alcove. It is roofless but enclosed by plastic wall elements that are 7-ft high, U-shaped, reinforced plastic units. These units are also used as partitions, wall dividers, and screens and, in addition, the U-shaped recess can accommodate shelving for books and objects, can be made into closets, and when cut, can be made into tables and chair frames.

Finally, a third degree of separation is a corrugated plastic wall — "like corrugated paper made out of

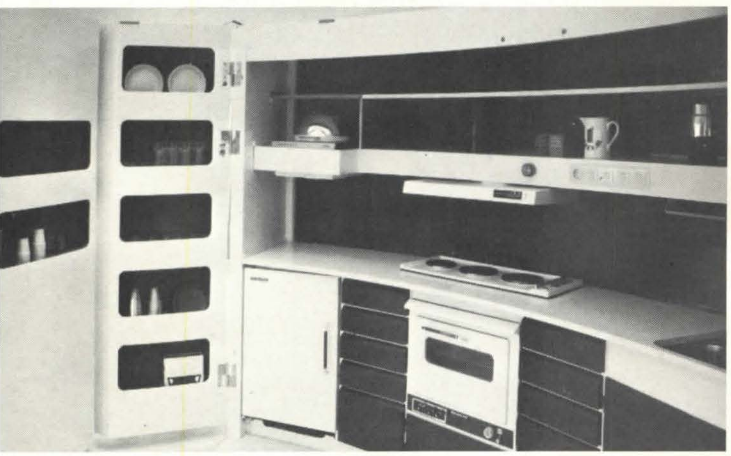
Photo, left, shows the conversation pit which is sunk into the living area. A portion of the "bed box" can be seen at the right of the photo.

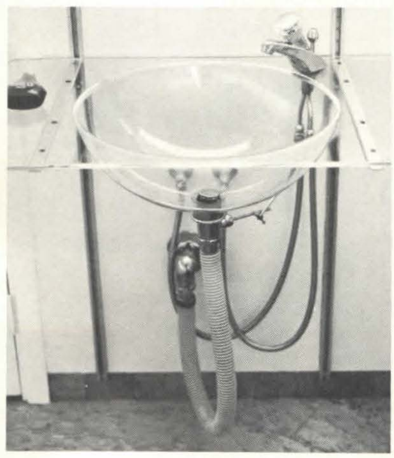
Plastic partitions, 7 ft high, separate the kitchen area from the living area (photo, lower left).

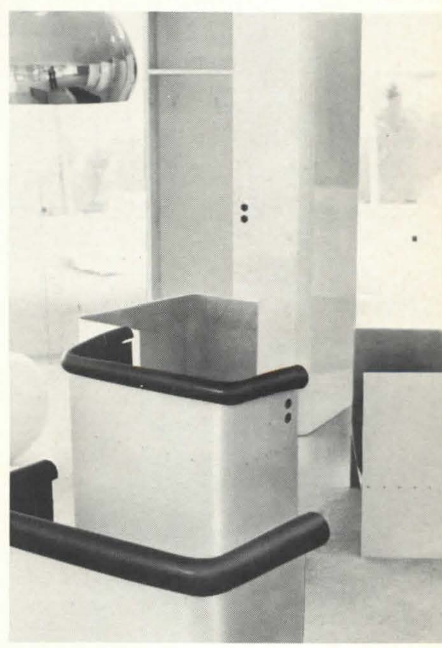
A clear acrylic sink installed for aesthetic rather than practical reasons is shown in the center photo.

Photo below is a detail of the electrical control panel in the conversation pit.

Seating, designed by the architect, is shown in bottom photo.







plastic" — which can be attached to other walls or to itself by means of magnetic plastic strips.

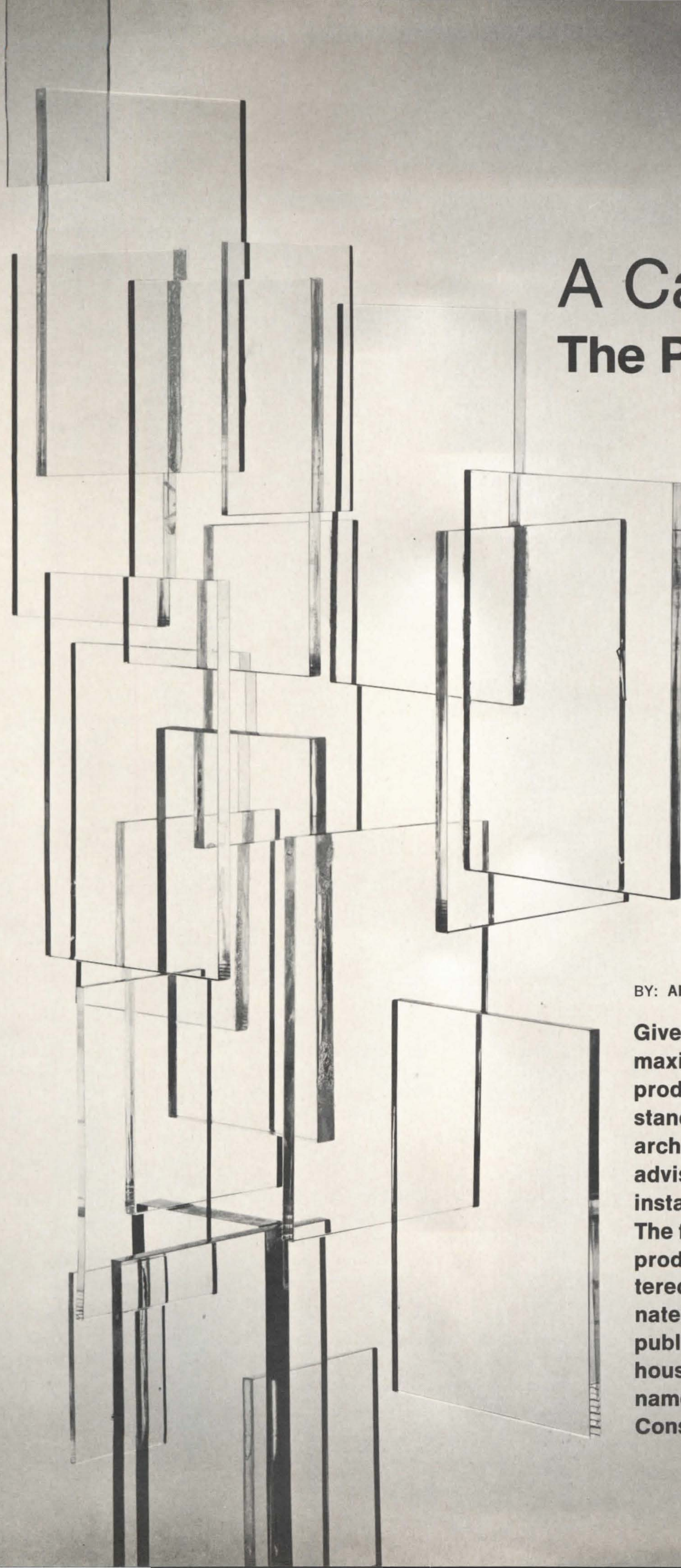
Other areas that received Architect Berglund's analysis and design experimentation were the outdoor terrace and the lighting and audio systems of the house.

What Architect Berglund has achieved, he admits, "has nothing to do with low-cost or low-income housing." This is purely an experiment — and not even a prototype for an industrialized house, since the clients do not have the funding and, in any case, are not in the building industry.

So what has been achieved is one more carefully analyzed, carefully planned, interestingly detailed, custom house. Unfortunately, as with all past houses in this category, the care and analysis and solutions will be largely lost. Other architects will again go over the same ground and reinvent the same architectural wheels with the same enthusiastic sense of discovery.

Surely the field of architecture could be organized enough to establish a central and readily available memory bank of learning and data against the time when the weight of that evidence alone may indeed break through to the manufacturer of well designed industrialized housing.

Architect: SAR Staffan Berglund; associates — Ove Ericson, Jan Dranger, and Johna Huldt. **Consultants:** Structure — Prof. Thorkild Rand; Electrical — Ing. Hans Ferm; Ventilation and plumbing — Overingenjor Jan Holmberg; Lighting — Ark. SAR Anders Liljefors; Acoustics — Ove Brandt.



A Case Study:
The Plastic House

BY: ARMAND G. WINFIELD

Given a program requiring the maximum utilization of plastic products in the construction of a standard wood-frame house, the architects asked the author to advise on applications and on-job installation of plastic materials. The following is an account of the products and problems encountered in that installation. Unfortunately, the client specified that no publicity photos be taken of the house. Therefore, it must remain nameless. The author is a Plastics Consultant in West Babylon, N.Y.

Most architects specify plastics only if these materials improve performance, meet existing codes, and lower costs. The architect who initiates a new, untried material and works it into a project is rare. Content to specify tested and approved materials regardless of the freedoms that plastics offer, he often fails to realize that plastics are acceptable in the locality where his structure is to be built.

The contractor must use what the architect specifies, but he, too, will often resist using a new material: his men do not know how to handle it, or it is not really so good as a more familiar material, or it is too expensive, or it is not readily available.

The workmen — carpenters, plumbers, electricians — reflecting the attitude of their contractor/employer, will emphasize the poor quality of plastics as they misuse and abuse them.

What do plastics have to offer the building profession? Most important, they release the architect and builder from the conventional confines of modules, and from restrictions of the senior materials (wood, metals, concrete, etc.). Most plastic building materials are lightweight, strong, tough, and formable. Some have excellent light transmission; others low stiffness moduli. Plastics are durable, fire-resistant, and colorful. Some have good resistance to weathering, others, excellent insulating properties, and still others can be used as additives or in conjunction with conventional building materials.

Conversely, plastics are expensive; they do not have fire-heat or fire resistance, are often toxic emitting heavy smoke when burned, and their weight-to-strength ratio compares unfavorably with steel or aluminum. Permanence or durability or both are unknown quantities when compared with well-known building materials, and property changes often occur in plastic materials over periods of outdoor exposure.

The facts that plastics are scarcely a century old, that they are chemical, that many and varied changes can occur in their manufacture, and that innovations of new raw materials are growing faster than production can absorb them all tend to add turmoil to confusion. With this growth of the plastics industry, and the ever-changing materials and their properties, testing is a problem. The establishment of meaningful standards for plastic materials' properties is both mandatory and long overdue.

The material's suitability for an end-use in building is many times overlooked in favor of no use at all. Failures set back the industry further than do testing delays. New uses of plastics have no precedence and must be job-tested.

Where then, are plastic materials used and where are the big growth potentials? For every dollar spent in new building today, over $1.30 is spent on the maintenance of buildings already constructed. Since less than 5 percent of building materials used are plastic, and 130 percent is spent on maintenance and repair, indications point to failures in the senior materials or in the method of construction or both. The senior materials and building technologies need revision and revitalization.

Despite the success of plastics as materials, man has failed to conceive or to accept plastics as plastics. In building, as in almost every other use, he wants plastics to resemble or duplicate the senior materials in appearance and cost, yet outlast them, with little or no maintenance. Plastics are seen only as substitutes and thus forced to meet standards comparable to those for materials they replace.

Those in control of building are influenced by union pressures that keep prices rising and by the senior-materials' lobbies that keep outmoded building codes alive to preclude the acceptance of rival products. Another major stumbling block in America are the power tactics of the unions that make it almost impossible to introduce new materials, methods, or ideas without making it economically difficult, if not impossible, to use them. Still another fault lies in the public's lack of trust in new materials, while the visionaries can make only slow inroads into the areas of public interest and public taste. Plastics, however, are here to stay. They are the truly exciting materials of today, and if we explore further, we will find, by using them, solutions to many of the problems man needs to resolve.

How is a new plastic material used, and how is a series of uses introduced? The following case history exemplifies some of the problems and their solutions.

The Client Specifies Plastics

In 1960 while in Germany, our client visited Dynamit-Nobel A/G[1] where he saw their experimental Kunststoff-Haus. For the past decade he had wanted to build a vacation house using plastics, and in 1968, when he finally retained an architect to plan his house, the basic criteria were to use as many plastic materials as possible. He provided an ample budget for this project, and a site in a sparsely populated area where building codes were virtually unknown.

Since the specifications required "as many plastic materials as possible," and plastics were out of their normal realm of materials, the architect retained our consulting services.

It was a rare opportunity. An ideal situation — it would be living research — a real chance for plastics.

What do plastics have to offer the building profession?

A rare opportunity for research... a real chance for plastics.

Two bathtubs added two tons to the second floor.

Although the client wanted a new concept in building, he was, in effect, quite conservative, and the architect knew he would be unhappy in an unconventional house. A compromise was made whereby standard slab and frame construction would be used, but almost everything else would be of plastic material.

While the architect was working out plans and details, our task as consultants was to provide a choice of plastic materials to meet the client's needs and tastes. We gathered existing materials and made available new materials or material concepts, some having been developed in our laboratory, while others, from major suppliers, were "advance" materials not yet available on the open market.

The client and architect visited our laboratory to become familiar with the materials and here the client got ideas for other uses. For example, he asked if the "cultured" marble used for vanity tops and fireplace facings could be made into a form-fitting, specially contoured bathtub. We suggested, instead, purely textural, filled polyester that did not resemble any given material, and were then asked to make two tubs — regardless of weight or bulk — one for him, one for his wife. Because each tub would weigh about a ton and hold almost another ton of water, it became necessary to design a framework capable of supporting the additional four tons.

Where Plastics Were Specified

Having visited Kunststoff-Haus myself, its contents and limitations were familiar and our recommendations for this house included some of the Kunststoff-Haus concepts. The following is a list of plastics applications for the client's house:

Polyethylene tarps: Placed under slab to retain moisture; vinyl water stops placed between concrete slab and foundation walls. Concrete cellar to be impregnated with siliconates to prevent ice formations during winter months; exterior concrete foundation wall to be either sheathed in vinyl or coated with liquid urethane.

Load-bearing framework: The high-rise elements and basic supporting structures to be made of steel beams covered with welded vinyl skins to preclude oxidization; secondary beams to be made of wood saturated and sealed with liquid urethanes for rot and termite protection.

Roofing: Foamed styrene, covered first with aluminum foil, then bitumen, and, finally, gravel.

Glazing: Polycarbonate[2] set quarter-blocked in wood or vinyl frames, calked with silicones;[3] skylights of acrylics.[4]

Lighting: Acrylics and vinyls throughout.

Insulation: Foamed styrene[5] as wall, floor, and roof insulation; foamed-in-place urethanes[6] in areas difficult to reach.

Pipes: Polyvinyl chloride[7] for drain, waste, and vent, hot and cold water; butyrate[8] (cellulose acetate butyrate) for oil.

Floor covering: Prewelded vinyl over foamed vinyl (as used at Kunststoff-Haus).

Ceilings: Acoustical urea foam.[9]

Wall covering: Melamine laminate[10] (melamine formaldehyde), vinyl, "cultured" stone[11] (filled polyester and epoxies), ABS[12] (thermoplastic acrylonitrile-butadiene-styrene copolymers).

Kick plates: "Cultured" stone, ABS.

Exterior siding: Extruded PVC clapboards.[13]

Water closet: Conventional bowls, ABS water tanks.[14]

Shower Stalls: Prefabricated FRP[15] (fiberglass-reinforced polyester).

Sinks: Acrylic.[16]

Vanity tops and fireplace facings: "Cultured" stones (marble or granite).

Counters, table tops: Laminated melamine (as used in Kunststoff-Haus).

Calking: Silicones.

Paint: Acrylic emulsion,[17] urethane.[18]

Folding doors: Rigid and flexible vinyls.

Internal partitions, doors: Glass-reinforced polyester sandwiches over rigid urethane core.

Patio: Floor; "cultured" granite. Windbreak; cast polyester (decorative).

Wiring: Polyethylene[19] covered.

Electrical fixtures: Phenolics,[20] melamine, ureas[21] (urea formaldehyde).

After the materials had been tentatively approved, the client had some afterthoughts. He wanted a totally winterized, indoor swimming pool in the basement. The pool was to be made of concrete, lined and coped with "cultured" marble, and edge-lighted with acrylics.

We worked with the architect first, outlining the limitations of those materials we recommended, and then obtained samples of the materials in various colors and textures for the client's examination. Those items that needed to be prefabricated or manufactured (tubs, sinks, etc.) were initiated in our shop together with samples and tests on other materials and material combinations.

The Contractor Is Chosen

A contractor was finally selected but he, too, was totally inexperienced in working with plastics, which necessitated our supervision of all plastic material installations throughout the house. Although the contractor had built exotic residences, this project was an unknown quantity, and he was unable to give actual estimates on time or materials. To further complicate matters, the local unions insisted that their men work on the job although none had ever before handled plastics. In fact, the carpenter's union local went so far as to "claim plastics," since no other local had jurisdiction over them.

While the contractor was working on land preparation and getting ready for our first field session of using plastics in the foundation, we were setting up our laboratory as an area to develop the tub, sink, and other prefabricated units. We would build the fiberglass-reinforced polyester shower stall, some of the internal partitions, and the patio windbreak. We would also import and pretest acrylic sinks and ABS water closet reservoirs.

Normally, a flat slab would have been poured in the foundation excavation, but since a swimming pool was now to be added, the foundation would be delayed until rock was blasted to accommodate it. Pool experts were imported to supervise this work; then basic foundation slabs were laid peripherally to the pool cavity. Polyethylene tarpaulins were laid over the ground on which the concrete slabs were to be poured. Siliconates were added to the concrete and it was poured by normal methods.

An extruded flexible PVC water stop imported from Denmark was placed between the floor slab and the wall forms. Inside the exterior wall forms were placed sheets of light green vinyl extruded in Italy. These extrusions have T-shaped extensions so that the concrete can lock around them. The flat side of the extrusion was placed against the inside of the external wall form. Since the extrusions were limited to 12 in. in width, they had to be prefabricated to fit the forms on the site. Although we had worked to the architect's details in our shop, almost every prefabricated unit had to be retailored on site to fit; even the carpenters would never take a dimension from a print: "Always take it off the wall to be sure."

When we began to place the sections of cut and cemented vinyl sheathing into the wood concrete forms, each section had to be tailored to fit the molds. We had welded the sections into sheets 4′ x 12′ — the height of the basement walls inclusive of the swimming pool areas. Following the prints, we knew just how many 4-ft sections would be needed, or just how many would be needed in lesser widths, so that they could be snapped into position in the forms.

During this critical fitting and trimming time, the carpenter informed us that he alone had cutting jurisdiction. Although he had never cut anything but wood, he would cut and trim the vinyl "sidings." He had neither the right saws, blades, touch, nor technique, and after damaging boards in several sections, his mistakes were getting expensive and our men were allowed to cut and trim. Then THF[22] was used to cement together the vinyl sheathing. We had got over our first hurdle; the carpenter, having watched our men, began to accept our special saws and to use them with care.

Once the concrete had been poured within the vinyl sheathing and the wood forms removed, the sheathing gave the concrete a slick finish that amazed the men (1). They took a new interest in plastics and caught our innovative spirit.

Liquid urethane was used to protect exposed concrete and to seal the wood beams. In confined areas, the material is extremely volatile and somewhat toxic, with a strong and acrid odor.

Almost every prefabricated unit had to be retailored on site to fit.

Liquid urethanes "cure" from moisture in the air, and congeal unless they are used immediately. Extreme care must be taken to close and seal containers. This was explained in detail to the painters, but it was only after several gallons of paint and some expensive paint brushes were ruined over weekends that proper care was taken.

Covering steel beams with vinyl was a major operation that had to be done on the job. The purpose of the vinyl sheath was to protect the steel against oxidization. This was a feature of the Kunststoff-Haus.

The moment we began to unpack our plastics hot-air welding equipment, vinyl sheets, and vinyl extruded "welding rods," we were told that a member of the area welder's union must do the work. Initially, the welder insisted on using his own equipment, but after totally destroying several pieces with his oxy-acetylene torches, he admitted he didn't think he could handle it so he watched our men work.

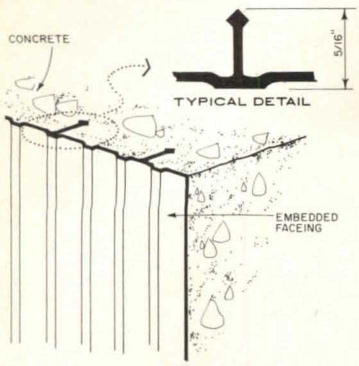
First, the steel must be cleaned of paint and rust. Next, a sheet of vinyl is placed over the "U" of the I-beam and heat applied to soften it so that it conforms to the shape of the beam. This was done with hot air from our plastics welding equipment. As the sheet is formed to the configuration of the beam, the beam is turned so that the forming will go around to the other sides. At the end, the two ends of the sheet are welded together using a bead of extruded vinyl to form the weld. Rigid PVC was used, .060-in. thick, gray in color (2).

It would have been easier, but "you don't paint first, you carpenter first," said the carpenters.

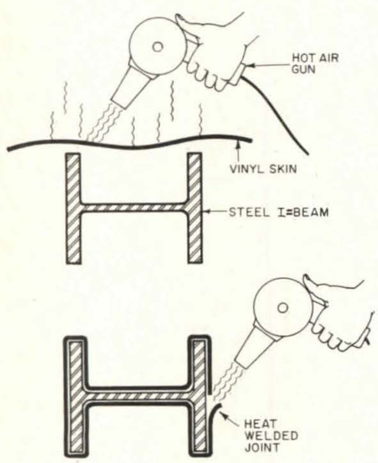
Covered beams had to be carefully handled, always wrapped at the points where chain hoists were used to lift them in place. At points of attachment, the vinyl had to be cut back, then post welded *in situ* to complete joints. The men began to respect our assistant for his skill, especially during the complicated welds and seams where two or more beams came together.

Wood beams and studs (2″ x 4″) were coated with liquid urethane once they were in place. It would have been easier had they been coated first, then installed, but the carpenters would not hear of it, saying, "you don't paint first, you carpenter first."

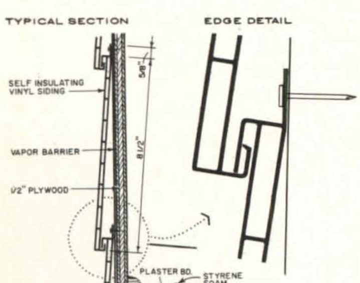
Walls, floors, and roof insulation were prefoamed styrene in precut, flame-retardant (blue) sheets. Available in boards 9′ x 12″ by various thicknesses, we suggested 2-



1. Vinyl sheathing in wood forms gave the concrete a slick finish.



2. Vinyl skin was heat welded over steel I-beams to ward off oxidation.



3. Wall is formed of urethane-soaked wood joints, vinyl clapboard exterior, polyethylene skin, styrene foam insulation.

in. insulation in wall, floor, and ceiling areas, and 3-in. insulation in the internal roof beams. This was a familiar material that the men had used or, at least, had seen used in floral arrangements.

