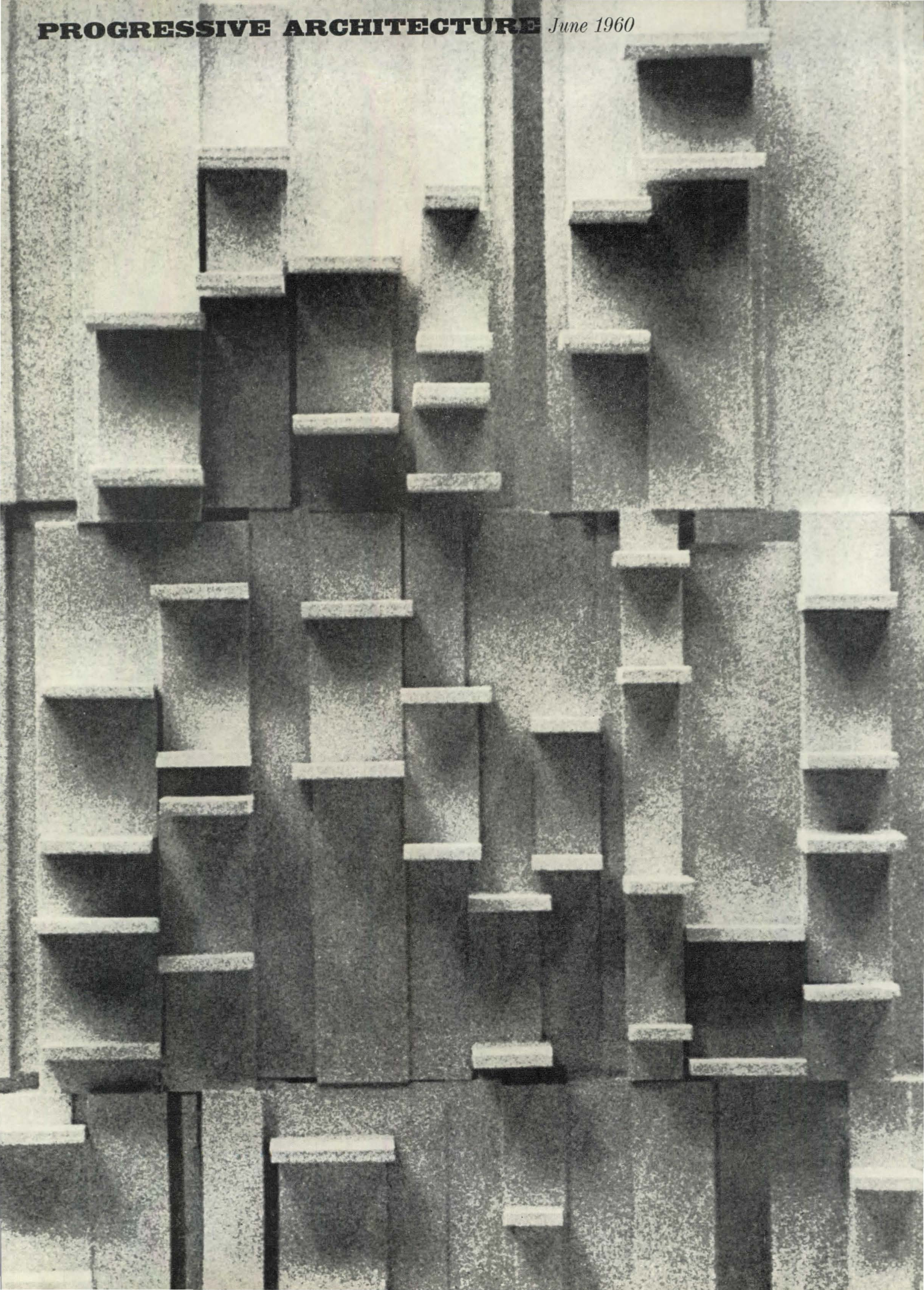
PROGRESSIVE ARCHITECTURE June 1960



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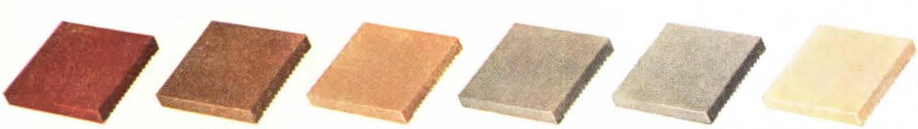