Polyethylene skins were stapled to the exterior of the wall frame, and a new vinyl clapboard[13] was attached to the exterior. This board is a ¼-in.-thick, vinyl clap, hollow with ribbing and connecting strips. It is well designed, lightweight, and virtually maintenance-free. It can be scratched, however, as can all vinyl (or for that matter, all plastics). Care is required in handling and it should be installed by experienced men. By this time a mutual respect for each other's craftsmanship had developed between the shop steward and our assistant, and these installations were trouble-free.

The wall section now was as follows: urethane-soaked wood joints, vinyl clapboard exterior, polyethylene skin, styrene foam insulation. We were ready for the inner wall facings (3).

Before this could be done, however, the electrical and plumbing systems had to be installed. Electrical work was no problem. Polyethylene-coated wire and phenolic outlets are accepted by the trades as standard, along with urea plugs. Only in the lighting fixtures and illuminated ceilings were newer plastics involved, but, even here, no jurisdictional or technical problems arose since the work, though not totally familiar to these men, had precedence eslewhere. Lighted ceilings were vinyl; most other fixtures were acrylic, vinyl, or polycarbonate.

Special lighting effects were required in the swimming pool. The client wanted it lit from below. Since it would be impractical to use underwater lighting, we devised a method for edge, side, and bottom surface lighting through acrylic fiber optics and acrylic rod edge-lighting effects. By thermoforming the rods and fiber bundles, intertwining them along the concrete pool walls and floors and eventually through the "cultured" marble façade to the water, the main bundle ends picked up light from one main source (dry) and carried it throughout the pool as tiny sparkles of light in the water (4). Perfectly safe, this system amazed the electricians, and it became a source of delight for everyone. Scratched ends were polished after the façade was installed; joints were calked with silicones.

Plumbing Was a Real Problem

Where configurations were extremely difficult, the plumber insisted on metal fittings. PVC[23] pipes were to be used in all drain, waste, vent, and hot and cold water applications. With several methods of attachment available, solvent welding was chosen for the drain, waste, and vent system, and heat welding for those applications where drinking water was concerned. The plumber's torches, which burned the PVC, were quickly abandoned and portable sonic[24] welding equipment proved to be a successful alternative.

The biggest problems were with the tubs and sinks. In order to make the tubs form-fitting, we used industrial design and human factor techniques.

Made of filled polyester weighing about 1 oz per cu in. or 108 lb per cu ft, the 69" x 32" x 20"-tubs weighed approximately 1900 lb each, and once on site, were not easily moved. They had been planned to fit into a free-flowing bathroom environment. This meant that several sides of the tubs would be exposed, and that it would be necessary to protect them from mars and scratches (soft urethane foam was used) during the pipe-fitting operation.

When installing the tubs, the fixtures were locked in place by epoxy[25] between the flush-mounted drain plates and the polyester surface. The tubs were turned upside down. The pipes that now extended through the tubs had to be soldered into their fittings, and this left little room in which to work to fill the voids between the pipes and the irregular holes. These voids were filled with liquid polyester, since it would shrink volumetrically 6 percent and should lock tightly around the copper piping. With the tubs upside down, we could only pour around the drains. The tubs had to be up-ended to fill around the entry and overflow pipes. This done, a test was made by filling the tubs to capacity with water and leaving it overnight. During the night some leaks occurred where the copper pipes joined the polyester. The difference in the coefficient of expansion between the metal pipes and the plastics had been overlooked. The pipes and polyester were sanded, and the area and the pipes covered with a filled epoxy. This resolved the leaks, but prior to installation all exposed areas were recalked with silicone as a final safety factor. The tubs were installed and no leaks have since developed.

When the shower stall, prefabricated of glass fiber-reinforced polyesters, was ready to be set in place, we found that our "to-print" dimensions were incorrect, and in order for it to fit the space allotted to it, the FRP[15] had to be cut and tailored to fit.

Labor Problems

During this time we had been forced to work "union hours," but now since we were ready to work on the walls — most of them decorative and demanding tedious and exacting individual tailoring and fitting — we preferred to work late without the noise and bustle of workmen around. Since the union could not produce a man who could handle our plastics wall covering materials and guarantee the job, we were allowed to work any hours and on weekends to complete our job.

Tailoring flexible vinyl sheeting over walls, around corners, through doorways, around windows, and around the rough stone of a fireplace is exacting work. Originally we had intended to use ⅛-in.-thick, reinforced-polyester sheets as the wall surfaces, covering them with attractive surface materials. But because the client's paintings were to be hung, which would necessitate drilling and bolting into the walls, a more conventional underwall seemed more appropriate so plaster over metal lath was used.

The wall coverings varied from room to room; in some rooms vinyl floor tiles were fitted and applied with a new pressure-sensitive cement.[26] Both the wall face and the tile backs were coated and dried for 10 to 30 minutes. When the tiles were laid against the wall there could be no mistakes, as the tile and wall section could be damaged or destroyed if an attempt was made to remove one.

Melamine sheets, applied in the same manner as the vinyl tiles, were used in the kitchen as wall facings. "Cultured" marble slabs were epoxied to fireplace façades as they were to the concrete facings of the swimming pool walls. ABS sheets used as baseboards and kickplates were either applied with cement or screwed into place, or both, depending on location and the amount of wear they would receive.

The most difficult applications were where decorative embossed vinyl skins had to be applied over large wall areas, around windows, in doorways, around fireplaces, and in recessed wall coves and nooks. This required making paper patterns prior to cutting the vinyl. The same pressure-sensitive adhesive system was used, but this time it was allowed to set for 24 hrs. Once direct pressure was applied, the sheet was locked in place and nothing could remove it.

As the skins were stretched and press-fitted to the walls, a strip of 2-in.-wide wax paper, placed under the opposite vertical edge from ceiling to floor, kept the edge from sticking to the wall. The rest of the wall was then tightly pressed into permanency by using a silk screen squeegie or paint roller. The next sheet was then laid 1 to 2 in. over the preceding one. Using a straight edge, a razor cut was made through the two overlapping sheets. With the excess and wax paper removed from under the first sheet, the two edges now came together in a perfectly aligned joint (5).

Another technique utilized a portable hot-air gun[27] to apply the vinyl sheathing. The vinyl was softened so it could be stretched around the edges of cabinet doors more easily and smoothly.

Polycarbonates had been designated for glazing in all vertical window areas of the house, with acrylic bubbles for the roof skylights. Unlike glass, polycarbonate has a high coefficient of expansion: 1/16-in. per ft. A window 5′ x 8′ needed a free space around it of ¼-in. per side. The window frames used were extruded vinyl with no inner core of wood or aluminum. Vinyl, too, expands and contracts with temperature, and this was taken into consideration by temporarily removing all outer moldings, leaving only the basic frame within which to work.

Quarter-blocking techniques were used to mount the ¼-in-thick polycarbonate sheets (6). Small blocks of polycarbonate were cut into ¼-in. cubes. A cube was placed one-quarter of the total length of the pane in from each side. Thus, on an 8-ft. window, the blocks would be 2 ft in from each side. The pane would also be cut so a free ¼-in. space was evident on all three remaining sides. Next, a ¼-in. bead of clear silicone calking was placed between the pane and the frame. The silicone cures from moisture in the air and forms a resilient bond that adheres to both the polycarbonate and the vinyl frame. As contraction or expansion takes place, the silicone stretches or compresses appropriately. The translucent color allows the passage of light, and the external molding, which is replaced around the window frame, hides the silicone from view.

Standard roofing techniques of foamed styrene, covered with aluminum paper, then bitumen, and, finally, gravel, were professionally used without difficulty by a team of roofers who had installed such roofing elsewhere (7).

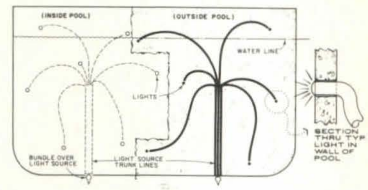
With the completion of the walls, the flooring was ready to be laid. Here again, the basic Kunststoff-Haus techniques were adapted. A layer of ¼-in. prefoamed vinyl was laid over all floor areas, room by room (8). Next, vinyl flooring, prewelded to cover an entire area, was laid over the foam, resulting in a feeling of walking on carpet. Since the technicians did the prewelding, the only job left was edge trimming and the laying of vinyl corner molding to keep it in place. No conventional mastics were used to cement either the foam or the vinyl.

Finally, painting the ceilings and trim was done with a glossy outdoor acrylic trim paint.[28] This is waterproof, strong, resilient, and never really hardens; rather, it remains like a plastic skin over whatever surface to which it is applied.

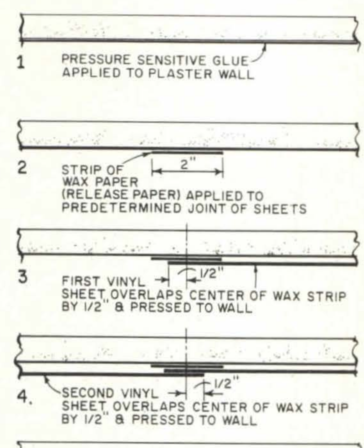
Vinyl folding doors, reinforced glass fiber partitions, lighting fixtures, and permanent sculpture were later installed.

Assessing the Job

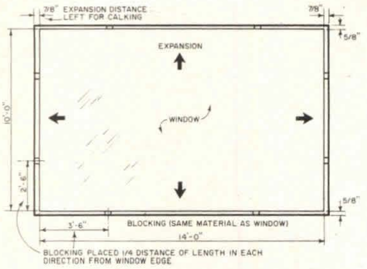
By the time the job was over, a mutual respect had developed between the tradesmen and ourselves. Although these men had been skeptical, indifferent, and difficult in the beginning, the more they saw and learned, the more interested they became. They soon took pride in their newly acquired knowl-



4. Acrylic fiber rods carry light from outside dry source through concrete to light pool from below water line.



5. Skinning technique used to apply embossed vinyl wall coverings involved temporary use of waxed paper at joints.



6. Polycarbonate glazing sheets were installed with ¼ in. cube quarter blocks.

People need to see plastics as plastics and not as substitutes.

edge and skills in plastic materials.

There are problems in the use of plastic building materials, but they can be resolved. The problems are not in the materials themselves, but in their correct usage and handling.

This case history has been related to point out some of plastics' problems, and to offer some practical solutions: (1) If unions presume the right to claim jurisdiction over a material, then the unions should establish schools in which to train apprentices and journeymen in the correct use and handling of these materials. (2) More architects and contractors should utilize the services of plastics consulting organizations in order to obtain a view of plastics materials that is broader than that of the manufacturer's literature. (3) The public must be made aware of plastics as a valid acceptable material, just as it now unquestioningly accepts the senior materials. Plastics must be used by engineering, architecture, design, and art students. (4) Cognizance must be taken of research work at the university level, which is much more than student work without practical application and realistic foresight. (5) Costs of plastic materials cannot be fairly compared to senior materials on a raw material basis alone. They must be compared on a finished installation basis. A laminated melamine vanity top compared to one made of filled polyester is a good example. First, a melamine sheet is laminated to a 1-in. plywood base. To make an L-shaped vanity top, two boards must be cut and mitered, discarding the scrap. Next, aprons and splash plates are attached. Finally, a sink hole is cut and the removed section is discarded. In each operation, there is labor, expense, and waste. The same vanity top made of filled polyester can be made in one mold and in one entire piece with corners, aprons, splash plates, and approximately sized sink aperture, even with molded-in bushings for the attachment of the ceramic bowl. Costwise, they are competitive. However, the latter has greater freedom and design potential. Wood beams protected by liquid urethane coating is another good example. Liquid urethane costs approximately \$0.27 per lb or approximately \$2.25 per gallon. A gallon will cover over 250 sq ft of wood and almost double this area if thinned with acetone. Compare this small cost to that of termite inspection, prevention, and "cures" over the years. (6) Plastics in building applications to date are resting on past achievements. People in a position of authority are needed to create change, and to be able to see and use plastics as plastics and not as substitutes.

Bibliography

Architectural Research Laboratory, The University of Michigan, *Architectural Research on Structural Potential of Foam Plastics for Housing in Underdeveloped Areas,* Research Report on ORA Project 05687, Second Edition, Ann Arbor, 1966.

Byggecentrum Gyldenløvesgade 19, København, 1961.

Winfield, Armand G., *"Cultured Stones" — The New Emergence into the Plastics Industry,* Technical Papers, 22nd Annual Technical Conference, Montreal, Quebec, Society of Plastics Engineers, Inc., Stamford, 1966.

Ein Kunststoff-Haus im Bungalow-Stil, Von Pipl.–Ing. Reinhold Freuz, Kunststoff, Jahrgang 1960, Heft 6, Seite 360–3655. Translated by Sven Richter.

Modern Plastics Encyclopedia — 1969–1970, McGraw-Hill, Inc., New York, 1969.

Winfield, Armand G., *100 Years Young,* The Society of Plastics Engineers, Inc., Greenwich, 1968.

Plastic i Byggeriet, Udgivet af Byggecentrum, København, 1961.

Winfield, Armand G., *Plastics for Architects, Artists and Interior Designers,* Society of Plastics Engineers, Inc., Stamford, 1960.

Skeist, Irving, ed., *Plastics in Building,* Reinhold Publishing Corporation, New York, 1966.

Winfield, Armand G., *Plastics in Building in the Soviet Union,* New Building Research Conference, Spring 1962 (S62-10), Building Research Institute, Washington, D.C., 1962.

Plastics in Building, Technical Papers, Society of Plastics Engineers, Inc., Regional Technical Conference, Chicago, Oct. 2–3, 1969.

Tent Structures, Final Report, Structures of Synthetic Fabrics, Chemstrand Company and Industrial Design Dept., Pratt Institute, Brooklyn, 1964.

Platzker, Joseph, *Why Plastics Are Not Used in Greater Quantities in Buildings,* SPE 26th ANTEC Technical Papers, Vol XIV, New York, May 6–10, 1968, pp 379–384.

Acknowledgements

The author gratefully acknowledges the information supplied by Staffan A. Berglund, and Dimitri Bulazel.

Appendix

[1] Dynamit-Nobel A/G, Troisdorf, Bez Koln, West Germany. Their plastics house is actually called "The Troisdorfer Kunststoff-Haus."

[2] Polycarbonate is a thermoplastic produced by such companies as General Electric Company, Pittsfield, Mass. under the trade name "Lexan"; and by Mobay Chemical Company, Pittsburgh.

[3] This type of silicone is produced by such companies as General Electric Company, Silicone Products Department, Waterford, N.Y., and by Dow Corning Corporation, Midland, Mich.

[4] Acrylics are produced by Rohm & Haas Company, Philadelphia, under the trade name "Plexiglas"; by E.I. duPont de Nemours & Co., Inc., Wilmington, under the trade name "Lucite"; and by American Cyanamid Company, Wallingford, Conn., under the trade name "Acrylic."

[5] Foamed styrenes are produced by such companies as the Dow Chemical Company, Midland,

Mich., under the trade name "Styrofoam"; the Koppers Company, Inc., Pittsburgh, under the trade name "Dylite"; and by The Gilman Bros. Company, Gilman, Conn., under the trade name "Gilfoam."

[6] Foam-in-place urethanes are produced by many companies including Allied Chemical Corporation, Morristown, N.J.; Freeman Chemical Corp., Port Washington, Wis.; Furane Plastics, Inc., Los Angeles; PPG Industries, Inc., Pittsburgh; Reichhold Chemicals, Inc., White Plains, N.Y.; Union Carbide Corporation, New York City; and The Upjohn Company, Kalamazoo, Mich.

[7] Polyvinyl chloride (PVC) is produced by many companies. Among the large producers are: Allied Chemical Corporation; Borden Chemical Division, New York City; Diamond Shamrock Corporation, Cleveland; B.F. Goodrich Chemical Company, Cleveland; Hooker Chemical Company, Hicksville, N.Y.; Monsanto Company, St. Louis; Union Carbide Corporation and Uniroyal, Inc., New York City.

[8] Butyrate is the shortened name for cellulose acetate butyrate, a thermoplastic produced by Eastman Chemical Products, Inc., Kingsport, Tenn.

[9] Urea foam is produced by Donray Products Company, Cleveland; E.I. duPont de Nemours & Co., Inc., Polyfoam Division, Harvey, La. Sprayed-urea foam as ceiling and wall insulation and acoustical barrier is produced by U.F. Chemical Corp., Woodside, Long Island, N.Y.

[10] Melamine, the shortened name for melamine formaldehyde, is a thermosetting resin produced by such firms as Allied Chemical Corporation; American Cyanamid Company.

[11] "Cultured" stone is a name applied to a multiplicity of filled polyesters and epoxies. These resins are filled to 80 percent with such aggregates as calcium carbonate, crushed marble, sand, and gravel. Grained and colored, they can be made to resemble marble and granite as well as other stones and gems. Plastics terrazzo can be made by this technique.

[12] ABS is the abbreviation for thermoplastic acrylonitrile-butadiene-styrene copolymers. They are produced by companies including Monsanto Company; Sinclair-Koppers Co., Pittsburgh; and Uniroyal, Inc.

[13] These new PVC extruded clapboards are manufactured by Extrudyne, Inc., Amityville, N.Y.

[14] ABS Water Tanks were first noted by the author in Byggecentrum, Copenhagen, Denmark. They are available through Maskinfabriken Phøenix A/S, Odense, Denmark.

[15] FRP is the abbreviation for fiberglass reinforced polyester, often called just "fiberglass."

[16] Acrylic sinks are produced in England by Troman Bros., Limited, Warwickshire, and P & S Plastics Ltd., Gloucester.

[17] Acrylic emulsions used in paints are based on Rohm & Haas Company's Rhoplex. Acrylic emulsion paints are among the best produced for outdoor use.

[18] The liquid urethane in this instance was #13–300 produced by Reichhold Chemicals, Inc., White Plains, N.Y.

[19] Polyethylene is a thermoplastic member of the olefin family. It is produced by many companies including Allied Chemical Corporation; Celanese Plastics Co., Linden, N.J.; duPont; Eastman Chemical Products, Inc.; Enjay Chemical Co., New York City; Monsanto Company; Sinclair-Koppers Co.; Union Carbide Corporation and U.S. Industrial Chemicals Co., New York City.

[20] Phenolics, the second oldest plastic — "Work-horse" of the plastics industry — is a thermoset produced by Allied Chemical Corp.; Durez Division of Hooker Chemical Corp., North Tonawanda, N.Y.; Fiberite Corp.; General Electric Company; Monsanto Company; and U.F. Chemical Corp.

[21] Urea, the shortened version of the family urea formaldehyde, is a thermoset produced by such companies as Allied Chemical Corp.; American Cyanamid Company; Borden Chemical Division; E.I. duPont de Nemours & Co., Inc.; General Electric Company; and Monsanto Company.

[22] THF abbreviation for tetrahydrofuran, a solvent for vinyls.

[23] See note No. 7.

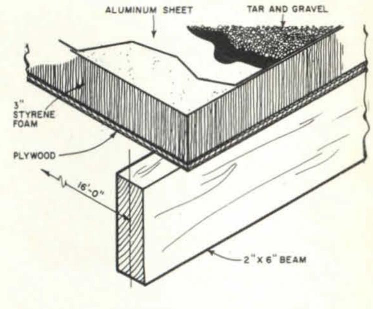
[24] Sonic generators, portable in nature, are produced by the Branson Sonic Power Co., Danbury, Conn.

[25] Epoxy is a thermosetting resin used as a cement. Cement producers include Cadillac Plastics and Chemical Co., Detroit, Mich.; Devcon Corp., Danvers, Mass.; Emerson & Cuming, Inc., Canton, Mass.; Furane Plastics, Inc., Los Angeles, Calif.; Hysol Division of Dexter Corp., Olean, N.Y.; and Ren Plastics, Inc., Lansing, Mich.

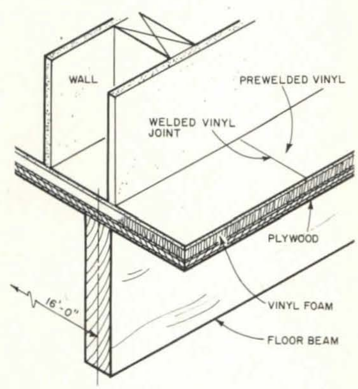
[26] 3M Pressure Sensitive Cement is their Industrial Adhesive #4693; available through Minnesota Mining & Manufacturing Company, St. Paul, Minn.

[27] "Mamco" HG–501 air gun is produced by Master Appliance Corporation, Racine, Wis.

[28] Among many available acrylic paints are those produced by National Lead Company ("Dutch Boy") and Pratt & Lambert, Inc.



7. Roofing is foamed styrene covered with aluminum sheet, bitumen, and gravel, installed by standard techniques.



8. Prefoamed vinyl serves as cushion for prewelded vinyl flooring.

Some Suggestions for the Architect:

1. Know plastics materials by their correct names.
2. Know their properties and limitations.
3. Think in terms of plastics materials and design with the freedoms which plastics allow.
4. Think of plastics free from conventional modules.
5. Think of plastics as plastics.
6. Use industrial designers to supplement interior designs on plastics projects.
7. Use plastics consultants.

INTERIOR DESIGN DATA

Plastics: The Future Has Arrived

After only a century of plastics, man has created the completely abstract, totally synthetic environment.

Two directions in the use of plastics are Douglas Deeds' innovative spray foamed room for the "Plastic as Plastic" exhibition at the Museum of Contemporary Crafts, and designer Ving Smith's display room for Uniroyal, Inc. to show how plastics can be used to imitate traditional forms and materials — plastic wood carved panels, plastic wood wall and beams, and plastic antique chest.

Photo, left: Ferdinand Boesch

Photo, right: Harr, Hedrich-Blessing

THE INVISIBLES

The minimal nude chair — like the emperor's new chair — is expressed as an invisible folded sheet by designer Spiros Zakas.

In interiors, the plastic world of the future has arrived. Every visible interior surface has already been made of plastics — of test-tube, man-made synthetics — with the exception of metal elements that are self-supporting or heat carrying. And space exploration has already realized those few remaining areas.

Plastics as floor coverings include sheeting, tiles, carpets, and synthetic fur; plastics as wall coverings include tiles, sheeting, and paints. And the backings and adhesives for both are plastic, too. On the ceiling are plastic acoustical tiles and spray materials as well as lighting diffusers, windows, and skylights; woodworking and cabinetry — both shelf and drawer units — are all available entirely in plastic also. Textiles for window coverings and upholstery are available of both woven and sheet plastics. Miscellaneous objects such as door and drawer hardware; air conditioner, television, and radio enclosures; as well as every utensil needed for our common diurnal functions is produced today in tomorrow's futuristic material.

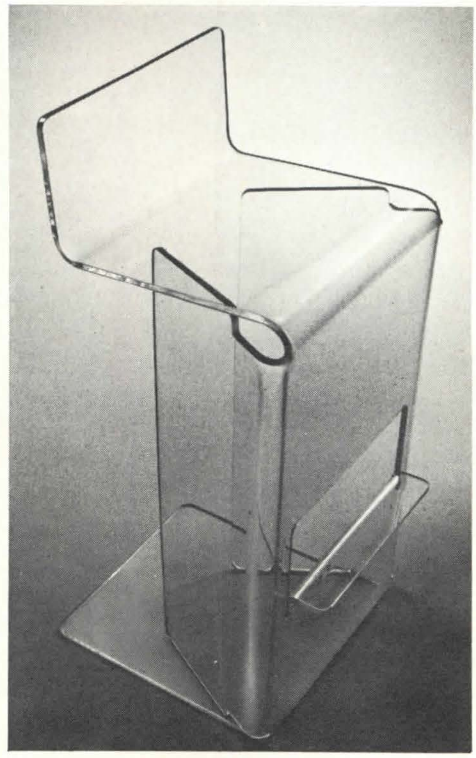
How far down the road toward the future totally synthetic environment have we come, with regard to interiors? As wall surfacing and upholstery, for example, 270.5 million yards of supported vinyl and vinyl sheeting were used in 1969 *vs.* 244.9 million in 1967, according to figures from the Vinyl Fabrics Institute. In carpeting, the consumption of face yarns in 1969 amounted to 971.8 million pounds. "In relation to total poundage for 1969," reports the Carpet and Rug Institute, "nylon accounted for 40 percent, acrylics/modacrylics 18 percent, and polyester 14 percent." Of the total face yarns of all carpeting sold in the United States in 1969, then, only 28 percent was of natural materials. The Textile Economics Bureau reports that the man-made fibers utilized throughout home furnishings (the antiquated term which for the Bureau includes "offices, hotels, institutions, etc.") increased from 25.7 percent of the total end uses in 1960 to 53.6 percent in 1968.

By far the most meteoric change has been in the area of movable furniture. In the past two years alone, the $5 billion furniture industry has made such enormous increases in the use and production of plastic pieces that, according to a spokesman for the Society of Plastics Industries, "People are predicting that by 1980 all furniture will be made of plastics." Another spokesman for the plastics industry reports that sales to the furniture field in 1969 approached $100 million. *Modern Plastics* magazine reports that the furniture industry grew from a use of 546 million pounds of plastics in 1968 to 655 million pounds in 1969.

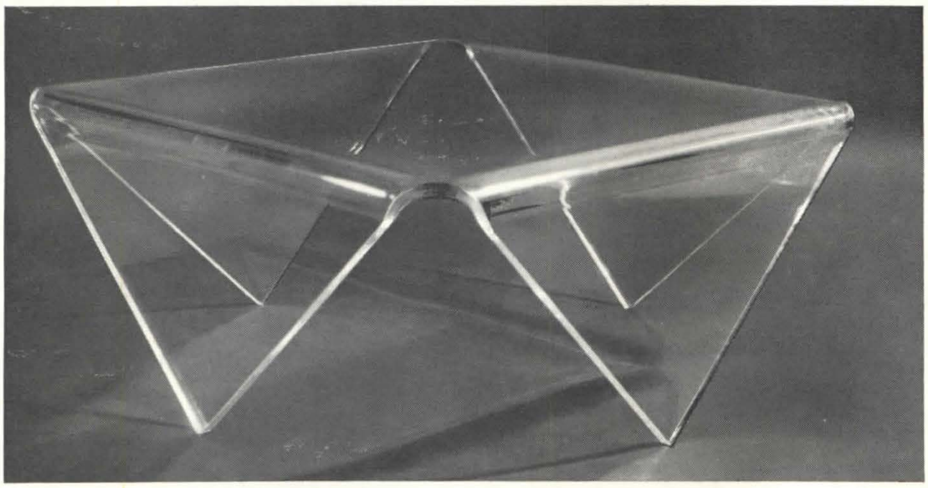
All kinds of plastics are used in the furniture industry today, both thermoplastics and thermosetting plastics. They include the thermoplastics ABS, SAN, polyethylene, polystyrene, polyurethane (both rigid and flexible foam), vinyl, and lesser amounts of acrylic, nylon, acetal, polycarbonate, and butyrate. They include thermosetting plastics such as melamine, phenolic, polyesters, epoxy, urea, casein, and silicone. According to *Modern Plastics,* vinyl and polyurethane flexible foam account for the largest amounts of plastics used in furniture.

Almost every element of furniture has been made of plastics so far: not only foam padding and drawer slides, but entire drawers, chair and sofa frames, table tops and pedestals, and the paneling of case-work pieces. These components in the 1970s are not merely faced with the customary high-pressure melamine laminates and vinyls, but, more and more, are becoming structural plastic elements. Some seating units are made entirely of foam. In addition, plastics are being used as virtually indestructible finishes for natural wood furniture.

To make these various components of furniture, nearly all of the plastics processing techniques have been explored. Casting, injection molding, rotational molding, and blow molding have been the most widely used; compression molding, extrusion, thermoforming (or vacuum forming), and transfer molding have also been investigated. As John R. Lawrence, editor of *Plastics World* magazine, has observed, "The current surge of interest in structural plastics shifts our attention to those processing techniques which are capable of producing massive or three-dimensional shapes." Furthermore, he points out a correlation between the plastics processing tech-



Sheets of transparent acrylic plastic have been folded with ingenious economy to produce what Steve Lachs of New York's Lucidity calls "transparent origami." Square tables by Neal Small (top left) and Kip Coburn (second from top) demonstrate virtual abstemiousness in the craft of folding sheet materials. Coburn duplicates plastic cylinders in a table base to produce a multiple mirror image (second from bottom). Designer John A. Weick has folded and bolted a single sheet of plastic to provide a two-level book table (bottom). Virtuosic folding of a single acrylic sheet by designer John Mascheroni has produced a tall, self-supporting bar stool.



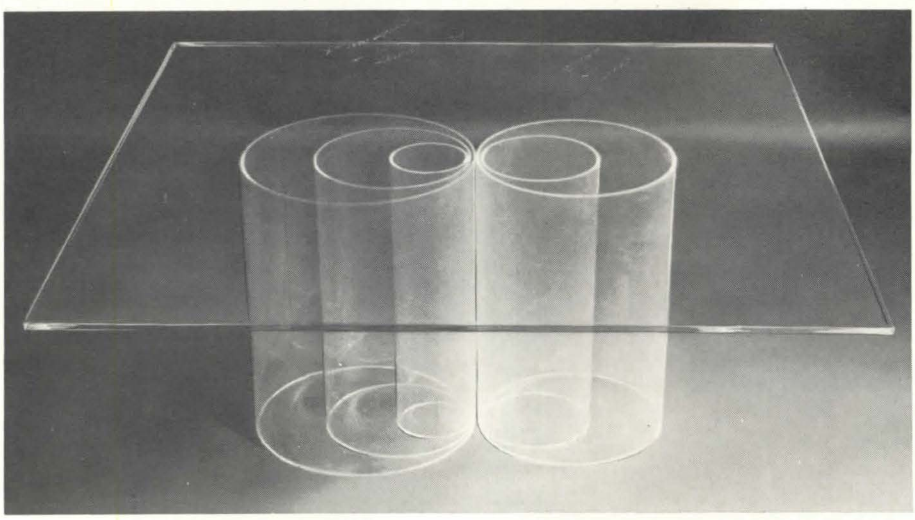
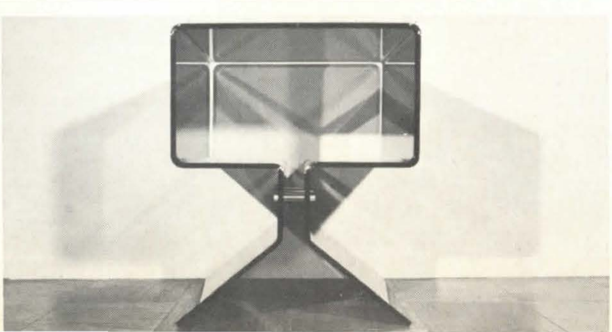


Photo: Van Brody



THE FAKES

nique and the general market needs and potential as well as between the material and the process. The low pressure processes, he explains, are characterized by low capital investment, high labor requirements, and more massive parts; the high pressure processes are characterized by high capital investment, low labor, and less massive parts.

Perhaps not surprisingly, two aesthetic approaches to plastic furniture design are now being pursued concurrently, and each of them appears to be directly related to one of the two processing groups. On the one hand, the low pressure, low investment techniques have been those predominantly available to the avant-garde, small custom-market designers and manufacturers who are interested in the appearance of plastic as plastic — for its own inherent characteristics. On the other hand, the high pressure, high capital techniques have been adopted by the mass volume producers who appear interested primarily in using plastics as a replacement and visual substitute for wood.

Within this schizoid aesthetic, our most progressive designers of plastic-as-plastic furniture and lighting have most prominently latched onto working with panels of acrylic plastic sheeting and onto folding, and bending or cementing and pinning them into tables, stools, chairs, and so on. Some of the most imaginative designs have been folded transparent acrylic sheeting of an elemental purity and simplicity that is literally

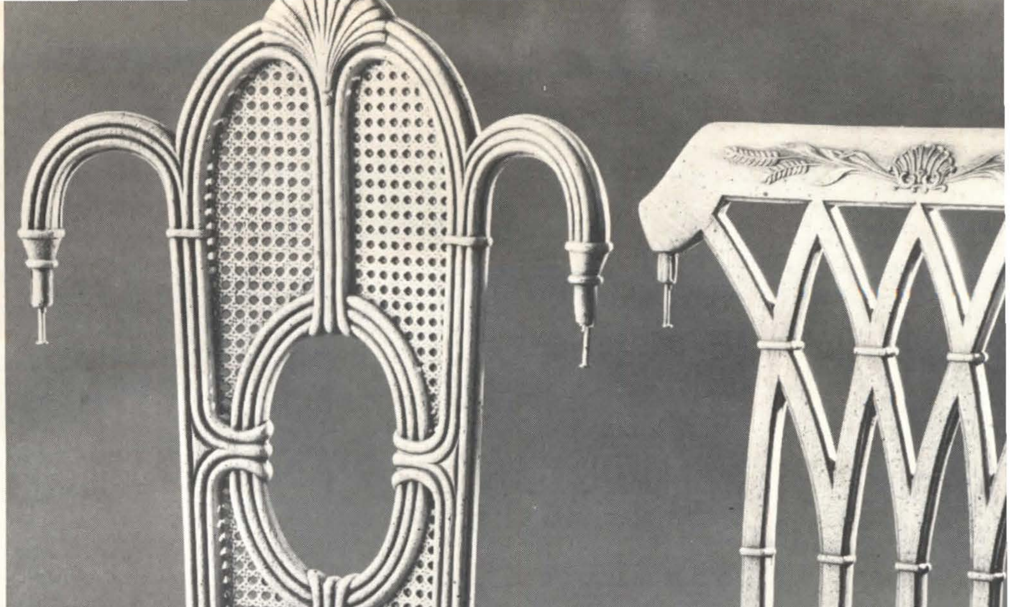


Photo: Monsanto Chemical Corp.

brilliant. Designers such as Paul Mayen, Neal Small, John Mascheroni, Kip Coburn, John Weick, and Spiros Zakas have each designed acrylic furniture that may become classics in the near future. Stephen Lax of New York's "Lucidity," a retail plastics outlet, compares these pieces to the oriental art of folding paper — "transparent origami," he calls some of this best work with acrylics.

Like the briefly brilliant inflatables of the early and mid-sixties, transparent and opaque acrylic furniture has been surprisingly slow in gaining acceptance. The reasons are interesting. As designer Neal Small explains, "Most people expect that if a piece is made of plastic it will be cheap. And they are shocked," he continues, "when they find out that plastics are not cheap."

Why not? First, the material itself is expensive. Cast as it is between two sheets of ¾-in. plate glass (the

Photo: Monsanto Chemical Corp.

Plasticamerica is offered pseudo-carved, pseudo-turned, pseudo-"Spanish-Mediterranean," furniture of authentic cast polystyrene direct from the ovens of the High Point, North Carolina furniture complex.

most evenly rolled and rigid of molds), there is a great deal of breakage in the manufacture of acrylic plastic sheeting, among other factors. "Every time you buy an order," observes designer Spiros Zakas, "you are paying for two sheets of ¾-in. plate glass."

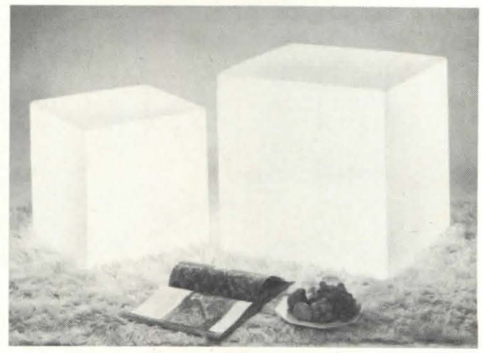
Second, according to Neal Small, "We are a hand operation and we make custom furniture. Our single pieces are made with a custom craft that cannot provide mass production. There is a good bit of waste in cutting the material. In addition, people are concerned about the scratching problem of plastics."

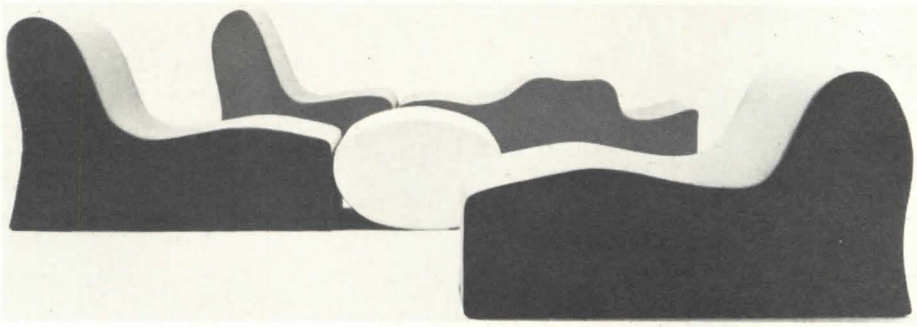
Actually, plastic scratches no more easily than fine hardwood furniture, and like those pieces it can be waxed with a scratch-removing wax made for fiber-glass cars. For major burns or scratches, buffing with jeweler's rouge will remove all scars. To eliminate this drawback permanently, acrylic manufacturing firms are working with scratch-proof laminated finishes, which are expected to be perfected soon. In any case, as Spiros Zakas believes, the concern over the scratch problem in plastics may vanish as people get used to the material — just as it did with glass furniture of the thirties and forties.

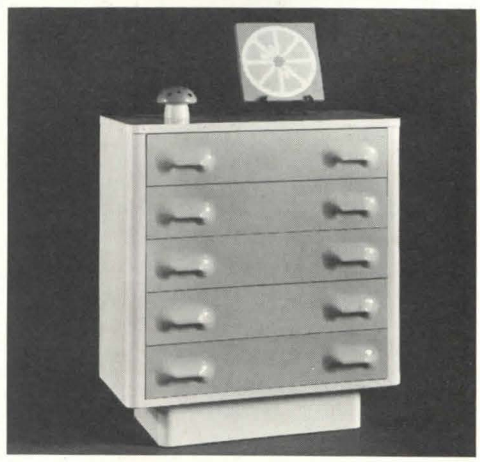
Despite these causes for hesitation, acrylic plastic furniture has been slowly gaining in public acceptance during the past several years. "We could not have opened such a store as Lucidity over two years ago," says co-owner Lloyd Jordan. The reasons for more recent acceptance, according to Neal Small, are that "Plastic sheeting is a beautiful, beautiful material, and it has worked its way into the high fashion market because it is the first different material that has come along. No other material can give that see-through look and be folded and worked in such interesting ways as acrylic.

Yet, predicts designer John Mascheroni, "The clear acrylics that have become the plastics medium for many young undercapitalized designer-manufacturers are really at a dead end. Designers will leave acrylic furniture and form collaborations with aggressive manufacturers willing to gamble capital and to develop

THE OPAQUES







Molded reinforced fiberglass Toga Chair (top left), designed by Sergio Mazza, is part of Simmons' Artemide Collection. The "True Cube" floor lamp (top right), designed by Paul Meyan for Habitat, is made of translucent "lumacryl" cast in one piece. Designer Sebastian Matte's picture puzzle lounge units for Knoll International's Gavina Group are made of one piece of polyurethane foam upholstered. The Valva 2 Armchair, designed by Tinsley Galyean and Marc Mermelin for Design Media, is a strip of polyurethane foam folded into shape. A chest of drawers made of injection-molded ABS plastic by Consolidated Broyhill Industries has molded integral drawer pulls. Injection molded ABS plastic stacking shelf units from Beylerian Ltd.'s Kartell of Italy collection are designed by Olaf von Bohr.
Photo: Ferdinand Boesch

THE FIBROUS

The molded fiberglass shell technique invented by Charles Eames and Eero Saarinen in 1941 has been applied by Eames to his original molded plywood chair of 1946 for Herman Miller, Inc.

designs in some other plastics."

By far the widest current acceptance of plastic furniture, however, is in furniture that does not admit to being plastic at all. This situation is comparable to the history of the plastic laminate sheeting field that editor Forrest Wilson has previously described (P/A Oct. 1968). As with plastic laminates, the first years of mass-produced plastic furniture are being spent in assiduously and slavishly imitating natural woods.

The reasons for this segment of the furniture industry turning to plastics, according to author Stuart Wood, whose series of articles in *Modern Plastics* magazine has studiously followed these changes, are "the dearth of skilled craftsmen, the diminishing supply and rising cost of acceptable hardwood lumber, and the need for greater productivity and flexibility to meet rising consumer demands within the limitations of tenable economics."

The growing production of cast parts for furniture follows the introduction of injection molded components, which had been adopted for the same reasons. The advantage of cast parts is one of adapting the processing technique to the particular market, for, as Stuart Wood explains, the molds required in casting are considerably less expensive to produce and last just long enough for the normally required 1000-piece run.

"It is ironic" says designer Paul Mayen of Habitat, Inc., "that all our supertechnology should be used to reproduce the forms, graining, and finish of an 18th-century chair right out of the plastics oven." Designer John Mascheroni points a finger about this, "The plastics industry itself should take the initiative to educate the public into accepting plastics as plastics and not as an imitation of wood."

There is, however, a third group of furniture designers and manufacturers who use plastics as plastics — other than the see-through designers. They are those leaders of the architectural furniture field — Knoll International, Herman Miller Inc., Architectural Fiberglass Inc., Habitat, Inc., and a few others. They stand in a peculiar place — respected by leading designers, they are relatively unknown and unsung by the mass of residential America.

Architectural Fiberglass Inc., in Los Angeles, is firmly committed to using fiberglass-reinforced plastics for their inherent qualities. According to vice-president Barry Rosengrant, "Our products are not produced for the home market. Instead, their greater strength is designed for the public market — for schools, shopping centers, and detention centers for youth — perhaps the hardest use of all. Our benches and other products are designed to be virtually indestructible for this market."

The designs of these firms, however, are all elegant and interesting enough to be used in other interior applications — in houses and housing, for example. Yet it is painful to see that the process for reinforced fiberglass chair shells, invented for mass production and mass use by Charles Eames and Eero Saarinen in the late 1940s should still be witnessing a time-lag in acceptance that makes such exposed chair shells desirable only as furniture for commercial uses — or for utilitarian application.

As Peter Protzmann says, "These synthetic materials emancipate design from the rigidity of forms dictated by directions of grains in woods, linear arrangements of structures in steel, and planes of boards This new freedom must be considered an obligation to improve the utilities of desks, chairs, and storage units. Creative environmental improvement is the task of the designer who can handle the daily chemical innovations appropriately."

"But there is no communication between the furniture industry and the design industry," author Stuart Wood points out. A direct way to more immediate acceptance of natural plastics by the furniture industry, therefore, is to establish some means of that dialogue.

One entrepreneur may have initiated such communication just this year by moving into the area of High Point's markets with unequivocal modern plastic furniture. George Beylerian, who founded the New York emporium "Scarabeus," has arranged for the U.S. production of the Italian "Kartell" furniture line of injection molded "cycolac," an ABS polymer. The effect of that production on Beylerian's High Point neighbors may well be to open the door of twentieth-century aesthetics to our "residential" common man.