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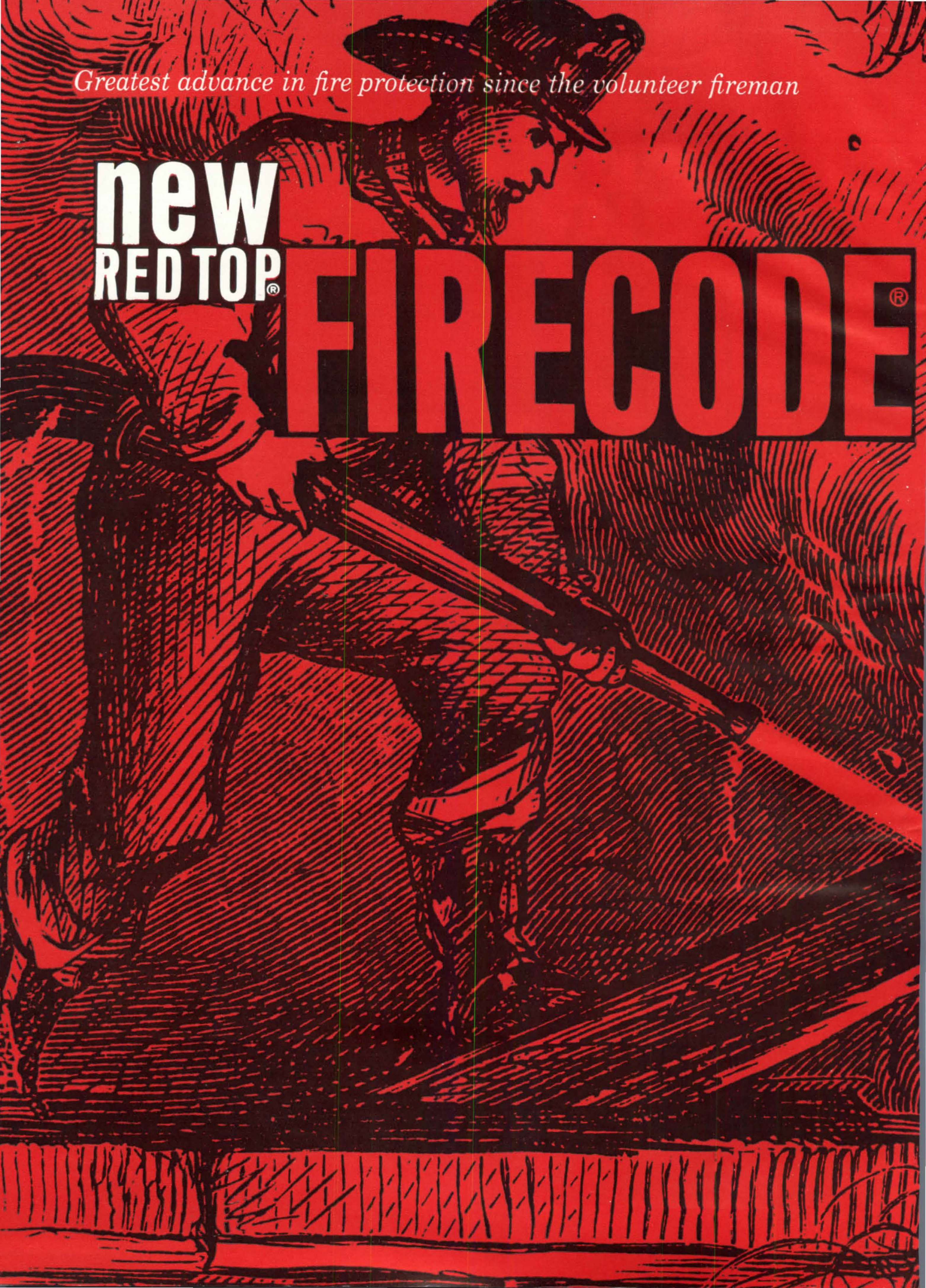
REINHOLD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PROGRESSIVE ARCHITECTURE JUNE 1960

NEWS REPORT

Architecture's Monthly News Digest of Buildings and Projects, Personalities, New Products