In fact, the reported copying of

Photos: Architectural Fiberglass

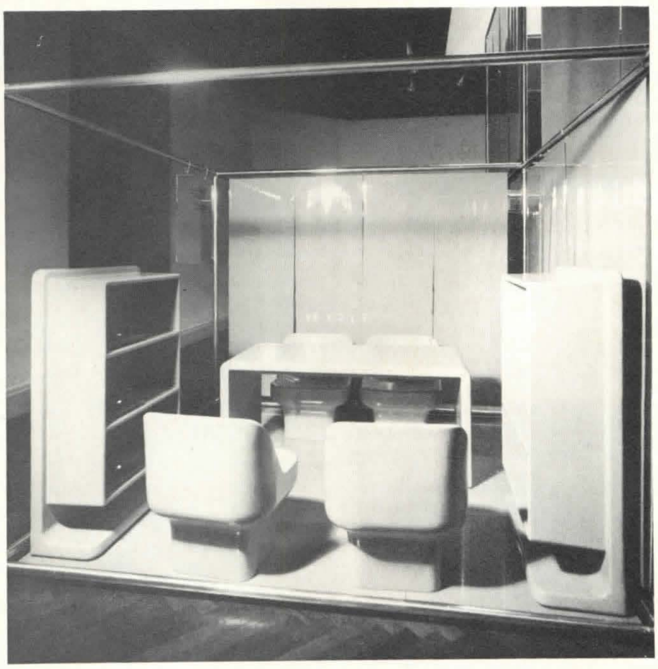


Photo: Mac Mizuki

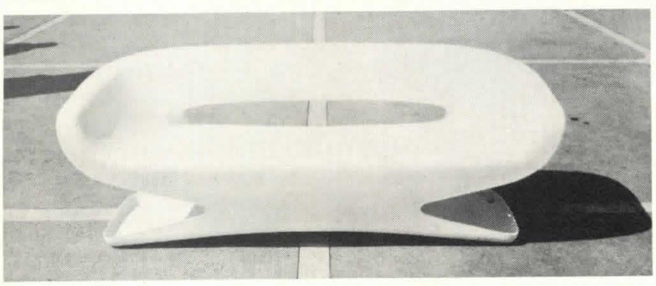


Photo: Museum of Modern Art

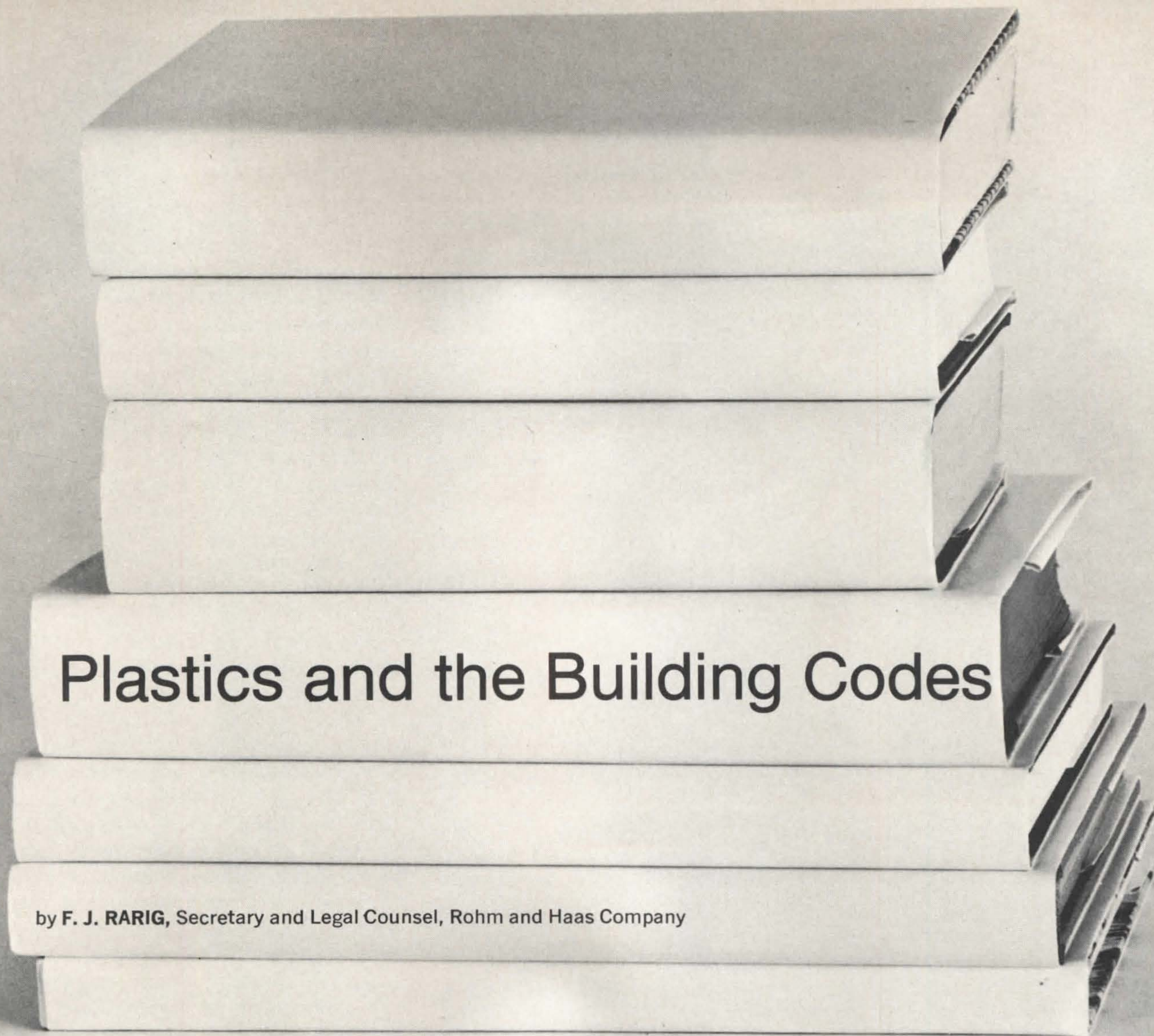
Mass production techniques of casting and molding produce simple forms requiring few manufacturing steps, such as these reinforced fiberglass chair, table, and bench units designed by Douglas Deeds and Barry Rosengrant for Architectural Fiberglass. They are on view in the "Product Environment" exhibit of foremost plastic furniture design, organized by the City Museum of St. Louis, currently at the Philadelphia Museum of Art (Oct. 2–Nov. 10); they will be at the Albright-Knox Art Gallery, Buffalo, Jan. 6–Feb. 14. Like Douglas Deeds' spray foamed room (page 88), a new approach to furniture construction is Aagaard Anderson's "Chesterfield Furniture." Formed of urethane foam sprayed layer upon layer without the use of a mold, it may well be the most revolutionary plastic furniture production method yet devised.

the Kartell designs by Polyform Corporation of America and the anticipated price war that that activity may engender should escalate the conversation between the furniture industry and the design industry into an argument, literally.

In fairness, other High Point manufacturers, such as Broyhill, Burris, and others, are also producing good, clean, simple modern pieces. And no one can overlook the enormous change in the industry that has been caused by the use of plastic chair shells instead of wood frames for upholstered pieces.

Douglas Deeds says, "There is no limit to what shape these plastic things can be, because they are just a bunch of chemicals jumping around in a barrel until you inject them into a mold or apply them. Now the materials are more advanced than the machines. As soon as technology is up to doing things in relatively large volume, then you could expect to mold entire rooms. I can foresee, also, that someone could come along with an applicator so that you could go into a store and buy a can and spray foam your own interior. And it isn't beyond the realm of possibility that you could just formulate the chemicals and just throw them into a room and they would form themselves."

In conclusion, Paul Mayen provides a sober warning in line with the current concern for ecological problems: "The new highly scientific technology of producing plastic furniture in ever increasing numbers is based on the philosophy of 'expendable furniture.' Strangely, furniture pollution is keeping pace with molecular technology but not with molecular biology. New plastic furniture is actually more durable than ourselves, our governments, and our society, though changing fashions and our mode of living cry out for more and more of these throw-away objects. The new plastic technology should not be allowed to produce products with such a high pollution potential. The right disposal should be thought of in terms of a world that must metabolize all its activities and products. This means that in the future, the newer plastics must have a high reconversion potential."



Plastics and the Building Codes

by **F. J. RARIG,** Secretary and Legal Counsel, Rohm and Haas Company

With enlightened foresight, a young industry has guided the formulation of codes applicable to its own products.

Perhaps the most remarkable fact about the subject of plastics and building codes is that most modern building codes provide for the use of plastics in buildings. This is significant because neither plastics as a group nor any one plastic is employed on a large scale by the building industry for structural elements or for nonbearing wall or spandrel assemblies. Provision in modern building codes for the use of plastics in buildings, therefore, is not a response of regulatory officials to problems resulting from the general use of plastics in construction, nor is it the result of an insistent demand by architects and builders that building codes provide for the use of plastics in buildings in anticipation of the development of important plastic building materials.

Plastics are included in modern codes because, at the end of World War II, the chemical industry, which produces the basic plastic materials, was determined to provide for whatever role plastic materials were to play in buildings on a sound and responsible basis. The industry had a sufficient sense of public responsibility and enlightened self-interest to initiate code proposals to govern the use, on even a modest scale, of plastics in buildings.

Leaders in the industry responsible for promoting the use of plastics in buildings recognized that proper use and orderly marketing of plastics in the construction field could only be assured if the materials were accepted and intelligently regulated under building codes. Their objective was to develop a pattern of control that would provide a means of accepting plastic materials for use in buildings in accordance with accepted standards of safety applicable to other materials.

The Problem of Definition

It is not surprising that when we approached building officials in those early days for approval of plastics we were asked, "What are you talking about? Those wartime substitutes? Do you expect us to approve plastics for use in building? Do you really think it is possible to write a building code for plastics?" It did no good for us to assure building officials that in defining acrylic sheet we were not defining plastics in general but were talking about a specific product with its own properties and possibilities.

In those circumstances, the industry had to make a choice between providing in building codes for the use of those specific classes of plastic products that appeared to have a role to play in the building field — such as polyvinyl chloride, reinforced polyester resins, acrylic sheet, butyrate sheet, and styrene foam — or to act in the faith that the word *plastics* would utimately be accepted as the general term that would cover all of these classes of materials and others not yet on the market.

This issue was finally resolved as a result of discussions with the building code committees of various architectural societies of our major cities whom we consulted regarding the scope and character of our proposed building regulations for plastic materials. The architects made it clear that they wanted plastic materials dealt with as plastics and indexed as plastics. They did not consider it practical to endeavor to establish in building codes separate provisions for individual classes of plastics that would be identified by esoteric generic terms identifying classes of polymers and copolymers.

When it came to defining plastics, we were again guided by the advice of architects. In our discussions with them, we had been impressed by the admonition that we should not freeze the status quo in plastics technology by limiting the scope of our proposed legislation to established plastic products. On the other hand, building officials and legislators were not interested in providing for the use of materials that did not have fixed, ascertainable properties, i.e., were not standardized. To solve this problem, we defined plastic products that are the subject of building code regulation when used in buildings as follows: Plastic materials are those made wholly or principally from standardized plastics listed and described in the current edition of *Technical Data on Plastics,* published by the Manufacturing Chemists' Association, Inc.

The Approval Procedure

Unfortunately, the listing of a plastic in the MCA Technical Data Book on Plastics, or in any other authoritative encyclopedia of plastics, does not establish its suitability for use in a building. Authority to determine the suitability of a proposed use of a plastic product in a building had to be vested in the building official or materials-approval board of the jurisdiction adopting the Model Chapter. Accordingly, most building codes provide that the manufacturer of a plastic material being offered for use in buildings must apply to the appropriate authority for approval of his material, and that he shall submit relevant data on the basis of which a judgment can be made regarding the safety of the material. Here we were employing the procedure established in the New York State Constitution for the approval of all building materials offered for use in New York City, which required the manufacturer to apply to the New York Board of Standards and Appeals for approval of his material.

Virtually all building code provisions for the use of plastics utilize this approval procedure. They do not legislate plastics into buildings, but establish authority in the building official or appropriate board to approve plastics on the basis of information supplied by the manufacturer and on information obtained from independent sources.

This means that the architect cannot turn to the building code to learn whether he can use a particular plastic for a given use in a particular jurisdiction. Reference to the plastics chapter of the applicable building code will be helpful because it will tell him whether, and on what basis, an approved plastic can be used, but it will not tell him the status of a particular plastic, i.e., if the plastic has been approved. Before specifying a plastic material for use in a given occupancy and class of structure, the architect should ascertain whether an approval for the proposed use of the material has been granted in that jurisdiction. He should not be satisfied with vague assurances from suppliers. He should insist upon official proof of the current status of the exact form of the material for the proposed use in the location, and in the amount, in which he proposes to employ the material.

Whether a plastic material will be approved for a given use is a matter of administrative discretion, but the exercise of this discretion by the approving official or agency is strictly limited in all chapters on plastics based on the Model Chapter.

The Law

The law is that an approved plastic may be used in buildings in accordance with the terms of its approval.

The law also provides that a plastic may be used in a building, without a specific approval, if it is part of a structural element or assembly which, under the provisions of the building code, is required to be tested and approved on a performance basis as a complete unit. No exception from performance standards is made on behalf of plastics for structural elements of walls, roofs, ceilings, floors, or doors; neither is a separate approval or special evaluation required for plastic components of such structural elements. The same is true of plastics used for interior finish. Plastic materials installed or applied as an interior finish are governed by the sections of the code applicable to finishes.

Some codes provide that if a plastic material, even though not installed as finish, covers or constitutes over 30 percent of a wall or ceiling area, it shall be deemed to be an interior finish and shall be regulated as such. An

Most building codes key acceptance of plastics to performance

unresolved question under many building codes is whether an approved plastic material installed as less than 30 percent of the ceiling area need not be an approved plastic if installed in an amount exceeding 30 percent of the ceiling area, but need merely meet the flame-spread index for the interior finish in the occupancy.

If plastic structural elements are controlled by performance standards applicable to such elements, and if plastic interior finish is treated like any other interior finish, what is left to be regulated by a plastics chapter? The answer is the many light-transmitting applications for plastics in buildings. The need for a plastics chapter arose from the fact that plastic materials installed to transmit or diffuse light, or to decorate the exterior surfaces of buildings, are not interior finishes. There were and are in building codes performance standards for interior finishes, but until plastics chapters were adopted there were no performance standards for light-transmitting materials or exterior veneers. In the absence of such performance standards providing for the approval of plastic materials, plastics could not be employed for light-transmitting puposes or exterior veneers in most types of buildings. The plastics chapter in the building code fills this need.

The typical plastics chapter authorizes the approval of plastics for the following light-transmitting purposes: wall panels; glazing for unprotetced openings; roof panels; skylights; light-transmitting panels in monitor and sawtooth roofs; light-diffusing systems in ceilings; light-transmitting panels for partitions; awnings and canopies; and greenhouses.

In addition to the provisions governing light-transmitting applications, most plastics chapters contain provisions governing the use of plastics as an exterior veneer employed for decorative, but not for light-transmitting, purposes.

The use of plastics as the light-diffusing elements of electrical fixtures is governed by the electrical codes of most cities; and the use of plastics in pipe, if provided for, is governed by the plumbing code. The central problem in the acceptance of plastics for pipe is that of accepted methods of testing to establish that plastic pipe has the capacity to perform the function of the proposed use of the pipe. The inevitable absence of experience conclusively establishing performance equivalent to that of customary materials made it extremely difficult for the industry to overcome the understandable caution of regulatory officials, as well as the understandable, but regrettable, opposition of vested interests that seek to bar the acceptance of plastic pipe — not out of concern for its capacity to perform, but out of concern for its effect on their economic interests.

The Flame-Spread Problem

Speaking broadly, the scheme for regulation of plastics employed for light-transmitting purposes is similar to that adopted for the regulation of interior finishes. Where the interior-finish section of most codes classifies interior finishes according to their propensity to transmit flame across their surface, based on evaluation in the ASTM E-84 Tunnel, the plastics chapters classify plastics on a comparative basis in terms of their rate of burning and their burning characteristics generally, and then limit the use of the various classes of plastics to avoid a continuous surface of plastics over which flame might spread from one part of an occupancy to another. The pattern of control is, as in the case of finishes, keyed to the function that the material is serving. In the case of finishes, the assumption is that the potential hazard of a surfacing material is that it may be the means by which flame will spread from one part of an occupancy to another because, by its very nature, a finish is a continuous surface. Plastics employed for light-transmitting purposes need not be installed in such a manner as to provide a continuous surface over which flame may spread in order to perform the function of light transmission. In other words, it is not necessary, in order to take advantage of the many positive attributes of plastics for transmission of light, to employ them in such a manner that, as installed, they will create a flame-spread hazard. Plastic regulations rely heavily on the fact that the fire hazard of a finish can be designed out of an installation of plastics for light-transmitting purposes, and that the installation will perform its function economically and artistically.

Facilitating the solution of the possible flame-spread problem involved in the use of plastics is the availability of transparent and translucent thermoplastic materials which, when exposed to heat, will fall from their mountings and not become involved in a ceiling or wall fire. For example, plastic light diffusers installed in fluorescent fixtures in ceiling areas are required to be installed in such a manner that they will fall from their mountings at an ambient temperature well below their ignition temperature, but well above a temperature consistent with human presence in the occupancy below the ceiling area.

Similarly, thermoplastic glazing in windows, when exposed to an occupancy fire or a severe exterior fire, seldom, if ever, becomes ignited in place and, if it does, the ignition occurs only after a wall area is heavily involved in the fire. The area limitations, the separation requirements, and the limitations on the height of plastic glazing in most building codes are designed to protect against the remote possibility that, if installed without separation requirements and height limitations, the material might serve as a means by which fire would spread from one part of the structure to another.

The same technique of negating flame-spread hazard by setting area limitations and separation requirements is employed in the regulation of roof and wall panels supplemented by restrictions on the type of structure and occupancy. These limitations preclude sheathing or roofing high-rise structures or Type I and II structures with monolithic plastic light-transmitting panels.

This restrictive approach to the use of plastics is, of course, dictated by the fact that plastic materials are combustible and by the further fact that most forms of plastic glazing offer no more resistance to fire penetration

The law is that an approved plastic may be used in buildings in

standards for structural and fire safety

than ordinary window glass. An exception to this observation is glass-reinforced, polyester resin, which by virtue of the glass mat offers considerable more resistance to fire penetration than does plain glass. Indeed, a good quality, flame-resistant, reinforced polyester-resin sheet installed as a roof or wall panel may offer fairly substantial resistance to fire penetration even though, at least in the monolithic form, it cannot be rated as a one-hour fire barrier. Some compositions of such materials also have very low flame-spread ratings when evaluated in the tunnel. These materials may be employed as a sheathing for fairly substantial structures that are not required to have fire-rated exterior walls. However, their use for this purpose may be curtailed under some administrative approvals because of the tremendous amount of smoke emitted when exposed to severe occupancy or exterior fires.

The Problem of Smoke

The problem of the relevance of smoke to an analysis of the overall hazard involved in a proposed use of plastics is a subject of considerable controversy and investigation. The plastics industry has taken the lead in developing methods of test for smoke, and it has proposed legislation that requires disclosure of the propensity of materials to emit large quantities of smoke — not because the industry believes that any jurisdiction should undertake to regulate smoke, but because it believes that the tendency of a material to release tremendous quantities of smoke is a property of the material that should be considered by the regulatory official in making an appraisal of the hazards involved in a proposed use of the material.

The Future of Plastics

Science-fiction readers and some enthusiastic proponents of plastic materials who expected plastic houses, plastic cities, and plastic-sheltered sports arenas to be commonplace by 1970 sometimes blame antiquated building codes and the bias of building officials for the slow progress of plastics in the building field. In my judgment, building code provisions for the use of plastics, and the open-minded, receptive attitude of building officials toward the use of plastics, have facilitated the use of plastics in buildings and made possible modest but sound technological progress by the plastics industry in this vital and challenging market.

Does this mean that building-code provisions that restrict the use of currently available plastics will make it impossible to fulfill the vision of the science-fiction writer and the aspirations of the more zealous proponents of plastic structures? The answer is emphatically no, because under virtually all building codes the key to acceptance of structural materials is performance. If the plastic structure meets performance standards for structural and fire safety, it will be accepted.

Can current plastics, which do not meet present-day performance standards for conventional structures, be used to build unique structures such as geodesic domes, to enclose such exotic structures as suspended pedestrian walkways? The answer is yes — on a special-permit basis — because most of the geodesic structures and other large space enclosures that employ plastic as the skin or as light-transmitting elements of the structure have been approved on a special-permit basis. Building officials are often willing to grant such permits where the exposure situation is favorable because lightweight, shatter-resistant, resilient plastics are the safest materials to use under the circumstances and often are the only materials that will enable the architect to accomplish his and his client's objectives.

Considerations that support an administrative decision to permit plastic materials to be used to enclose large structures include the following: use of a plastic material can reduce the load-bearing limits that would be required to support the weight of glass; use of a plastic material can eliminate the shattering hazard of glass; a plastic material can withstand movement without cracking; thermooplastic materials will vent a fire and thus protect exposed structural elements in the event of an interior fire; plastic can be supplied in colors and configurations that will control light and reduce heat gain and heat loss.

Whenever an exception to current limitations on the use of an approved plastic is requested, it is relevant to present information on the response to fire exposure of the plastic material as employed in the structure. When properly selected and installed, even elements made from slow-burning plastics (an ordinary combustible) will not aggravate the hazard of either an interior or exterior conflagration. It should be borne in mind that the critical issue of fire safety is not resolved merely by analyzing the ignition and burning characteristics of the materials, but by investigating the response of the material, as used, to a fire exposure of the sort reasonably to be anticipated under the conditions of use. If an unacceptable level of hazard is considered to be present after such a study is made, the hazard can be further reduced by providing sprinkler protection or automatic mechanical venting to prevent development of destructively high temperatures.

If the architect will realize that he can substantially control hazard through design that takes into account the fundamental principles of structural and fire safety, he can accomplish great things even with the less-than-perfect plastics of today. Most suppliers of plastic material will work with the architects in conforming uses of their materials to the performance standards of the applicable building code, and in obtaining special permits for unconventional structures and techniques. If we work together within the frame of reference of modern performance codes to explore the role that plastics can play in creating new structural forms and new solutions to some of the age-old problems that have limited the scope of our undertakings to enclose space, building officials will respond sympathetically; and future generations of architects and builders will be prepared by our accomplishments as well as by our frustrations to take advantage of the improved plastic building materials that may even now be gestating in the test tubes of precocious synthesizers.

accordance with the terms of its approval

Plastics: The Next Decade

In forecasting the future of plastics in building, Professor Dietz, offers his views on composite materials and structure, high-strength/high-stiffness fibers, filament winding, continuous generation, constraints, fire, and costs.

Forecasting future developments is always risky, and this is no less true of the future of plastics than of any other aspect of building. The potentialities are great, but the constraints and the problems to be solved are no less great. Realization of the former will depend upon resolution of the latter.

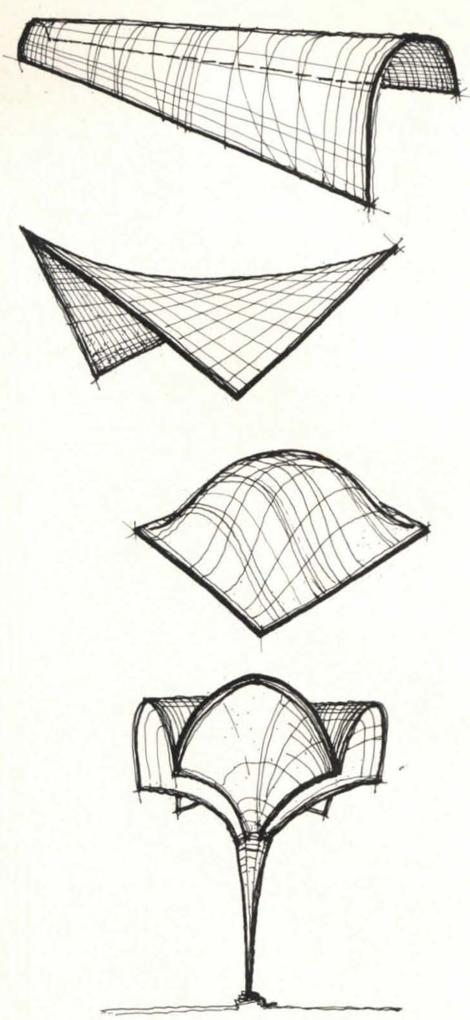
Extrapolating from present trends, it seems probable that in the immediate future plastics will continue to make progress mainly in those areas in which they are already well established. This includes principally interior and exterior finishes for floors, walls, ceilings; architectural trim; moisture control; insulation; natural and artificial illumination; hardware; piping; fixtures; and many miscellaneous items.

These nonstructural uses will be accompanied by exploration of structural and semistructural applications of plastics, either by themselves or in combination with other materials, in conventional and unconventional forms. Some of these can be expected to result in practicable economical solutions of building problems, and to become firmly established. Others will undoubtedly prove impractical and disappear.

In this discussion, an attempt is made to explore some of these newer trends, to speculate on possible developments, and to delineate some of the constraints that must be solved if such trends are to be successful.

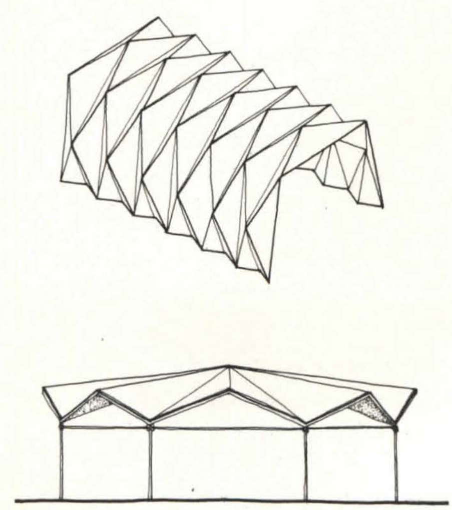
Composite Materials and Structures

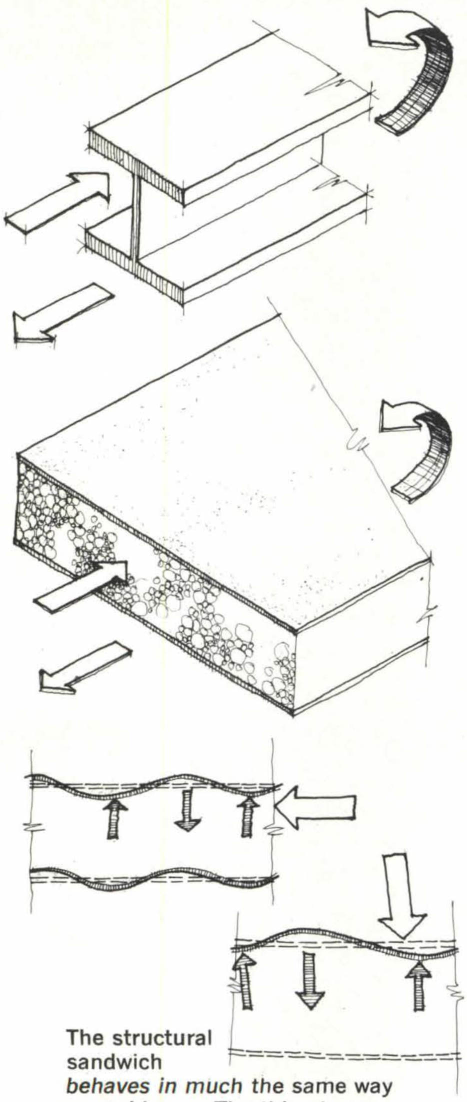
As was pointed out in the introduction to this issue, unmodified plastics are moderately strong but low in stiffness. When combined with high strength, higher stiffness fibers such as glass, the resulting composite, or reinforced plastic, can be employed in lightweight, strong,



Structural plastics lend themselves particularly well to efficient shell forms such as the conoid, hyperbolic, paraboloid, dome, or free form.

Several types of folded plates that make efficient use of thin structural materials, providing strength and stiffness with a minimum of material.





The structural sandwich *behaves in much the same way* as an I-beam. The thin strong facings act in a manner similar to flanges; the continuous lightweight core provides a tie between the facings similar to the web of an I-beam. The core also stabilizes the facings against wrinkling under compresssive stresses. The facings provide the internal resisting couple and the core takes up shear.

General view of German reinforced-plastics house incorporating molded glass fiber-reinforced plastic shells plus sandwiches for floor and interior surfaces.

Erection of house showing room panels, full length, being joined to molded wall panels. (Photo: courtesy Wolfgang Feierbach)

tough, and often light-transmitting structures.

They are particularly well suited for shells, folded plates, and sandwiches, for which they have some inherent advantages. Among them are: **Formability:** Fiber-reinforced plastics have no inherent shape. They begin as liquid resin and masses of fiber and must be molded into final form. Consequently, it is possible and desirable to employ shapes that are economical of material and efficient structurally while providing space that meets the use requirements. For reinforced-plastic composites, therefore, shells of single or double curvature, ribbed and folded plates, and sandwiches with thin strong facings on thick lightweight cores are better than standard I-beams or similar forms.

Lightness and Toughness: Unit weight of plastics, including fiber-reinforced plastics, is considerably *less than* many standard construction materials. Furthermore, their toughness allows thin sections to be employed, unlike hard brittle materials that must be relatively thick. Consequently, dead weight is reduced, thus reducing weight of supporting members and foundations.

Light Transmission: In the thin sections possible with reinforced plastics, a high degree of translucence can be achieved, thus combining light transmission with structure and enclosure.

There are limitations that must be recognized and observed.

Moderate Stiffness: Even with high-strength fibers incorporated in them, the stiffness or elastic modulus of these materials is only moderately high. Consequently, advantage must be taken of their formability to provide inherently stiff shapes such as shells, folded plates, and sandwiches.

Cost: The per pound cost is relatively high, compared with standard structural materials, so each pound should be stretched to its *utmost;* another reason for inherently efficient shapes.

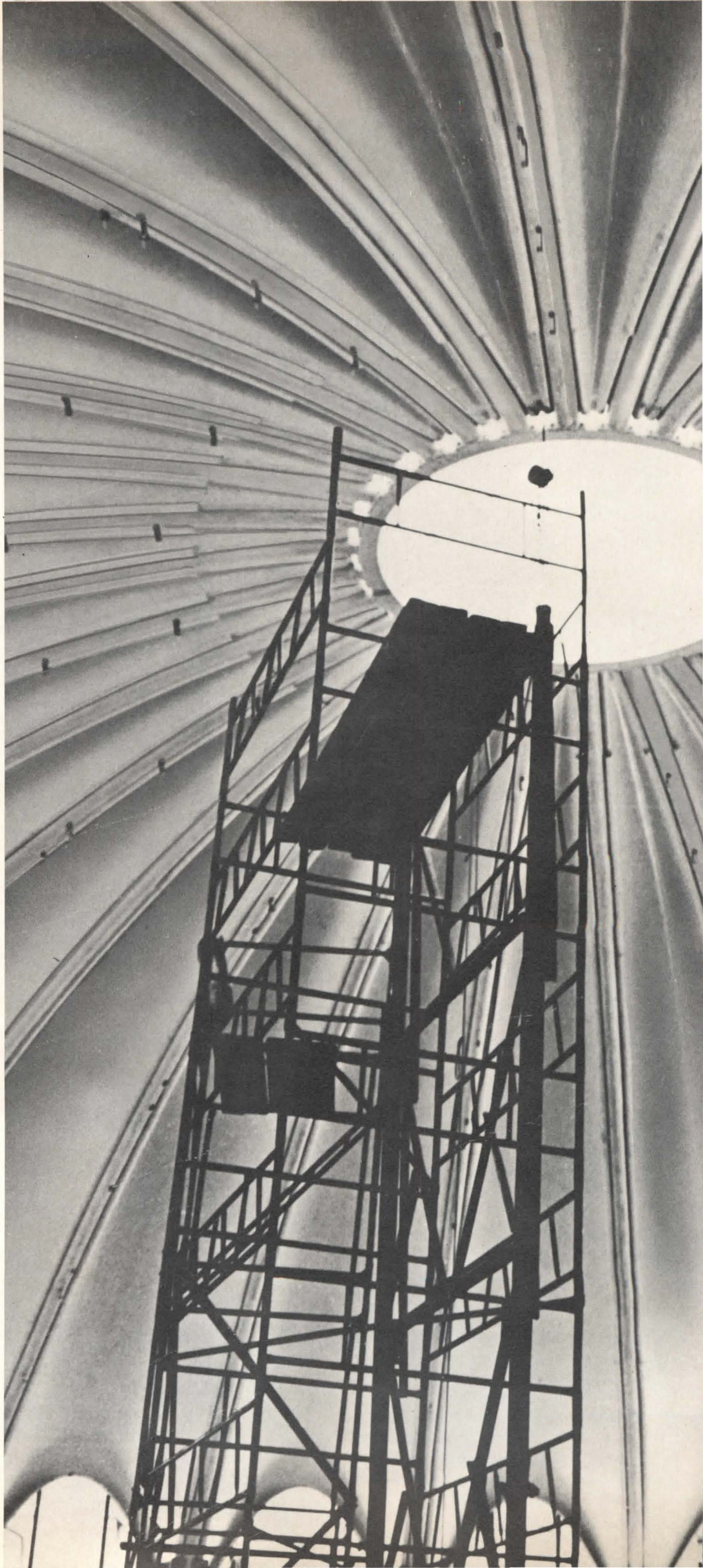
Uncertain Durability: These materials are still relatively new, and long histories of exposure do not exist for many of them. Some, however, such as the acrylics, polyvinyl chloride, the fluorides, silicones, and some of the reinforced polyesters, have histories extending over 15 to 25 years or more of outdoor use. Each year that passes adds to experience respecting long-time behavior.

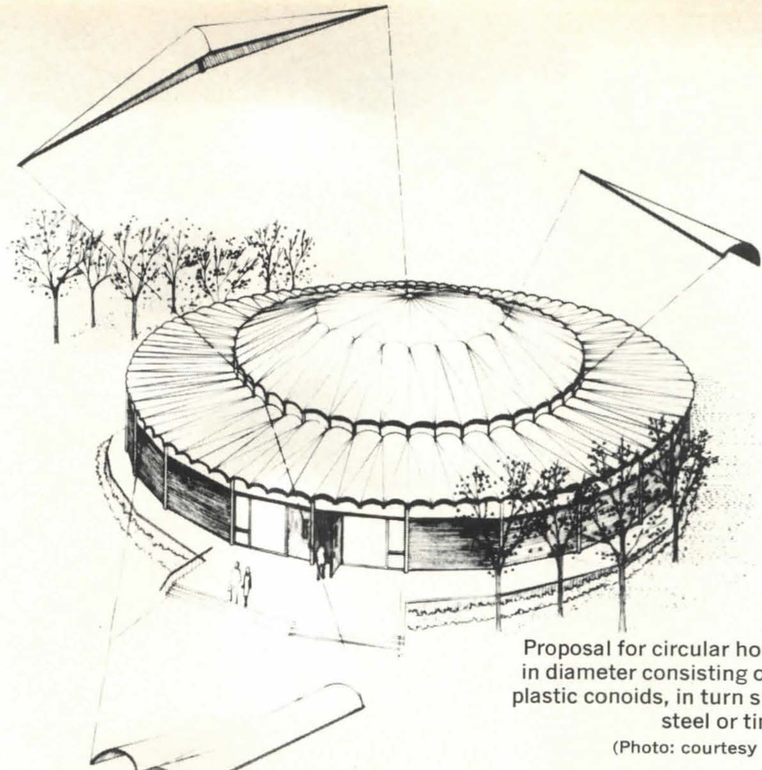
A recently developed dwelling house in Germany carries along the concept of shells and sandwiches. The doubly curved outer shells are thin but inherently stiff and strong when combined with floor, ceilings, and inner wall surfaces into sandwich-shells spanning the width of the house.

Examples of shells, folded plates, and sandwiches are shown.

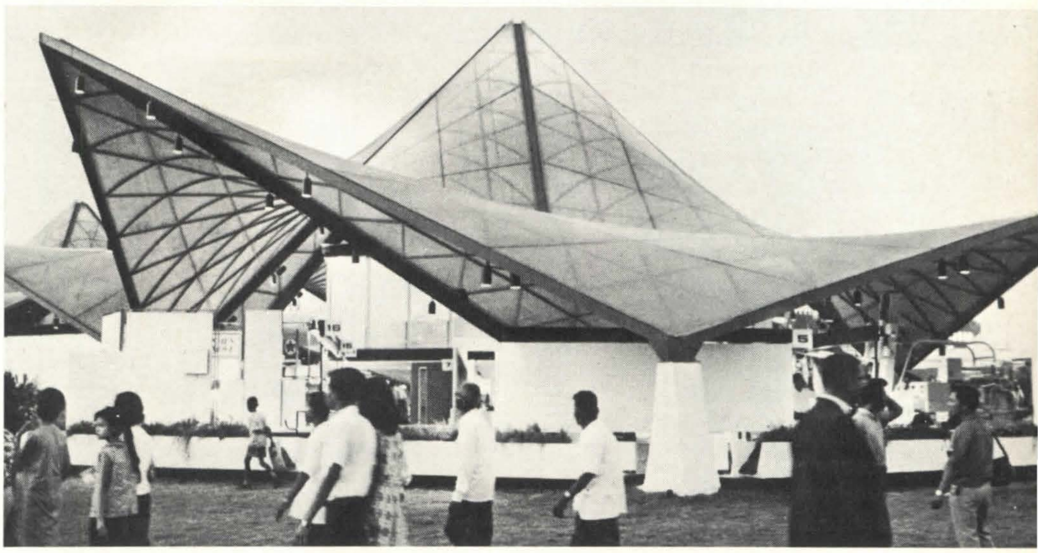
High-Strength, High-Stiffness Fibers

Because of their highly favorable strength-to-weight ratios, fiber-reinforced plastics structures are extensively used in space vehicles,





Proposal for circular hospital 100 ft in diameter consisting of reinforced plastic conoids, in turn supported by steel or timber frame.
(Photo: courtesy Frank Heger)



Hyperbolic paraboloid at Bangkok International Fair consists of glass fiber-reinforced plastics approximately 1/10-in. thick fastened to steel edge ribs. The roof is highly translucent. (Photo: courtesy United States Information Service)

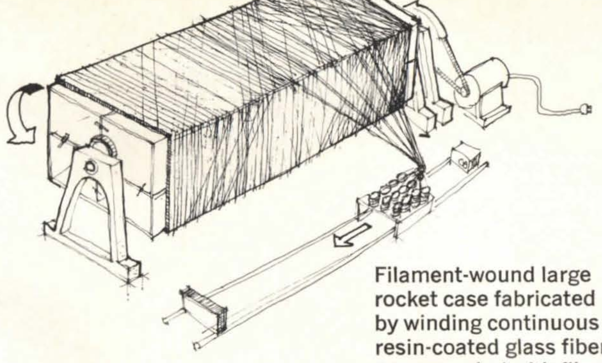
but their usefulness in many such applications is limited by their only moderate stiffness, even though this is considerably better than unmodified plastics. The search for other strong and lightweight fibers of much greater stiffness is, therefore, being intensively pursued on a worldwide scale by aerospace research workers.

Among the most promising of these strong stiff fibers are graphite, boron, beryllium, and various carbides such as silicon carbide. These all can achieve strengths considerably in excess of structural steel and the equal of the highest strength heat-treated steel wire, at small fractions of its weight. More important, their stiffnesses can be several times that of steel. These fibers are still highly experimental, although graphite, for example, is already used in making composite compressor blades for jet engines. Costs are high and completely out of sight for building purposes at present. Whether costs can be made attractive in building applications remains to be seen.

Even more exciting, but still more experimental and costly, are the "whiskers," or extremely fine single-crystal fibers, almost free of internal defects, that approach their theoretically achievable strengths and stiffnesses. Medieval silversmiths are said to have no-

Circular domed market building in France consists of curved conoids of glass fiber-reinforced plastics bolted to steel peripheral tension ring and pipe ribs.
(Photo: courtesy Stephane du Chateau)

Filament-wound large rocket case fabricated by winding continuous resin-coated glass fibers on a mandrel with fibers oriented in various helical, circumferential, and logitudinal directions to meet the imposed stresses.
(Photo: courtesy Aerojet)



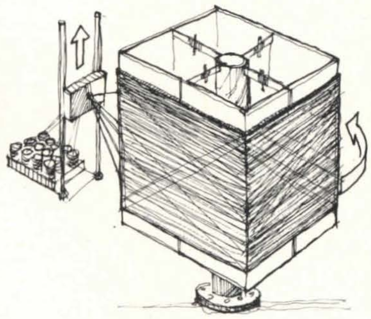


Diagram of filament winding technique. As the mandrel rotates, glass fibers pass through a resin bath and are wound on the mandrel by a mechanism that moves back and forth as the mandrel rotates. The mandrel may be horizontal or vertical.

ticed that if they stroked heated silver surfaces, fine hairs would develop. These were "whiskers." Fine crystals of materials such as aluminum oxide (sapphire) and others are undergoing research and development for aerospace vehicles. It is conceivable that in the future, small quantities of such high-strength high-stiffness fibers and whiskers may be combined with larger quantities of lower cost fibers and matrices for building materials.

Filament Winding

In addition to the exploratory work on composite materials, aerospace research and development may contribute a useful fabrication procedure for building. This is the wrap-around technique exemplified by the filament winding of rocket cases, pressure bottles, and other aerospace components. By winding continuous strands of resin-coated glass filaments on a collapsible mandrel, high-strength, lightweight structures are achieved whose strength properties are tailored to meet the imposed stresses by orienting the filaments in helical, longitudinal, or circumferential directions as needed.

This technique has been tried experimentally to produce room-sized boxes with two thin layers or facings of filament-wound resin-coated glass fibers surrounding a core of lightweight plastic foam. An extension to wrap-around consisting of a combination of fibrous sheets, gypsum board, and honeycomb, has been proposed for industrialized housing production. Evidently, in the process, it is possible to incorporate stiffening and strengthening struts and ribs, and to vary the depths of walls, floors, and ceilings as necessary to carry loads within the boxes or superimposed upon them as they are stacked or incorporated into supporting structures.

Continuous Generation

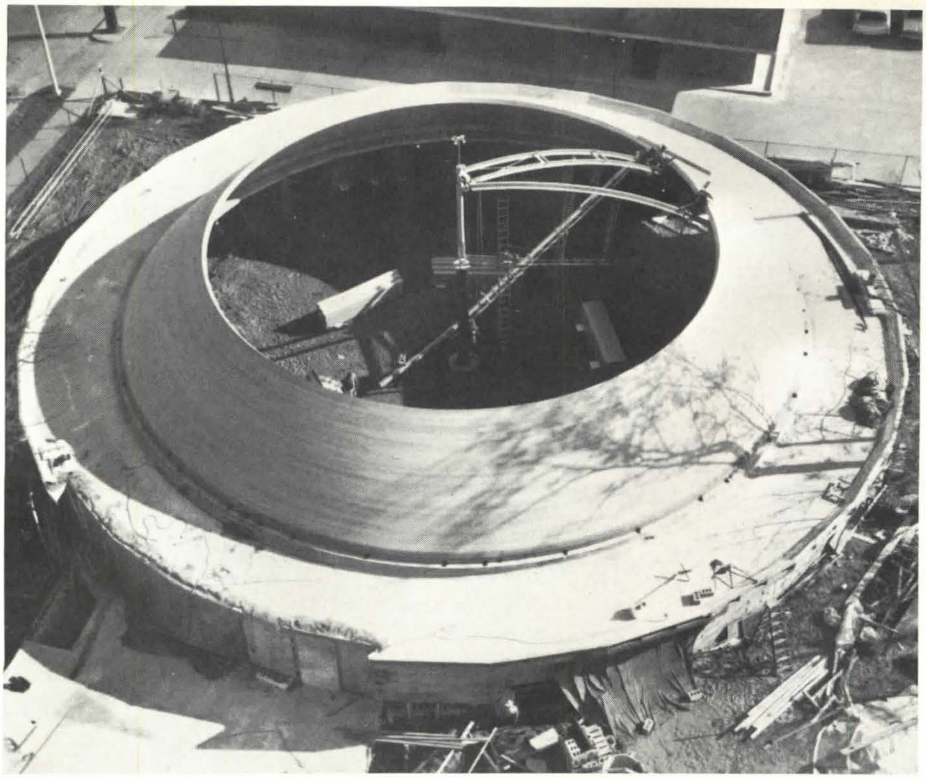
When fast-rising and hardening plastic foams were introduced, it was suggested that foam shells could be produced by placing a pair of small boards at the end of an arm pivoted at the other end, and pumping the fast-reacting liquid ingredients through a mixer just before they entered the form. By swinging the form around in an ascending spiral, a spherical dome could be continuously generated if the length of the arm was fixed. Other shapes could be generated by using an articulated arm that could be lengthened or shortened, or whose center of rotation could be shifted, to produce a variety of shapes. Other shapes could be generated; hyperbolic paraboloids, for example, by moving a linear slip along a pair of inclined edge ribs.

This procedure is now currently under research and development. Foams are being tried, for example, that generate a dense unfoamed skin on the surface, thus providing a sandwichlike structure with foamed core and dense facings.

In an analogous prodecure, pre-foamed plastic planks are laid down at the end of a rotating pivoted arm and welded together as they are deposited. Spherical domes are produced with arms of fixed length, ellipses, and other shapes by changing the length of the arm as it swings around. Foamed shapes such as these have been employed for shell-shaped buildings and for elliptical or spherical dome covers for water reservoirs.

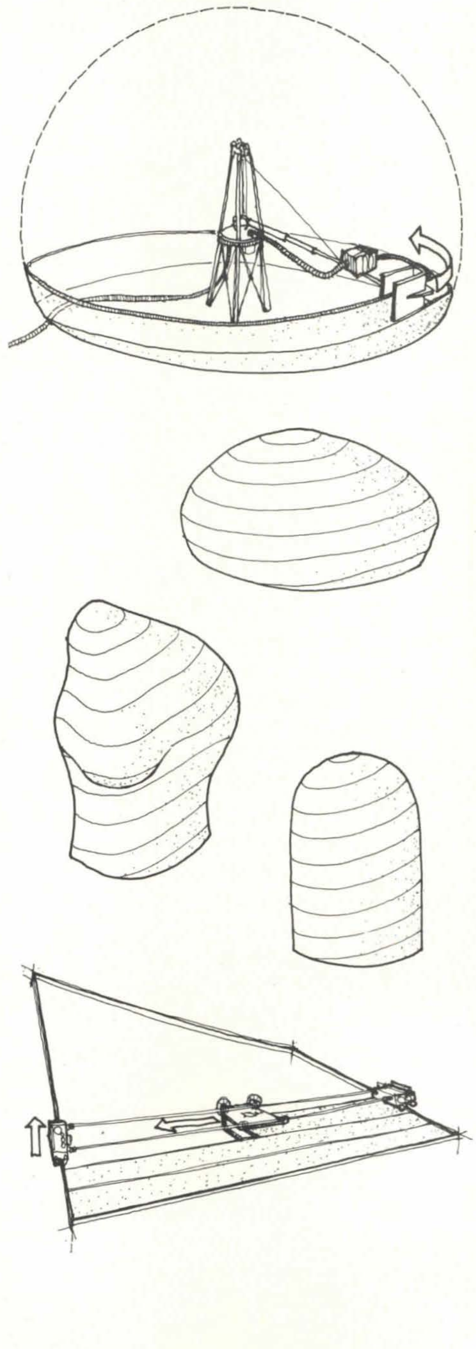
An extension of the idea of a form at the end of a swinging arm is to eliminate the arm entirely and have a computer-controlled self-propelled "bug" that lays down a continuous trail of quick-hardening material as it moves along.

Foam shells such as those generated continuously, although light in weight, have considerable structural integrity because of their shapes. However, they can be strengthened, for example, by spraying chopped fibers and liquid plastics such as polyesters, epoxies, or urethanes on their surfaces, thus providing strong sandwich struc-



Continuous genertaion of shell forms. Ingredients of fast-reacting foaming material are pumped into a mixer and immediately transferred into a small molding form at the end of an arm. As the arm rotates, a continuous layer of material is deposited. If arm is fixed in length, a sphere is generated. If arm is articulated, various shapes can be generated as desired. A moving slit running on inclined edge ribs generates a hyperbolic paraboloid.

Large dome is fabricated by laying down planks of polystyrene foam at the end of a pivot arm. As plank is laid down, the surface is heated, and welded to previously deposited foam. With an articulated arm, various shapes can be achieved. (Photo: courtesy Dow)



tures. Alternatively, reinforcing mesh can be laid over them and plaster or other finish applied on the inside. In these cases, the generated foam shell forms the base for other materials and eliminates the need for expensive molds or forms to achieve a wide variety of shell configurations.

Large Enclosures

The means are already at hand, or at least in sight, to provide enclosures for spaces possibly as large as entire communities. These means include shells, space-frames, and air-supported structures, singly or in combination.