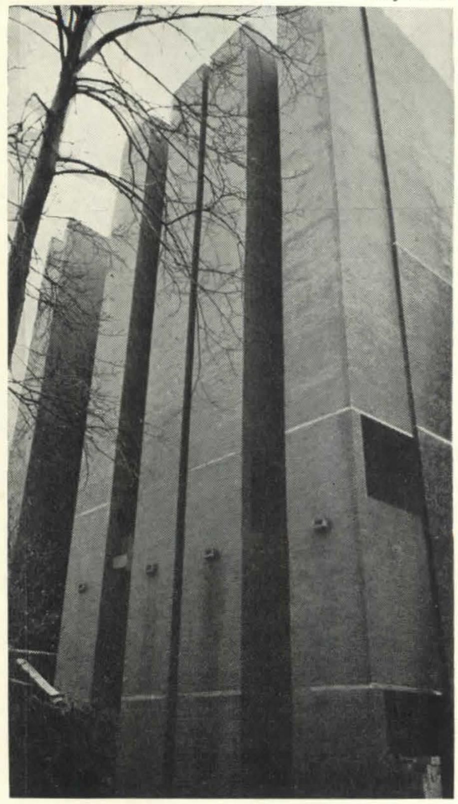
Louis I. Kahn's Alfred Newton Richards Medical Research Building at University of Pennsylvania, dedicated last month.

For more information, turn to Reader Service card, circle No. 300

Jules Schick

Stair and fume-vent towers rise higher than laboratory structure.

Larry Mersel



"Breathing" towers face gardens from building's utility wing.

Kahn's Medical Science Building Dedicated at UofP

Exciting Structure Makes Use of Precast Concrete

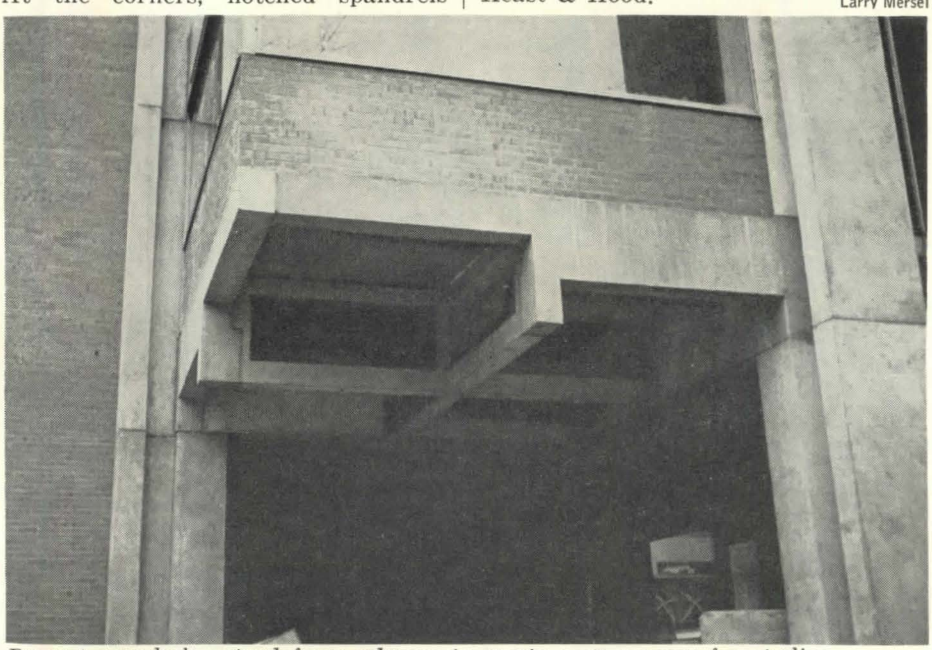
PHILADELPHIA, PA. What may well prove to be one of the most significant buildings of the 20th Century has been dedicated at the University of Pennsylvania. It is the Alfred Newton Richards Medical Research Building by Louis I. Kahn (see p. 67). Already, the building has been called "virtually a text piece for younger architects" by the *1960 Britannica Book of the Year*, and Philip Johnson has written in *Art in America* that when the building opens, "Kahn will be world famous."

Kahn has created three seven-story towers containing a 45-ft-square free-span laboratory studio on each floor. These radiate from a fourth tower containing mechanical equipment, elevators, animal quarters, and storage areas. From the studio wings extend slender towers for stairways and contaminated air exhaust. These towers rise about 25 ft above the laboratory buildings, as does the utility tower. Intake of fresh air and exhaust air ducts are separated, fresh air being "inhaled" through four tall, thin towers extending from the utility wing and overlooking the Botanical Gardens. Air circulating through the building is expelled, after use, through the exhaust stacks adjoining each laboratory.

The precast elements which make up the construction system of the laboratory towers give architectural expression as well as act as structural members. Trusses span the floors, supported at each wall by H-beams. At the corners, notched spandrels cantilever from the columns. Between columns, secondary trusses occur. The floor-ceiling created between stories thus becomes a three-ft-deep "container" for laboratory facilities. Stair and vent towers are placed at mid-floor to provide light at corners.

Structural Consultant: Dr. August E. Komendant; Consulting Engineers: Keast & Hood.

Larry Mersel



Precast spandrels extend from columns to create open corners for studios.

Las Vegas Airport Design Shown

Concrete Waiting Building Will Be Focal Point

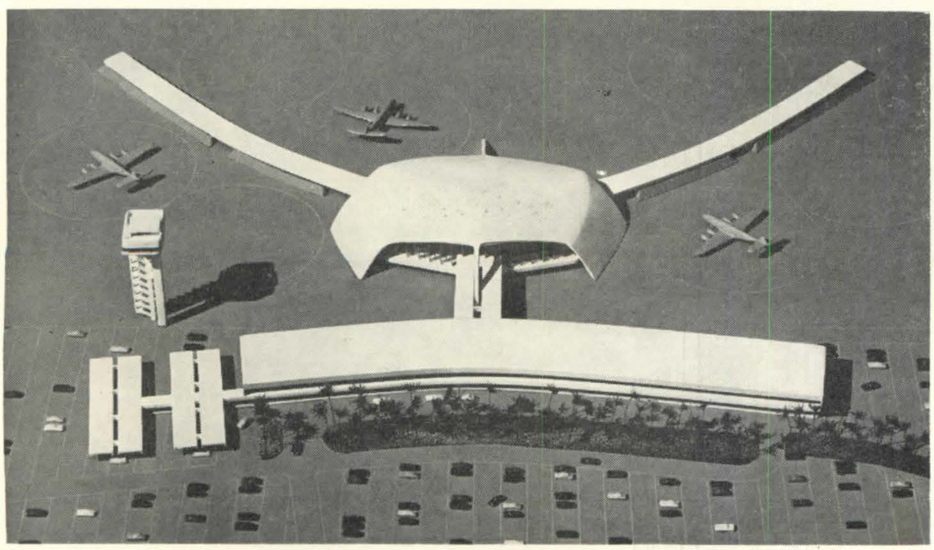
LAS VEGAS, NEV. Designs by Welton Becket & Associates and Associate Architect John Replogle for the terminal at Las Vegas's McCarran Field have been shown in their final form. The terminal will be in three parts: ticketing building, passenger waiting building, and airlines loading fingers.

Focal point of the group will be the passenger waiting building (above), to be roofed with three poured-in-place, thin-shell, vaulted concrete segments, each describing an arch from ground to peak of 40 ft. Three "spines" will occur between these elements, with passages leading through to the ticketing building on the entrance side and the fingers on the field side. The waiting building will have two levels; restaurant-coffee shop, cocktail lounge, nursery, concessions, and restrooms on the upper level, and mechanical equipment, kitchen, and staff cafeteria on the lower. An earlier, more sophisticated design for this building is shown below.

The ticketing building will be a 500-ft-long, 90-ft-wide "V" open to the entrance side. Ticketing desks, baggage claim department, and concessions will be on the ground level, and airlines ticket offices will occupy the mezzanine. A precast concrete screen will cover the façade over glass walls. This screen will be repeated on the 95-ft-high control tower. Parking for 1400 cars will be provided in front of the ticketing building, and an area for 36 rental cars will be located at its south end.