Rapidly developing means of enclosing large spaces are provided by air-supported structures. Thin membranes enclosing a space are held in position by internal air pressure. The principle is simple: as long as a membrane is in tension it will retain its shape. Consequently, if the air pressure inside the enclosure is high enough to maintain tension in the membrane against loads such as snow, wind, and rain, the structure will not collapse.

The simplest such structure consists of a single flexible membrane fastened along its edges and inflated. Inflation pressure need only be high enough to support the membrane and to withstand external loads. Pressures may be surprisingly low, usually a small fraction of a psi. Inflated radomes of ruber- or vinyl chloride-coated fabric such as nylon or glass are designed to withstand winds of 150 mph velocity.

When spans become large, as in the United States Exhibit at Osaka's Expo '70, cables may be needed to reinforce the membrane and provide anchorage at the periphery. This super-ellipse (470′ x 270′), of exponent 2.5 instead of the usual 2, is supported by air at a pressure of only .002 atmosphere and held by cables 1.5 to 2.5 in. in diameter anchored at their ends to a heavy concrete peripheral ring.

That heavy ring is important, and a clue to a principal limitation on the sizes of simple air-supported structures. Although the internal pressure is low, when multiplied by a large area the resulting uplift forces along the edge become high, and call for great strength in the structure as well as heavy anchorage against uplift, hence, the cables and the concrete ring.

This problem of large peripheral forces, the problem of sealing the edges against leakage, and the need for air locks such as revolving doors at entrances, can be overcome by using double membranes enclosing air under pressure. The simplest is an inflated rib, or series of adjacent ribs such as were employed in the Fuji building at Osaka. Such a rib is held rigid by internal air pressure, but an arched rib, for example, exerts no uplift at its ends; indeed, its weight and any loads such as snow that might be superimposed, must be supported at the ends, as is true of any structural rib. Internal air pressure must be high enough to keep the membrane in tension, no matter what loads may be applied.

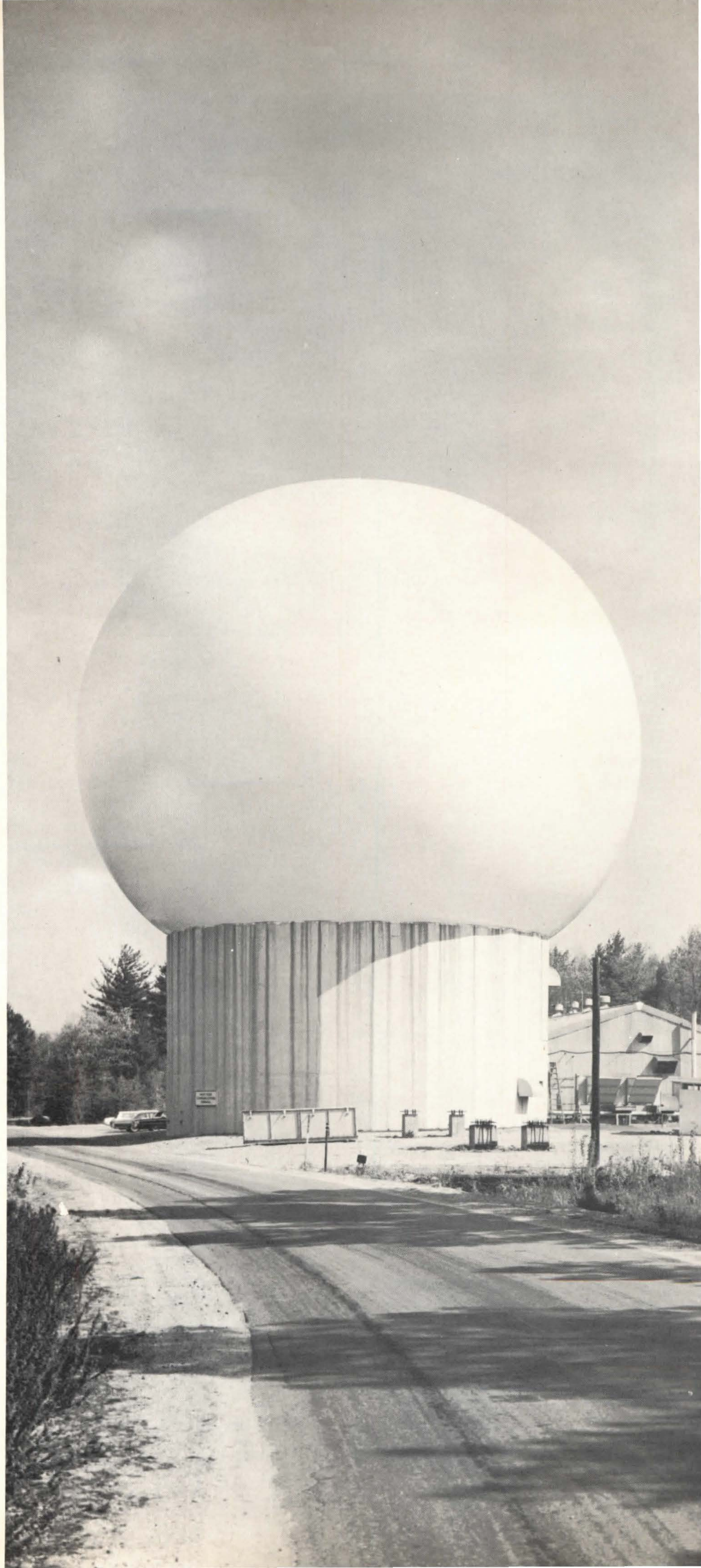
There are many variants of double membranes such as quilts, pillows, and intersecting or crossed ribs with single membranes between. Although they do not entail large uplift forces along the periphery, their spans are ultimately limited by their ability to support their own weight and superimposed loads such as snow.

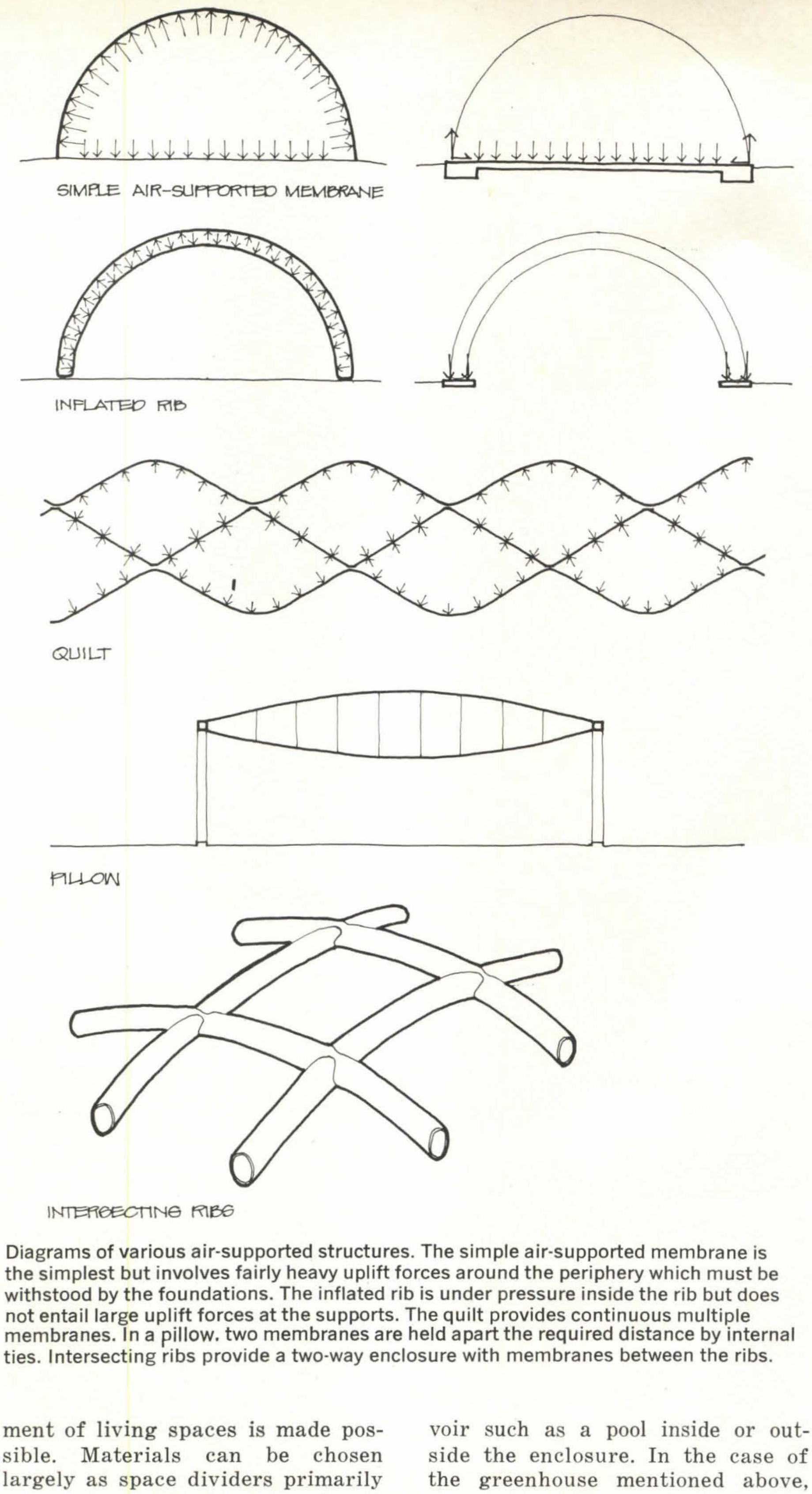
One means of overcoming span limitations is to provide intermediate anchorage points. With such a system, a simple air-supported membrane may be extended indefinitely. In one type of installation, for example, thin transparent plastic sheets are fastened along their edges to small cables. These, in turn, run to secondary cables whose ends are anchored to the ground by hold-down cables. Hold-down cables can be of any length, and permit the air-supported membrane to be high enough to go over trees or buildings, if desired. This system can evidently be extended indefinitely, and distances between anchorages can be varied by using heavier or lighter cables.

The system has been used in greenhouses an acre or more in extent. The thin, transparent membrane allows a high precentage of sunlight to penetrate, and pumps keep a constant stream of air flowing through the enclosure.

The ability to enclose large spaces, possibly large enough for entire communities, raises completely new possibilities with respect to architectural design, construction materials, and internal environmental control, including control of atmosphere pollution.

Rain, snow, and wind are eliminated, but sunlight may penetrate strongly or weakly, depending upon the transparency and composition of the enclosure. The usual weathering effects brought about by combined temperature variations, atmospheric gases, and moisture, including freezing and thawing, are either eliminated or greatly reduced. Greater freedom in arrange-





Diagrams of various air-supported structures. The simple air-supported membrane is the simplest but involves fairly heavy uplift forces around the periphery which must be withstood by the foundations. The inflated rib is under pressure inside the rib but does not entail large uplift forces at the supports. The quilt provides continuous multiple membranes. In a pillow. two membranes are held apart the required distance by internal ties. Intersecting ribs provide a two-way enclosure with membranes between the ribs.

ment of living spaces is made possible. Materials can be chosen largely as space dividers primarily for privacy, acoustical control, and control of light. Materials such as lightweight foamed plastics or inorganic foams, usually not weather-resistant, can be employed. They may need tough skins to resist wear and tear but not to resist moisture. Lawns, shrubbery, and trees must be irrigated. The water needed can be supplied, at least in part, by the rain runoff from the space enclosure, which can be led to a reservoir such as a pool inside or outside the enclosure. In the case of the greenhouse mentioned above, all of the irrigation water needed has been supplied by the runoff collected at the hold-down points and led by underground drainage lines to a pool. Practically all of the rainwater can be recovered in this manner.

Collecting Solar Heat

If we return to the large enclosure, with its possibility of overheating because of the sun, and at the same time examine the solar collector, it becomes evident that if the two are combined as a system, each may benefit from the other. One of the problems with the standard flat-plate collector lies in making it weather-resistant, leakproof, and able to withstand the rigors of year-round exposure. If a transparent enclosure is already provided, problems of weather resistance are greatly diminished and one less sheet of transparent material, which might well be the same as the overall enclosure, need be supplied. Not all of the enclosure need be devoted to collectors; only a relatively small proportion, facing toward the sun, would be required to heat and cool the "living" portions of the enclosed space.

Several interesting materials problems arise. For large enclosures, it would be desirable to have high-strength, tough, transparent membranes that could span considerable distances and, thus, reduce the number of cables needed and increase resistance to damaging agents such as hail. Glass fiber incorporated in the membrane could provide that strength, but mismatch of indices of refraction, and imperfect bonding between membrane and embedded fiber results in scattering of light at their interfaces with resulting decrease in transmission as well as in visibility. If indices of refraction of fiber and membrane were matched, and if perfect bonding of membrane and fiber could be achieved, a perfectly transparent film possessing great strength could be provided.

For those portions of an enclosure not associated with solar collectors, and, in general, for large window areas facing the sun, it is desirable to have a transparent material whose transmission decreases as the intensity of sunlight increases. Photochromic glass behaves in that manner, it darkens upon exposure to light, becoming darker as the light intensity increases, and becoming lighter as the intensity decreases. Speed of response needs to be improved, especially during the lightening phase, but progress has been made. The same effect, made available for any transparent material employed in large enclosures, could help to overcome solar overheating and glare.

If large enclosures become feasible, designers will have much pio-

ir-supported radome of coated fabric. Internal air pressure maintains shape against winds f 150 mph velocity. (Photo: courtesy Lincoln Laboratory) neering design to carry out, but behavioral scientists may have even more new territory to explore. How will human beings react to large enclosed spaces in which the environment is much more nearly controlled than is usual outdoors, but not so much as traditional indoors? For one thing, air pollution control should be much more feasible than in the present uncontrolled urban outdoors. Air drawn from outside can be filtered or washed. Rain is nonexistent, except for possible condensation dripping from the enclosure — another problem for designers and scientists to combat. Will people tend toward an opener "outdoor" life under the giant enclosure? Will this lead to more communal living? Will the present compact dwelling give way to a series of disconnected cubicles where absolute privacy is needed, with only screens used elsewhere? Or will people simply refuse to live in this kind of enclosed space?

Some inkling may be obtained from a young student couple who lived in this kind of bubble for several weeks. It covered an area of 18,000 sq ft; part of the bubble was fabric-lined and only moderately translucent, and constituted the "living space," but it opened directly onto the "garden space" under a transparent canopy covering a lawn (at first natural, then artificial) and a small pool plus shrubbery and some small trees. They enjoyed it immensely, but preferred the artificial lawn (no watering needed, less humid), and did not live in it for an extended period. Plans are now underway to place perhaps 50 university students in such a space for an academic year, to determine livability and their reactions to such an environment, which will include the winter, spring, and fall seasons, and possibly the summer. Universities are considering still larger enclosures for academic complexes. Sociologists and architects are looking forward to the experiments, but are keeping open-minded about it.

Constraints

If plastics are to fulfill their seemingly indicated function in future building, a number of constraints will have to be overcome; and the limitations, common to plastics as to all materials, must be circumvented or accommodated. Among the more serious constraints and limitations are codes, prediction of performance, the evaluation of innovation, fire resistance, cost, and unfamiliarity with the materials on the part of designers and unfamiliarity with the building industry on the part of plastics suppliers.

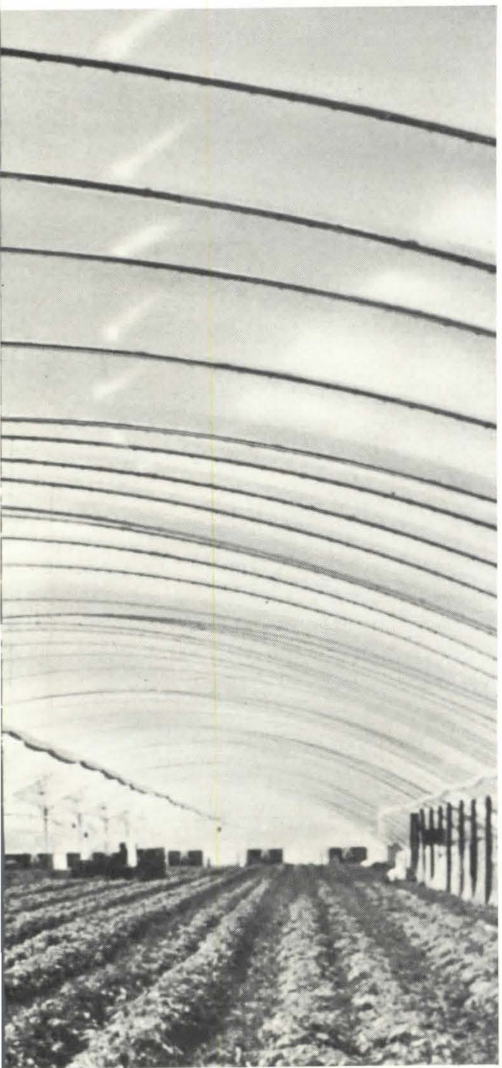
Prediction

Many plastics are relatively new and have no long history of actual use in buildings or in similar applications; consequently, their probable behavior in buildings must be

Greenhouse, 1 acre in extent, consists of transparent 5-mil-thick sheet fastened along edges to cables, in turn, fastened at their ends to secondary cables held down at intervals by cables going to ground anchors.

extrapolated from relatively short-time tests carried out in a laboratory. Such predictions are frequently uncertain because completely reliable short-time tests that will predict long-time behavior are often not available. This is particularly true of weathering. The complexities of the weather and the interactions of the various constituents of the atmosphere combining with solar radiation and temperature variations are not completely understood. Consequently, it is difficult to develop laboratory tests that faithfully reproduce the long-time effects of weathering. With established materials that have a long history of use, it is sometimes possible to correlate short-time tests with existing long-time histories and to extrapolate from them. This is not usually possible with new materials; there is, therefore, a pressing need for the development of testing procedures that can predict long-time behavior.

(Photo: courtesy Goodyear)



It is a rather singular situation that the vast inventory of buildings of all types, standing for short to long periods of time under all conceivable weathering and climatic conditions, have not been thoroughly studied to determine the behavior of materials under actual conditions of use. Such a study, including those uses of plastics that already exist, would be helpful in predicting the behavior of materials generally, including plastics.

Innovation

Many of the proposed uses of plastics in building are necessarily more or less innovative, and do not strictly follow established custom. There is no universally recognized central organization or agency whose function it is to examine innovative ideas and to determine their validity, to issue certificates or statements with respect to how those innovative ideas may be used, and how they may be expected to perform in buildings. The lack of such a recognized agency makes it difficult for innovative ideas of all kinds, not only those involving plastics, to be generally accepted. The innovator has a long arduous task in convincing skeptical designers, builders, public officials, owners, and others to accept his innovation. This difficulty is probably more severe with respect to plastics because they are among the newest materials, and their applications are less familiar than is true of conventional materials.

Fire

Since plastics materials are organic in nature, they, like other organic materials such as wood, can be destroyed by fire. This must be kept in mind when designing with plastics, just as is true of older conventional materials that can also be destroyed by fire. The evaluation of fire resistance is particularly difficult because of the complexity of fire conditions and the difficulty of developing fire tests in the laboratory that will predict fire behavior in the field. The flammability of materials is not the only important criterion; the rate and extent of smoke evolution may be equally important in a building fire. Existing fire tests are frequently criticized, not only by plastics people but also by manufacturers of other materials, as not being true indicators of fire behavior. Some fire tests seem to be unduly influenced by small variations in test conditions which may lead to large variations in results, in turn leading to uncertainty respecting their significance.

Costs

Costs per pound of many plastics materials are relatively high compared with conventional materials of construction; and, therefore, every pound must be stretched to its utmost to justify its use. On the other hand, the density of many plastics materials is relatively low; and, consequently, the volume occupied by a pound is higher than the volume occupied by many conventional materials. Since plastics are synthetic materials, the manufacturing cost may be fairly high, and the original research and development costs are, generally, also high. Until these are recovered, the per pound cost may remain high and, therefore, militate against their introduction into the highly competitive building field. It may be expected, however, that, in general, costs of plastics will be reduced as volume increases and, therefore, make them more attractive for building applications.

Unfamiliarity

This is probably the greatest constraint of all. Architects, engineers, builders, owners, public officials, financial institutions, and many others are unfamiliar with plastics and, therefore, hesitate to employ them. It takes some effort to acquire a knowledge of plastics and their properties, and not many practitioners have the time to devote to extensive study. Misapplications have resulted in disillusionment and disenchantment, and ignorance of the properties of plastics frequently results in lack of application where they would be advantageous. On the other side of the coin, suppliers frequently are unfamiliar with the requirements of building and may, for example, merely make their materials available to designers without putting them into a form or developing a system for application that the designer can use.

Generally speaking, the successful plastics applications have been those in which building needs were recognized, and plastics were offered in readily applicable forms.

 / By JOHN L. KMETZO, P.E.

Building Automation

In discussing automatic control of environmental conditioning in buildings, operational considerations, use of the computer, and architectural considerations are reviewed by a Senior Engineer of Syska & Hennessy, Inc., Consulting Engineers, New York City.

Control consoles, from which building mechanical and electrical systems can be operated, have been widely applied for the past 10 years or so. These consoles, their wiring and switching (or "multiplexing") equipment, and the sensing and actuating elements attached to individual remote control systems, are known as building automation systems.

Automatic control of environmental conditions in buildings is primarily accomplished through independent control subsystems associated with individual air conditioning or ventilating units, lighting circuits, etc. The building operating engineer must keep constant watch on the conditions in each of these separate systems to insure uninterrupted efficient performance and to make adjustments if necessary.

The consoles enable one operator *to exercise* "supervisory set-point control" over the individual control systems scattered throughout a building complex. Thus, from this central point the operator can: start and stop equipment; read temperature, humidity, and flow conditions; automatically record these conditions; reset the device controlling these conditions; and receive and acknowledge alarms.

Operational Considerations

Since a central console provides one operator with an overall knowledge of, and control over, a building's operation at any given time, manpower requirements are substantially decreased. Generally speaking, any degree of automation will result in labor economies. This has been the primary basis of economic justification for these installations.

In addition, an operator's accumulated experience enables him to become familiar enough with the building plant's characteristics so that he can take advantage of opportunities for improving the operating and maintenance performance. One of the major results of this will be the reduction of energy consumption. The accessibility of operating data and controls eliminates the need for additional manpower to realize these operating savings.

Implementation of any operating economies is severely limited without an automation system because the cost of manpower required to go out into the buildings, take a series of related readings, analyze them, and perform manual adjustments outweighs the energy reduction economies that might be attained.

The Computer

Installation has recently been completed on several automation systems incorporating a small digital computer. These are industrial "process control" computers costing from $10,000 to $50,000 and are considerably less expensive than the data processing computers with which the general public is familiar. On its simplest level, the computer replaces a large number of individual components that would otherwise be required. The automation system's functional performance remains essentially the same.