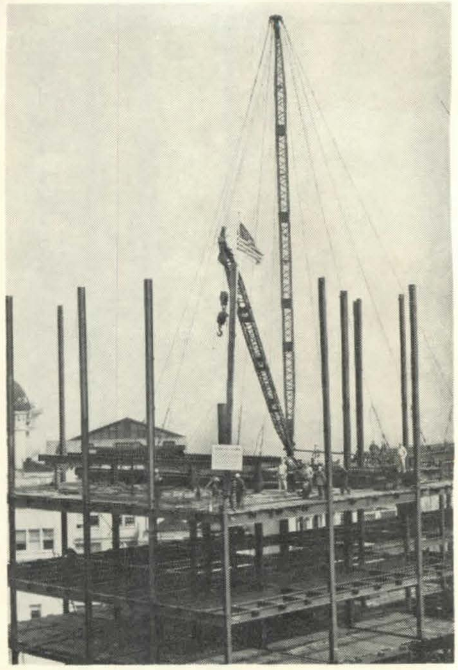
Becket states: "The new McCarran Field facilities have been designed for the convenience of the jet-age air traveler. We have tried to provide as efficient service on the ground as he receives in the air."

Associate structural engineer: Richard R. Bradshaw, Inc.



Earlier model of Las Vegas Terminal shows simpler handling.

WELDED STEEL REACHES NEW HEIGHTS



NEW YORK, N. Y. Another "first" was added to this city's famous skyline last month with the topping out of the city's tallest all-welded steel-framed building. The entire 31-story structure will be used by Western Electric Company, to consolidate offices that were previously scattered throughout the downtown area.

The Western Electric building replaces another "first" on its site at Broadway between Fulton and Ann Streets. One of the earliest steel skyscrapers, the St. Paul building, was built there late in the 19th Century. It was briefly famous as the tallest office building in the world, and drew many sightseers to its 25th-story roof balcony for its magnificent view of the city. Earlier on this site, P. T. Barnum opened his famous American Museum, featuring "Tom Thumb."

For the new building, steel fabricators were invited to submit bids for riveted, high-strength bolted, or welded connections. Dreier Structural Steel Company furnished bids on all three alternates, winning the contract with its lowest bid on welding, an erection method that also proved to be the quietest and fastest. The firm estimates that 20 tons of welding rods were used in the fabrication of the 10,000 tons of structural steel.

Shreve, Lamb & Harmon are architects for the building, and Purdy & Henderson, consulting structural engineers. George A. Fuller Company is the general contractor.

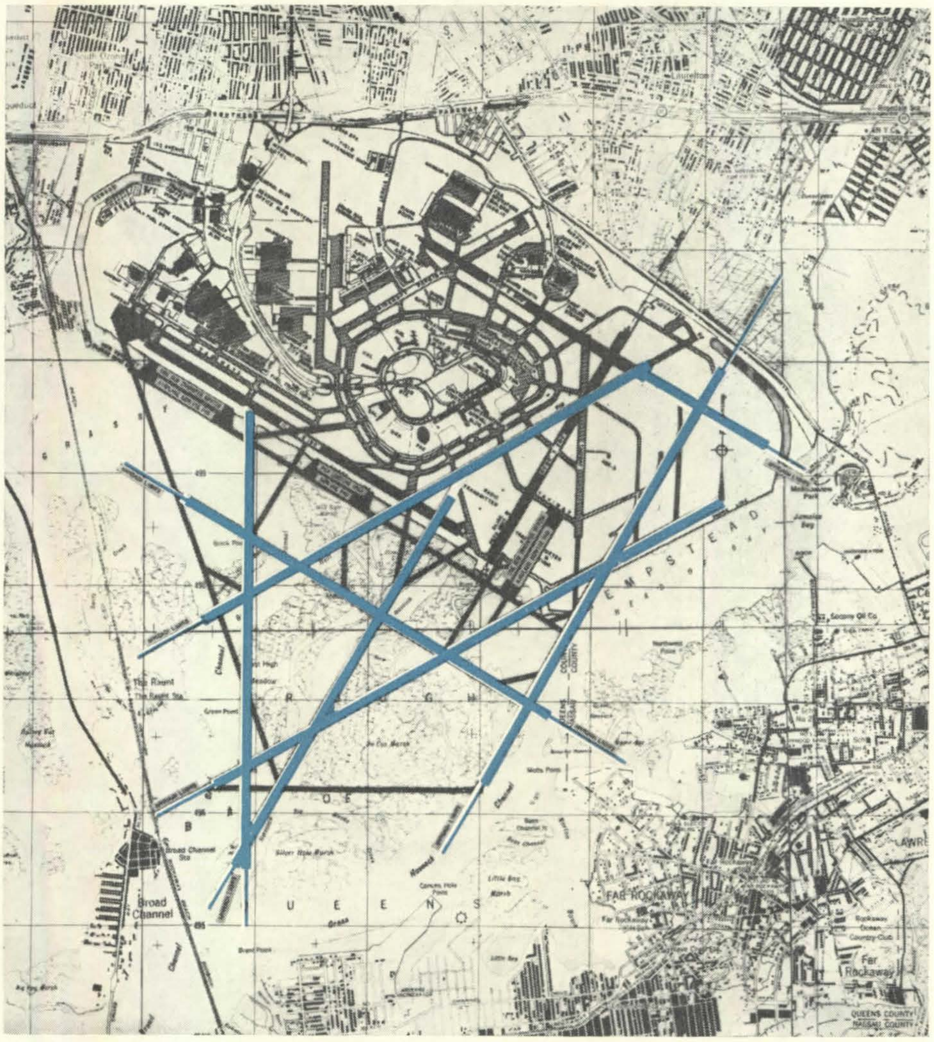
Architect Proposes Updating of Airport Runways

Ingenious System Would Utilize Jamaica Bay

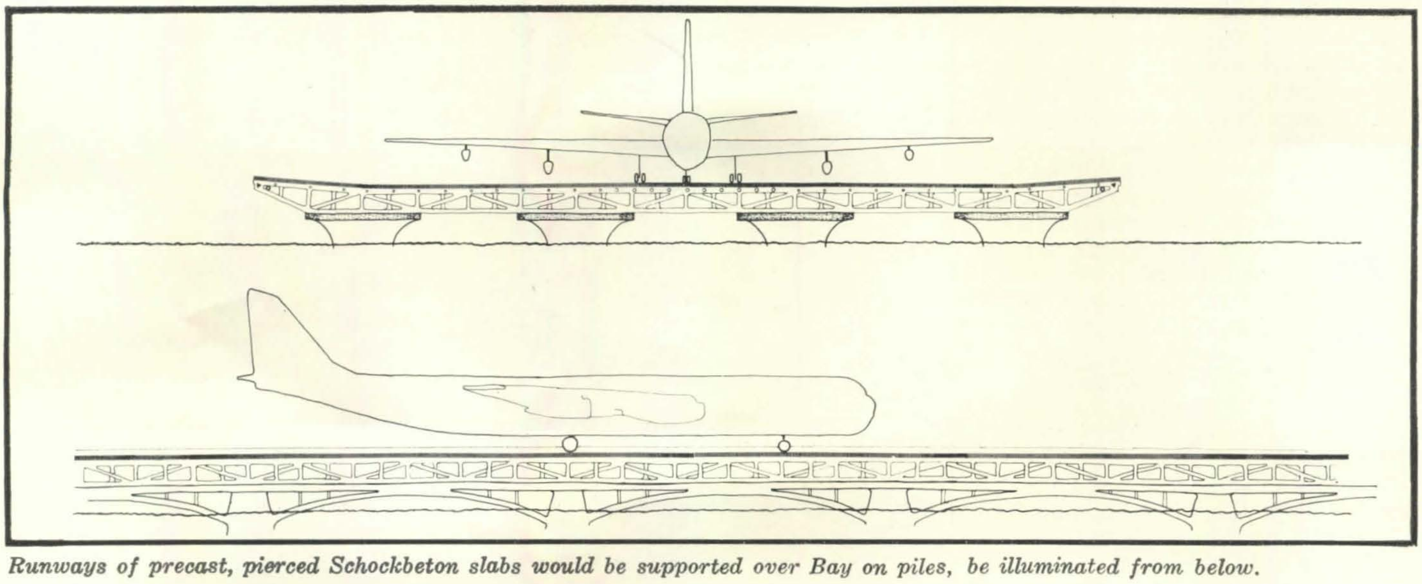
NEW YORK, N. Y. The landing and takeoff facilities of New York International Airport, like many present airports, were obsolete the day they were finished, according to New York Architect E. N. Turano (Turano & Gardner). The jet age has broken the airport design barrier as well as the sonic barrier, he says.