Beyond this, the computer provides the ability for automatic optimized operation of the building systems. This is an extension of any operating improvements an experienced operator is able to initiate. It can be especially important in a large building complex where an operator cannot continuously and systematically perform all of the tasks necessary for optimum operation of the building.

The successful adoption of these optimization procedures is highly dependent upon proper and thorough specification and implementation of the computer programming. A definition of these programming requirements should be based upon detailed analysis of building subsystem design characteristics, energy cost structure, and prevalent climatological conditions.

Thorough evaluation of suggested programming techniques for a given project sometimes includes preliminary simulation on a separate computer to reveal the relative economic merits of the various techniques. After installation, the optimization programming must be updated during the first few seasons of operation to incorporate observed characteristics of building behavior.

Architectural Considerations

While design of an automation system is primarily the concern of the consulting engineer, the architect must make certain provisions to accommodate it. Enough space should be allocated in the original design so that the control center presents an efficient and organized appearance and so that adequate working area is provided. The bare *minimum* floor area required is several hundred sq ft, and comfort conditions for the operator must be maintained. The central console area is generally located adjacent to a central mechanical plant, although it can also be located in a building lobby with the operations displayed to visitors as a public relations gesture.

Other provisions for an automation system should include primary electric power, conduit for the trunk cable connecting the console to remote locations, grounding provisions, and space for the remote equipment. These requirements are relatively modest and may be easily incorporated into the preliminary design of the building.

They should, however, be included in the early planning, for the owner and architect will then be able to postpone a final decision on an automation center until the project is well into the design stage.

Earthwork Specifications: Part I

That exact methods of specifications insure an equitable and precise relationship between owner and contractor is reinforced by the Chief Specifications Writer of Skidmore, Owings & Merrill, New York City.

There are a number of significant items that occur in the technical section on earthwork that require careful attention and exact methods of specifying in order to insure an equitable and precise relationship between the owner and the contractor. There are many unknowns that a contractor has to contend with in the construction industry such as unforeseen increases in labor and materials costs, bad weather, strikes, unavailability of specified material, etc. Why plague the contractor with poorly prepared earthwork specifications that would only add to his gambling with the unknown?

By writing precise, definitive earthwork specifications, spelling out clearly those items that should be included in the contractor's estimate and bid, and delineating those items which are unknown quantities, the *specifier* can reduce the risks both for the owner and the contractor. Firm bids should be based on known conditions and it is unfair to both owner and contractor to pay for items that may or may not materialize during earthwork operations.

Grandfather clauses, which require a contractor to excavate anything and everything he encounters, can work both ways. While the specifier may assume that he is protecting the owner by making the contractor responsible for all of the unknown conditions — such as rock, unmarked utility lines, and latent subsoil conditions, he may be inadvertently performing a disservice to the owner. The contractor in order to protect himself, under the terms of such a specification, must include a contingency in his bid to take care of these grandfather clauses. If these unknown conditions do not materialize during the earthwork operations, the contractor will have benefited at the expense of the owner. If the contractor has underestimated the unknown conditions, he can literally lose his shirt. In many instances, the parties to the contract often resort to the courts for a legal adjudication of their contested claims.

To reduce the unknowns, a changed condition clause should be added to the specifications as follows: "Should the contractor encounter, during the progress of the work, subsurface latent physical conditions at the site, materially differing from those shown on the drawings or specified, or unknown conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the drawings and specifications, the attention of the architect shall be called immediately to such conditions before they are disturbed. The architect shall thereupon promptly investigate the conditions, and if he finds that they do so materially differ, the contract price shall, with the written approval of the owner, be increased or decreased in accordance with such conditions."

Therefore, when the specifications state that "All material now in place shall be removed as necessary for the performance of the contract," it implies that the contractor must excavate to the required elevations and dimensions. However, if the contractor encounters subsurface or latent conditions differing materially from that shown or specified, the contract price would be adjusted accordingly as provided for in the language of the foregoing paragraph. As a result, the contractor bids without contingencies, thereby reducing his bid to the owner and the owner pays for only the extraordinary conditions as they arise.

The changed conditions clause is equitable in that it provides for these basic elements:

1. The owner should pay for the unusual or unexpected.
2. The architect or engineer shall determine whether the unexpected has occurred.
3. The work is stopped so that the unusual situation is not disturbed and can be assessed.
4. The contract price and time can be changed if there is a latent subsurface condition.

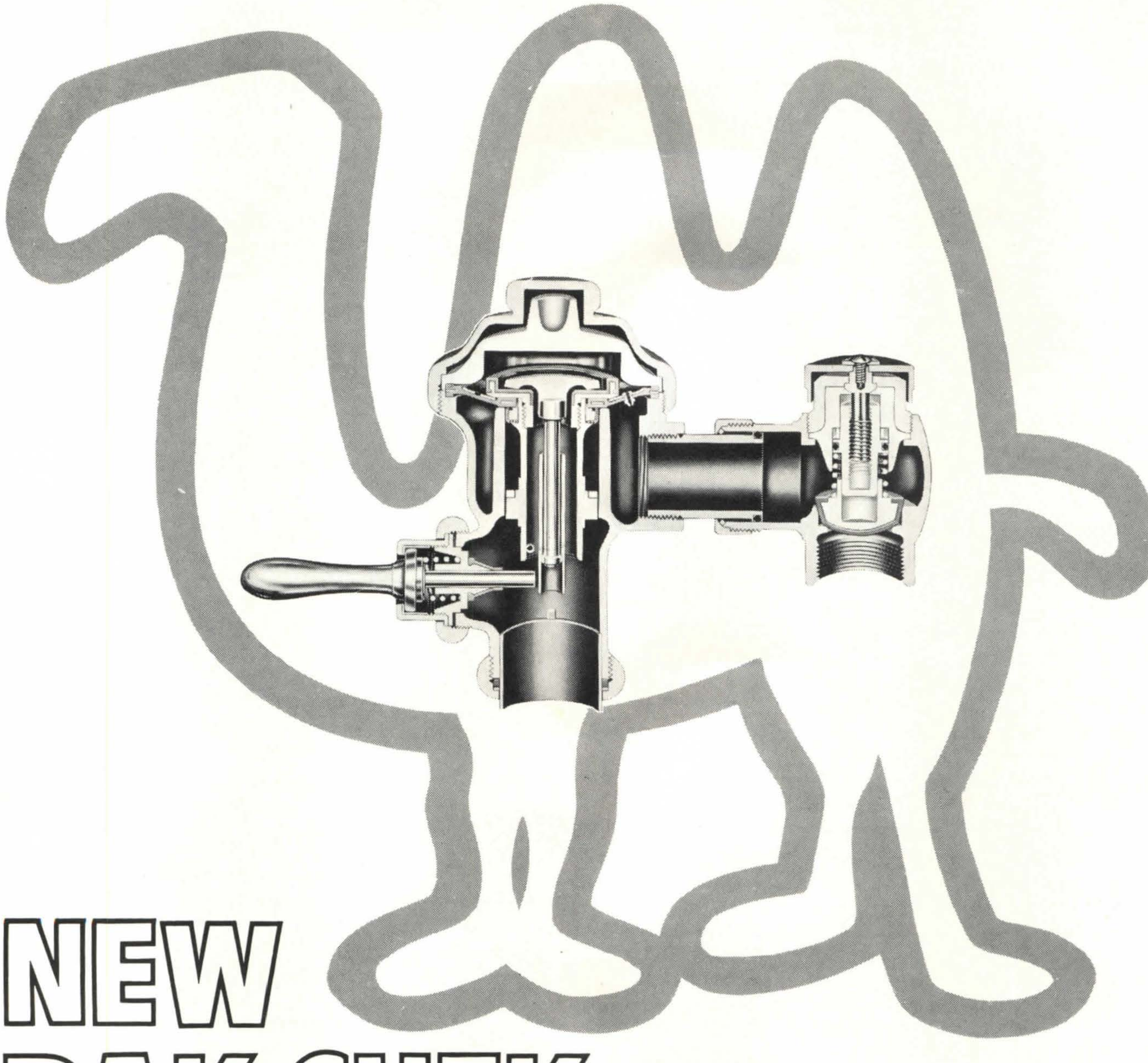
To avoid problems and provide for firm bids with respect to known and unknown utility lines that may be encountered during earthwork operations, the following clauses should be used:

"Existing utility lines shown on drawings such as cables, ducts, conduits, and piping shall, if damaged (unless they are to be abandoned), be immediately repaired, protected, and maintained in use until relocation of same has been completed, or shall be cut and capped where directed, or shall be prepared for service connections when so required."

"Any utilities encountered that are not shown on the drawings and are to remain as active utilities, if inadvertently damaged by the contractor, shall be repaired by him. An adjustment in the contract price will be made at rates determined and approved by the architect. If any extra expense is incurred in protecting and maintaining any utility line not shown on the drawings, an adjustment in the price will be made."

The above clauses relating to both known and unknown utility lines establish the criteria to be used in administering the contract. Known utility lines shown are the responsibility of the contractor and if any of these are damaged as a result of his operations, it is the contractor's obligation to do everything necessary to maintain them without additional compensation. In addition, where he encounters unchartered utilities, and additional work is required to protect or maintain them, he is reimbursed for this by the owner.

ANOTHER PLUS FEATURE OF SLOAN FLUSH VALVES . . .



NEW BAK-CHEK

retains water at normal line pressure to protect against supply line pressure failures

Our "camel" has a new way of storing water. By spring-loading the seat plug of the Sloan Control Stop, we now retain water at normal line pressure in the *control stop* and in the *flush valve* when not in use.

This new feature, which we call Bak-Chek, means simply that the retained water is *held* at *normal* line pressure regardless of a significant drop or loss of pressure in the supply line—even if a negative pressure develops. This prevents spontaneous flushing or continuous running flush valves when normal supply line pressure is again restored.

Bak-Chek is incorporated in all new Sloan Flush Valves as standard equipment—no extra charge. It is but one of seven flush valve features introduced by Sloan within the past eighteen months—seven more reasons for Sloan's continuing flush valve leadership. For the best in flush valves specify and insist on Sloan—most people do.

SLOAN VALVE COMPANY
4300 West Lake Street • Chicago, Illinois 60624

On Reader Service Card, Circle No. 371

IT'S THE LAW / By BERNARD TOMSON, District Court Judge, Nassau County, N.Y., Hon. AIA
and NORMAN COPLAN, Attorney, Counsel to New York State Chapter AIA

Incorporating Professional Practice

Should the architect or engineer incorporate his professional practice? P/A's legal team discusses the benefits and basic factors to consider.

As of this writing, there are 49 states which have adopted legislation permitting some or all professions to incorporate. The latest state to adopt such a bill is New York, which now permits the incorporation of architects, engineers, lawyers, physicians, and other professions. Under the New York statute, as in the case of many of the statutes in other states, all stockholders of the professional corporations must be licensed in their profession. The enthusiasts for corporate professional practice assert that the tax advantages of corporate practice dictate the corporate *form of* operation. Taxes, however, are not the only factor to be considered. Incorporation is not necessarily for everyone, and in making a decision as to whether or not to incorporate, the amount of income, kind of practice, aims and goals, how it affects the older and younger firm members, and the extent to which the firm can accommodate to the required disciplines, are all factors. Also to be considered is whether incorporation would engender any unwelcome reactions from clients.

If a determination is made to incorporate, the former partners become employees of the corporation, and the entire range of tax favored fringe benefits which are available to corporate employees generally, become available to the professional employee. For example, the corporation can purchase group life insurance policies and disability insurance policies, the cost of which is deductible by the corporation and, within limits, such cost is not taxable as income to the employee. Also, the corporation can adopt a plan to reimburse the professional employees and their dependents for all medical and dental expenses, which reimbursement would be a deductible corporation expense and not taxable income to the recipient.

The greatest benefit, however, to be derived from the incorporation of professional practice lies in a pension or profit sharing program. Contributions made by a corporation to an approved pension or profit sharing plan are tax deductible by the corporation, and the earnings of the plan are free of income tax. The benefits to participating employees are only taxable when and as received. These benefits are substantially greater than those that could be obtained under retirement plans available for the employees of partnerships or individual proprietors.

In considering incorporation to take advantage of a corporate pension or profit sharing plan, the amount of the professional's income becomes an important factor, as a determination must be made whether it is large enough to enable the professional to take advantage of the tax benefits and still have enough income for ordinary living purposes. By setting aside substantial sums of money to provide a large retirement fund, the architect or engineer may be depriving his practice of sufficient personnel, and hampering the growth of his practice by diverting substantial sums of money to pension objectives, rather than the hiring and development of professional employees who can maintain the practice and profits in later years.

Incorporation creates problems and difficulties which must be dealt with and with which the professional would not otherwise be concerned if he had continued in practice as an individual or as a partnership. For example, corporations are subject to penalties for undue accumulation of earnings. Officers' salaries may be deemed by Internal Revenue as unreasonable. There is a problem as to whether the accounts receivable of a partnership should be assigned to the corporation when it is formed, and whether, despite such assignment, such receivables will nevertheless be taxed to the individuals. To preserve its corporate status for tax purposes, there are many technicalities with which there must be compliance. These involve board of directors and stockholders meetings, accounting reports, withholding and Social Security taxes, corporate tax returns, transfer of insurance policies, etc. If there is not compliance with these technicalities, it is possible that Internal Revenue would withdraw its acceptance of the company as one entitled to corporate tax consideration. There is also a substantial possibility that there will be more frequent audits by Internal Revenue when operating in a corporate form, as compared to the partner*ship form.*

Architects and engineers may find corporate practice awkward and strange. However, benefits may be derived from this form of practice which are significant, and corporate professional practice will probably become increasingly popular. There are, however, many problems attendant upon the establishment and operation of a corporate professional practice. Whether or not to incorporate, and the procedures to follow in the event the decision is made to incorporate, require the assistance and guidance of experts.

On Reader Service Card, Circle No. 395

Whole Earth Catalog: Access to Tools.

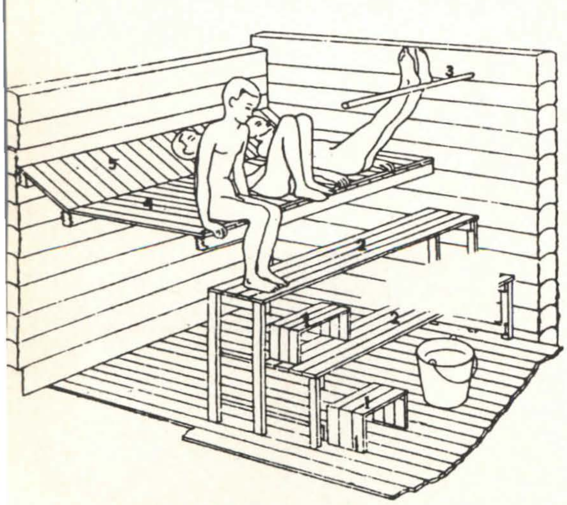
Portola Institute, Menlo Park, Calif., Fall, 1969. 128 pp. $4.

Reviewed by Forrest Wilson. *Mr. Wilson is editor of* PROGRESSIVE ARCHITECTURE *magazine and the author and illustrator of several books on architecture.*

Why should people either love or hate a catalog? Most people either can take Sears Roebuck's catalog or leave it alone. Not so with the Whole Earth Catalog (WEC). No less a collection of advertisements than Sears Roebuck's annual publication, it is, to many, a revolutionary document.

To appreciate the WEC, we will have to accept the fact that the language of revolution has changed. We can define language as a series of entities with rules for their combination. Words are identified and placed in syntax. Entities must be defined in such a way that they fit the rules, and rules devised to accommodate entities. Words out of syntax break the rules and obscure meaning.

The process of language — that of identifying things, combining them in proper sequence to create meaning — is in capsulation the assumption upon which our social institutions are built. Progress means that things are identified, put in their proper order, and then improved. In school we progress from grade to grade, the army advances from rank to rank, and the corporation hierarchy moves from junior executive to company president in much the same ordered fashion, first things first, in proper sequence as words are arranged in sentences.



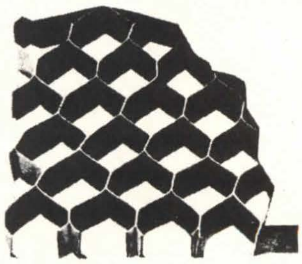
Finnish Sauna

The strength and affluence of America was built upon our ability to refine and improve the entities we brought from Europe; from the ballpeen hammer to the railroad trestle. Progress, we are told, rests upon our ability to make *better* toasters, automobiles, and airplanes, to get a better education, to improve the army's efficiency and to evolve more complex corporations.

The Whole Earth Catalog questions the validity of this incremental sequential advance to perfection. By the selection and juxtaposition of seemingly unrelated entities, it suggests that entities can be combined within other rules.

Despite our prejudice that progressive change comes from refining existing entities, the fact is that most of the technical innovations during the past few years that have had a major effect upon our way of life have not been sequential. Things do not improve; instead, they are supplanted by other things quantitatively different. For example, economical copying processes, devised to improve carbon paper, have been of major consequence to established information media such as magazines and newspapers and threaten to bankrupt the textbook industry. These effects could not have been foreseen by the innovators who began with the idea of mechanizing carbon paper. Multiple copying turned out to be, not better than, but quantitatively different from carbon paper.

The concept of the WEC has as much to do with the Sears Roebuck catalog as Xeroxing has to do with carbon paper. It is a collection of entities equivalent to words without syntax. In its pages one finds advertisements for self-built housing, from primitive earth shelters to sophisticated inflated structures, and books and literature on natural childbirth, natural food, hi-fi amplification, and strobe lights. The reader is invited to combine his own entities and to make his own rules.



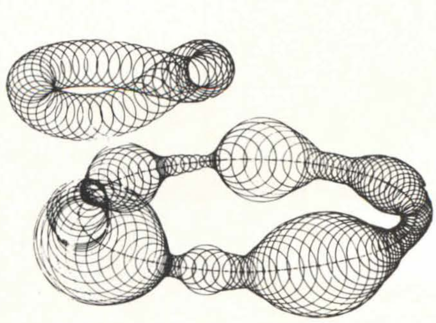
Plastics in Building

None of the items listed are new in themselves, that is, are improvements over existing things.

The WEC calls itself a list of tools and had its origin as a service to the communes of California. The listing of those things in the established culture that the counter culture finds valuable makes the Whole Earth Catalog a historic document. It is as personal as our neighbor's bathroom or his cellar workshop. We are fortunate to have at hand a documentation of what will be either an abortion or the birth of a new culture.

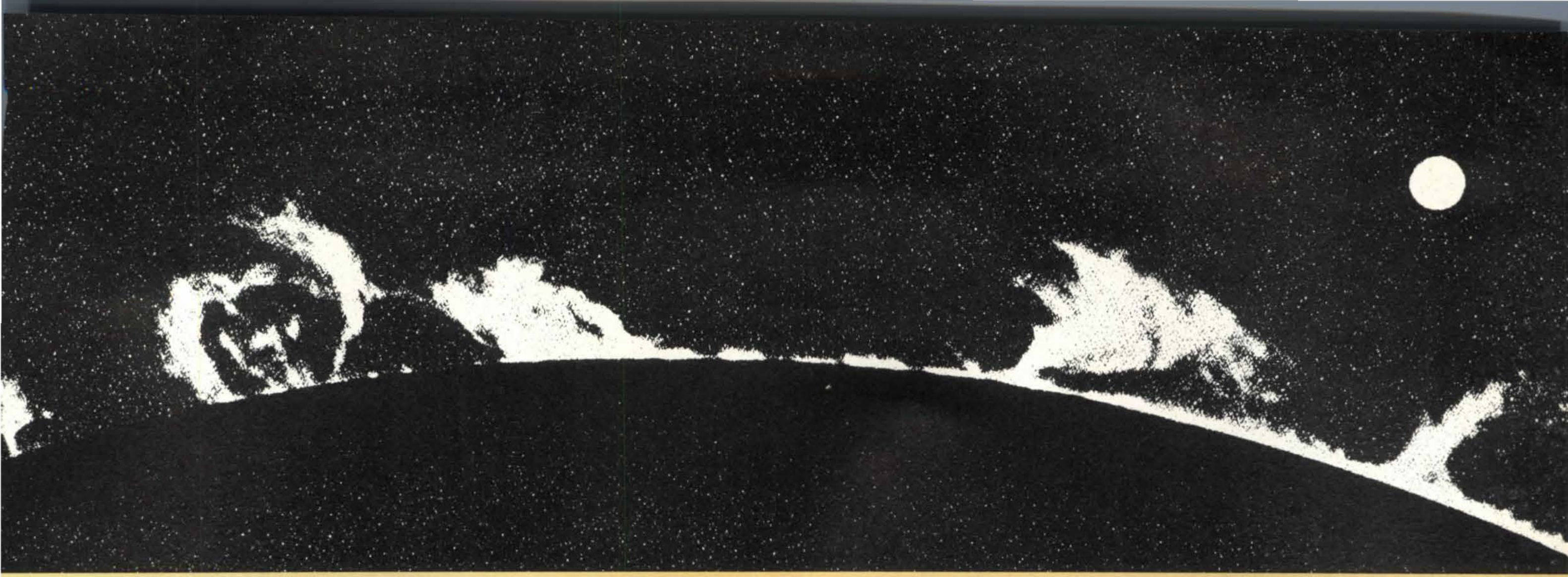
The WEC reflects the revolution in architecture that says architecture is only the perfection of building types. As architecture seeks to look for alternatives such as user-creation of his own environment, as medicine advocates patient-aid in his own cure, and law encourages the wronged to be his own advocate, they are, in effect, questioning, as does the WEC, the rules for combining entities which the established culture implies is the only way to find a meaningful existence.

People either love or hate the Whole Earth Catalog in direct proportion to how much they feel threatened by alternatives to their established way of life.



Tensile Structures

(Book Reviews continued on page 124)



Outside heat raises inside cooling costs. Zonolite can help reduce the problem at its foundation.

Look into Grace-Zonolite® Masonry Fill Insulation. It's incredible stuff. To put it another way, it's a lightweight, free-flowing, water-repellent, vermin-proof, rot-proof, fire-proof, sound-deadening, inorganic, granular vermiculite!

Year after year, it can deliver savings in cooling and heating dollars that far exceed the initial cost of the fill.

Other virtues? Yep.

Zonolite® Masonry Fill Insulation reduces sound transmission 20%to 31%. It increases a 2-hour fire rating to 4. It pours in at the rate of 28 square feet per minute. It's acceptable in FHA-financed housing.

Want all the details, test data, specifications, and such?

Say the word!

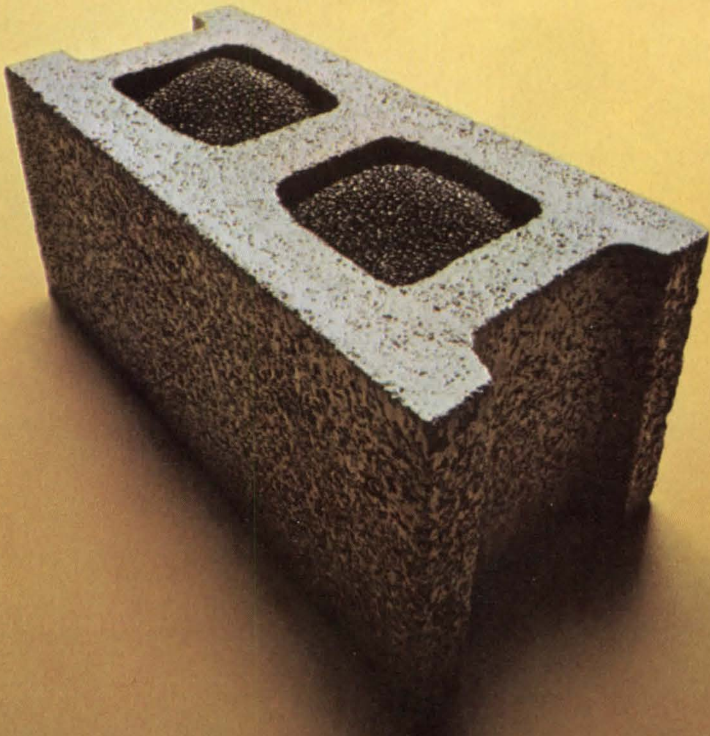
"U" VALUES—concrete block walls

Wall Thickness, Inches	Type of Block	Block Only: Unin-sulated	Block Only: In-sulated
6	Lightweight	.40	.26
8	Lightweight	.33	.17
	Heavyweight	.53	.36
12	Lightweight	.33	.12
	Heavyweight	.46	.25

ZONOLITE

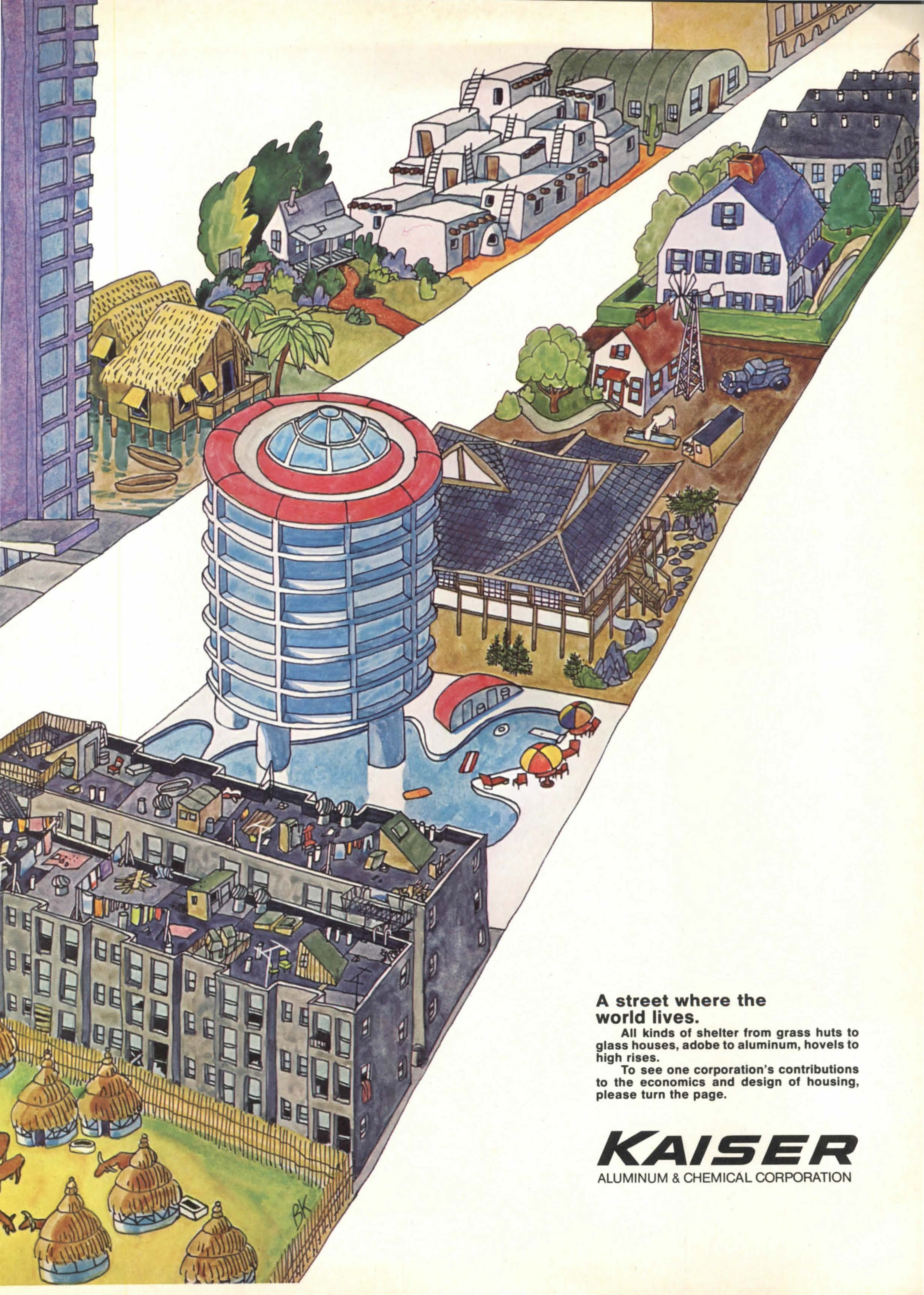
W. R. GRACE & CO.
62 Whittemore Avenue
Cambridge, Mass. 02140

GRACE



Just say Grace.

On Reader Service Card, Circle No. 385


BK

Shelter serves the same functions for man as do caves, dens, shells and nests for animals. Physiologically for protection. Culturally for communication.

Just as the covering on an animal's body is genetically determined, man's style of shelter is culturally determined. The "proper" style for human-built shelter is almost as rigidly limited by ritual as an animal's outer coating is by genetic code.

That contemporary man has, for the most part, elected to entomb himself in little cubicles is, at least, remarkable—considering the diversity of shapes and variety of materials available to him now.

Recent studies of the interactions between man and his man-made environments suggest that, on a crowded planet, a number of quite different solutions to the shelter "problem" may be explored in the next 20 years. Some of these possibilities are examined in depth in the second of a series of issues of our company magazine this year under the general title, "The Markets of Change."

This new series will become a companion book to "The Dynamics of Change," available from Prentice-Hall, Dept. D, Englewood Cliffs, New Jersey.

For your copy of the issue, "Markets of Change—Shelter", or information about any product shown here, please write: Kaiser Aluminum & Chemical Corp., Dept. L-13, Room 864, Kaiser Center, Oakland, CA 94604.

KAISER

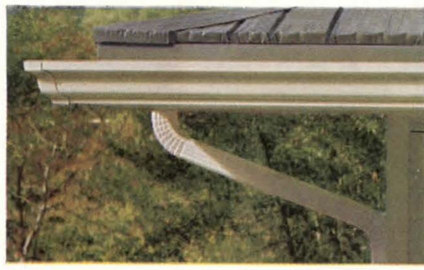
ALUMINUM & CHEMICAL CORPORATION

Serving "The Markets of Change" Worldwide. Aluminum, Chemicals, Computing, Specialty Metals, Mining and Exploration, Nickel, Real Estate, Refractories, International Trading.

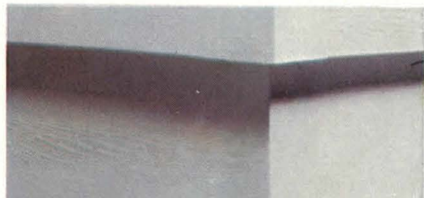
FIVE WAYS YOU CAN LIVE ON A BETTER STREET:

Advances for the shelter market, showing how Kaiser Aluminum & Chemical Corporation is serving the markets of change.

Kaiser Aluminum Rustic Shingle has the look of authentic hand-split shake.



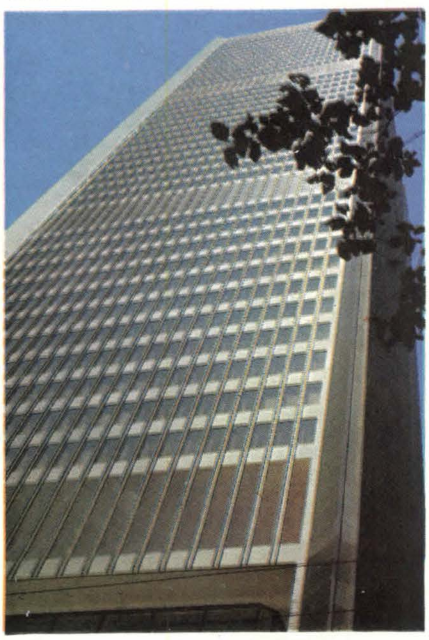
Aluminum rain-carrying systems, soffit & fascia, and shutters add distinctive touches to a truly low maintenance exterior.



Our Rough Sawn siding looks like freshly painted mill-textured lumber. Patented Sculptured Siding has the quality of expensive handcrafted carpentry.

1. A home that looks and feels like wood. Many times longer than freshly painted wood. Kaiser Aluminum "low maintenance exterior" doesn't need painting every few years. It won't rot or peel. A blessing for homeowners and a bargain for homebuilders.

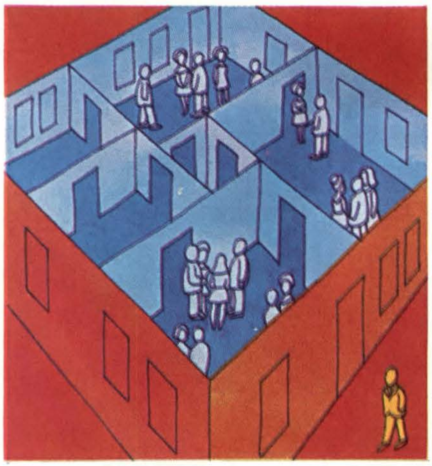
In the future, you'll see quality homes factory-made in modular aluminum units, easy to erect and maintain.



2. Almost every big new building now goes up with aluminum windows, aluminum doors, or an aluminum face.

Lightfast gold, amber, grey or black finished parts are Kalcolor® aluminum. The anodizing process that makes these uniform, durable and attractive color finishes possible is a patented Kaiser Aluminum development now licensed worldwide.

For new or renewal projects, still greater visual variety is attainable with our Mirawal® laminated building panels faced with porcelain enamel, aggregate, tile or aluminum.



3. Get an air conditioner and you'll have lots of company. Four out of ten U.S. homes now have one.

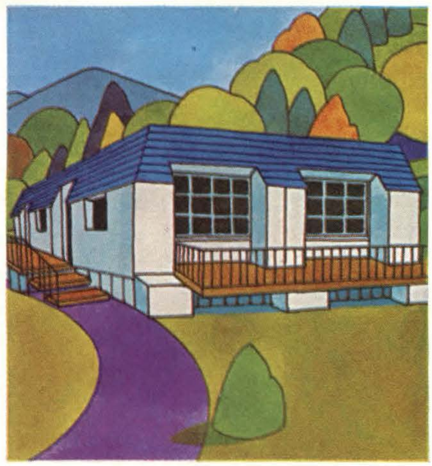
Our Kaiser Chemicals division produces the refrigerant, fluorocarbon gas that makes new home units comfortable, healthful and clean.

Aluminum sheet used throughout better models keeps them non-rusting.

4. President Nixon's executive office complex—at the Western White House at San Clemente, California—was manufactured by our Designed Facilities Corporation. They pioneered the integrated approach to design, manufacture and installation of permanent, code-approved buildings on an assembly-line basis.

Their structures have found wide acceptance as schools, offices (as shown above), motels and in a wide range of other light commercial building applications.

The attractiveness of their designs has been recognized through several architectural design awards.



5. Mobile homes attracted 400,000 new owners last year. One out of five new home buyers. To help manufacturers who build them, Kaiser Aluminum has fabricating Service Centers located where they're needed.

Aluminum gives people more of what they want in mobile homes. Residential styling. Minimum maintenance. High resale value.

We supply fabricated panels, accessories, and ideas—like new wood-looking board & batten panels that give a fresh residential look to well-styled mobile homes.

KAISER
ALUMINUM & CHEMICAL CORPORATION

On Reader Service Card, Circle No. 398

On Reader Service Card, Circle No. 329

BOOK REVIEWS

Three Books On: Struggle for Life on Spaceship Earth

Reviewed by Craig Hodgetts. *The reviewer is Associate Dean of the School of Design at the California Institute of the Arts.*

The Environmental Handbook, edited by Garrett DeBell. *Ballentine Books, 365 pp. 1970.*

Ecotactics, edited by John G. Mitchell with Constance L. Stallings. *Pocket Books, 1970.*

S.S.T. and Sonic Boom Handbook. By William A. Shurcliff. *Ballentine Books, 110 pp. 1970.*

When I left California in 1963 for the big city lights on the East Coast, the FSM (Free Speech Movement) at Berkeley had just had its first big bust. Mario Savio, Mike Rossman, and others were beginning to describe a new kind of education without hierarchy, without authority, without even buildings. A great consciousness of the interrelatedness and integrity of students all over the world was beginning to spring up. A sense of community, sharing, each other, began to flow, full of energy, hopeful. From my perch in New Haven, busy with the business of the Establishment, it seemed remote and even irrelevant. Our problems of slums, housing, jobs, welfare, graft, crime — the list of "the" problems of the sixties is endless — were too urgent to deflect for the luxury of community. It was too convenient to turn to technology for an answer. After all, wasn't the nation committed to landing a man on the moon by the end of the decade?

When Betty Schwimmer, a cofounder of Ecology Action, Berkeley, and an old friend from college visited, I found her notions preposterous and reactionary. The literary elite, I thought, had always been afraid of the machine and its obvious benefits. The American space-age plastic cowboy had the obvious answer to environmental problems and, like the Man from Glad, or the Lone Ranger, or John Wayne as a Green Beret, he was sure to have some gadget or other hanging around his Bat-Belt to boost the standard of living and free the subjugated peoples of the world.

I wasn't around when Stuart Brand, publisher of the Whole Earth Catalog, was running around with Ken Kesey and the merry pranksters either, but Tom Wolfe says, "Brand took some LSD right after an Explorer satellite went up to photograph the earth and as the old synapses began rapping around inside his skull at 5000 thoughts per second, he was struck with one of those questions which inflame men's brains: Why haven't we seen a photograph of the whole earth yet?"

And, that was it. The beginning of a cosmological consciousness that is only now emerging as the one issue big enough to hold all the radicals, and leftists, and Birchers, and, yes, the Ku Klux Klan, because it's the only issue that deals in the common currency of all of our paranoias, and that's survival. We had all known, all along, that the earth was round and

(Continued on page 137)

What on earth convinced a designer he could use beautiful wood flooring in high-traffic store areas?

PermaGrain™ did.

O'Neil's Department Store, Mansfield, Ohio, division of May Company

PermaGrain is real red oak impregnated with a liquid plastic, which is hardened throughout the pore structure by nuclear radiation. It has all the warmth and beauty of wood plus remarkable durability. Maintenance is minimal.

O'Neil's Department Store likes the warm, rich look it gives the store and the way it takes everyday rough treatment of foot traffic and heavily loaded stock trucks. Ordinary wood would have been scratched and gouged.

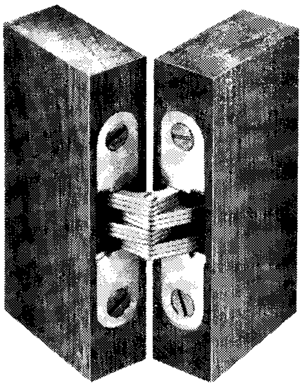
PermaGrain comes in 12x12-inch prefinished 5/16-inch-thick parquet tiles. Six colors are available: Natural, Provincial, Americana, Barcelona, Gothic and Charcoal. Installed cost is about $1.50/sq. ft. Decorative pickets and feature strips are also available for creating exciting designs.

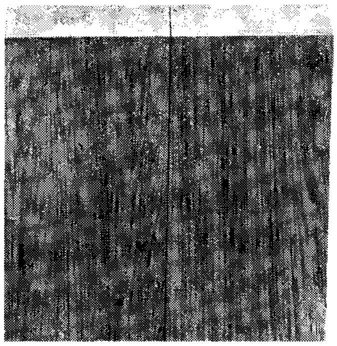
You don't have to design store interiors to take advantage of PermaGrain. Use it wherever you need that touch of elegance to set off walls, draperies or upholstery. Or wherever you want to complement an overall design.

If you'd like to know more about PermaGrain, call 800-243-6000 toll-free for the name of the dealer nearest you. (In Connecticut, call 800-942-0655.)

ARCO Chemical Company
Division of AtlanticRichfieldCompany
260 South Broad St.
Philadelphia, Pa. 19101

The hinge that hides





NOW YOU SEE IT **NOW YOU DON'T**

The Soss Invisibles—for a custom look for any room! These amazing hinges hide when closed, eliminating unsightly gaps, hinges, and door jambs. They're the perfect hidden touch for doors, doorwalls, storage cabinets, built-in bars, stereos, and TV's. Specify the Soss Invisibles wherever looks matter. See listing in Sweet's or write for catalog: Soss Manufacturing Co., Division of SOS Consolidated, Inc., P.O. Box 8200, Detroit, Mich. 48213.

the SOSS Invisibles

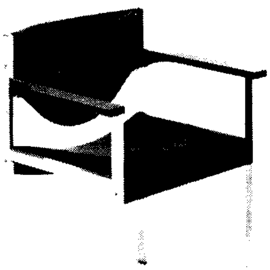
On Reader Service Card, Circle No. 394

Compotite waterproofing can result in a **fully tiled** shower area at no more than the cost of a tub or open-base receptor. For Compotite is less in price than any other shower pan material. Beautify your baths, upstairs laundry rooms, and other wet-areas with everlasting ceramic tile based on Compotite. Give her the tile she loves!

Compotite
Shower Pan

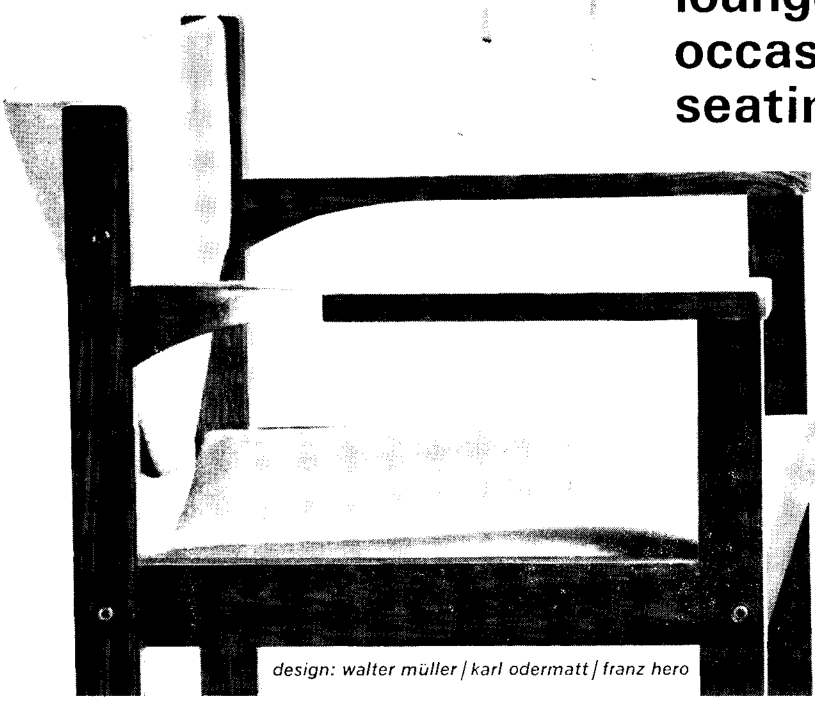
P.O. Box 26188
Los Angeles, California 90026
Phone: (213) 483-4444

On Reader Service Card, Circle No. 334



team form

conference · lounge · occasional · seating



design: walter müller / karl odermatt / franz hero

Team Form — with the refreshingly different seat and back — subtly, doubly curved for comfort.

The concept is Swiss. Manufactured with care here in the U.S.A. by Harter/Lübke. And offered with your choice of chromed steel, oak, or walnut frames. Write today for your brochure.

HARTER | Lübke

HARTER CORPORATION
1017 Prairie, Sturgis, Michigan 49091

On Reader Service Card, Circle No. 346

DESIGN
VERSATILITY

Conwed®

FIVE PLUS FIVE
CEILING
SYSTEMS

more........

Conwed®

FIVE PLUS FIVE CEILING SYSTEMS

FIVE PLUS FIVE MEETS YOUR REQUIREMENTS FOR DESIGN FLEXIBILITY, AESTHETICS AND BUDGET . . .

- **Lighting** — Five-foot modular light sources.
- **Air Supply** — Relocatable air supply devices.
- **Partitioning** — Modular partition-accepting grids.
- **Air Return** — Inconspicuous, compatible returns.
- **Acoustical** — Effective acoustical options.

No single ceiling system can meet every project's requirements. That's why Conwed created Five Plus Five . . . a truly total systems concept encompassing many ceiling system options. Five Plus Five gives you:

- **Lighting** — not one but FIVE options.
- **Suspension** — not one but SIX choices.
- **Air Supply** — not one but FIVE methods.
- **Air Return** — not one but EIGHT options.
- **Acoustical** — not one but SEVEN choices.

Let the knowledgeable Conwed professional field service team help you with ceiling plans and problems. For further information on Five Plus Five Ceiling Systems, see the Conwed section in Sweets Architectural File (No. $\frac{14a}{Co}$) or write: **Conwed Corporation, Dept. C 5+5, 332 Minnesota Street, St. Paul, Minnesota 55101.**

For information on flexible Conwed 7000 Series Partition system (shown on front) write Conwed Department C/P Partitions.

High quality (top right) . . . illustrated by this striking application of one Five Plus Five System. Unique ceiling design provides integrated air supply and high, non-glare light levels.

Higher quality (bottom right) . . . represented in this office remodeling project with well illuminated employee work area. Five Plus Five compatibility with partitioning is apparent.

Highest quality (left) . . . dramatically demonstrated by this customer service area in a newly-remodeled bank.

Ceilings created by your imagination can very likely be supplied by Conwed.

Conwed
CORPORATION

Front Page Photo

PRODUCT: 7000 Series partitions combined with Five Plus Five Ceiling System.

Left

PROJECT: East Lansing State Bank, East Lansing, Mich.

PRODUCT: Conwed 5+5, bays of 60"x60" regressed splays (perforated) 3'x3' fixtures.

ACOUSTICAL CONTRACTOR: Larry Brooks & Associates

Top Right

PROJECT: Western State Bank, St. Paul, Minnesota

PRODUCTS: Conwed 5+5, 30"x60" vaulted fixtures, ventilating grid and semi-concealed lay-in panels.

ACOUSTICAL CONTRACTOR: Hauenstein Burmeister

Bottom Right

PROJECT: Barber-Colman Corp., Rockford, Illinois

PRODUCT: Conwed 5+5, 30"x60" air delivery fixtures, low profile air fittings, 30"x60" fissura panels.

ACOUSTICAL CONTRACTOR: Continental of Rockford

On Reader's Service Card circle no. 315.