Recent attempts to cope with present and future air traffic loads by adding a fifth member to New York's present airport complex (Idlewild, La Guardia, Newark, and Teterboro) are described as unrealistic by Turano. He claims, and has graphically exhibited his claims to the Port of New York Authority, that facilities at Idlewild (New York International) can be expanded to meet future needs.

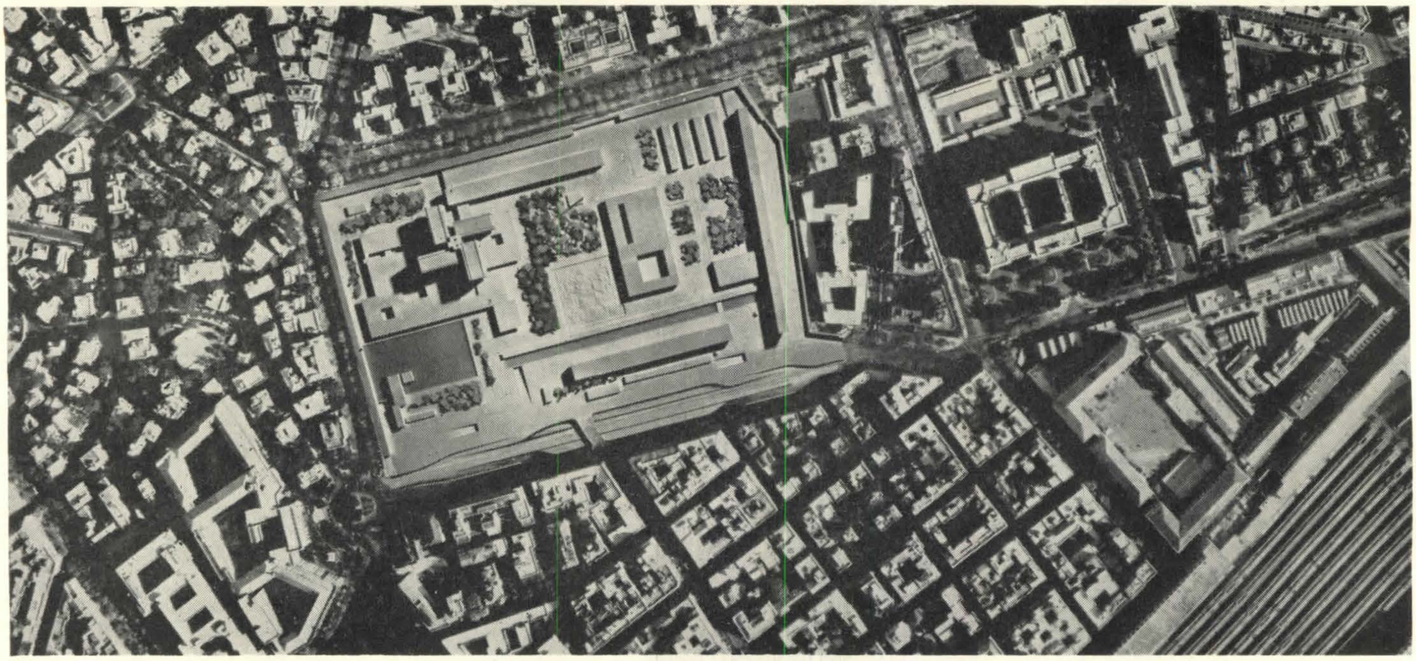
What Turano proposes is the creation of new runways and the extension of present ones into the marsh waters of Jamaica Bay which surround the airport. These extensions would be in the form of precast, prestressed concrete elements supported by concrete pilings. Perforations in the deck would permit rain water to drain off easily. Runways would be slanted upward slightly at the edges to insure greater safety in landing. Turano claims that building runways over water provides another safety factor, since incidence of casualties and severe damage to aircraft is less on water than on land. He says that nozzles for chemical foam could be installed at outside edges of the runways to spray a foam "blanket" on the water for disabled planes to land on. Taking such planes off regular runways for emergency landings would also free the rest of the airport for normal flights (currently, emergencies tie up virtually the entire field). For night landings and takeoffs, the runways would be lighted from below—the light shining up through the perforations—and "color coded" for ready identification from the air. Passengers would be transported from plane to terminal in buses.



Extension of old runways and creation of new ones shown in color.



Runways of precast, pierced Schockbeton slabs would be supported over Bay on piles, be illuminated from below.



Bird's-eye view shows 14-acre cultural center in mid-Rome with railroad station at lower right.

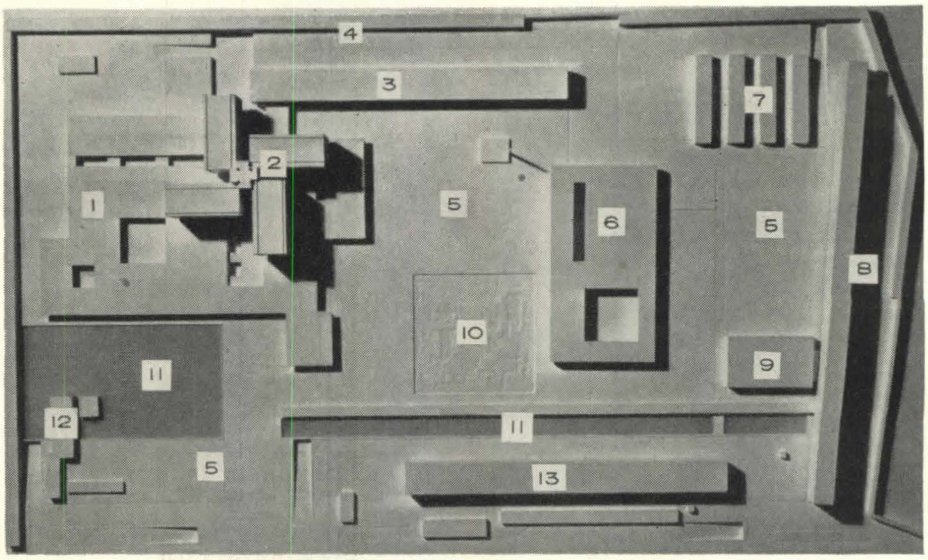
Cultural Center to Rise in Heart of Rome

Buildings to "Float" Above Old Surroundings

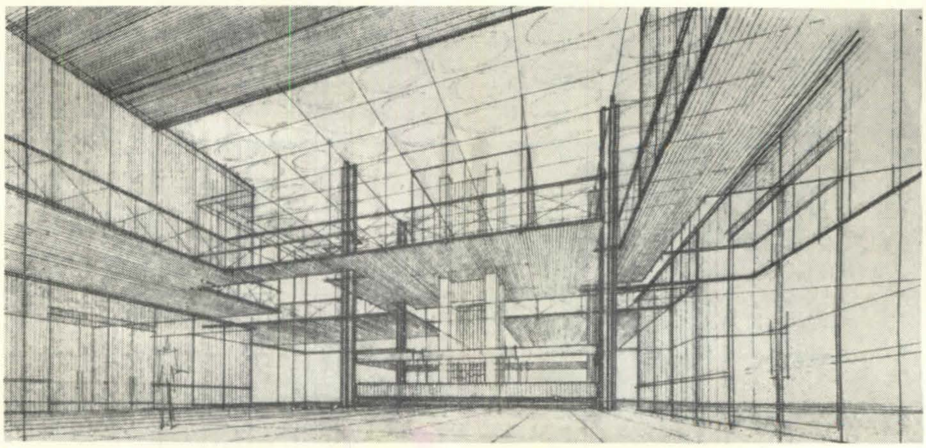
ROME, ITALY On the site of an ancient Roman military reservation, later the location of barracks built by Pope Pius IX, a National Library and Cultural Center for Rome is scheduled to be built. Bounded on three sides by the historic Aurelian Walls, the area rises more than 15 ft above street level, commanding the heart of the Eternal City. Winner of first prize for the design of the center was Studio di Architettura e Urbanistica (Dr. Ing. Guido Gigli, Architects Manfredi Nicoletti and Mario Manieri Elia).

It was required that the center, which will lie between University City and the Termini Railroad Station, be a balanced combination to fulfill both the city's cultural requirements and the commercial possibilities of the site. Consequently, a commercial zone will be built on the side which is not enclosed by the Aurelian Walls. Separated from this area by pools will be the library, book storage buildings, and an office building for the use of various cultural groups represented in the center. Dispersed in the parklike center will be a restaurant, museum of modern art, university laboratories, auditorium, and another high-rise building. Parking will be provided under the pool and commercial area.

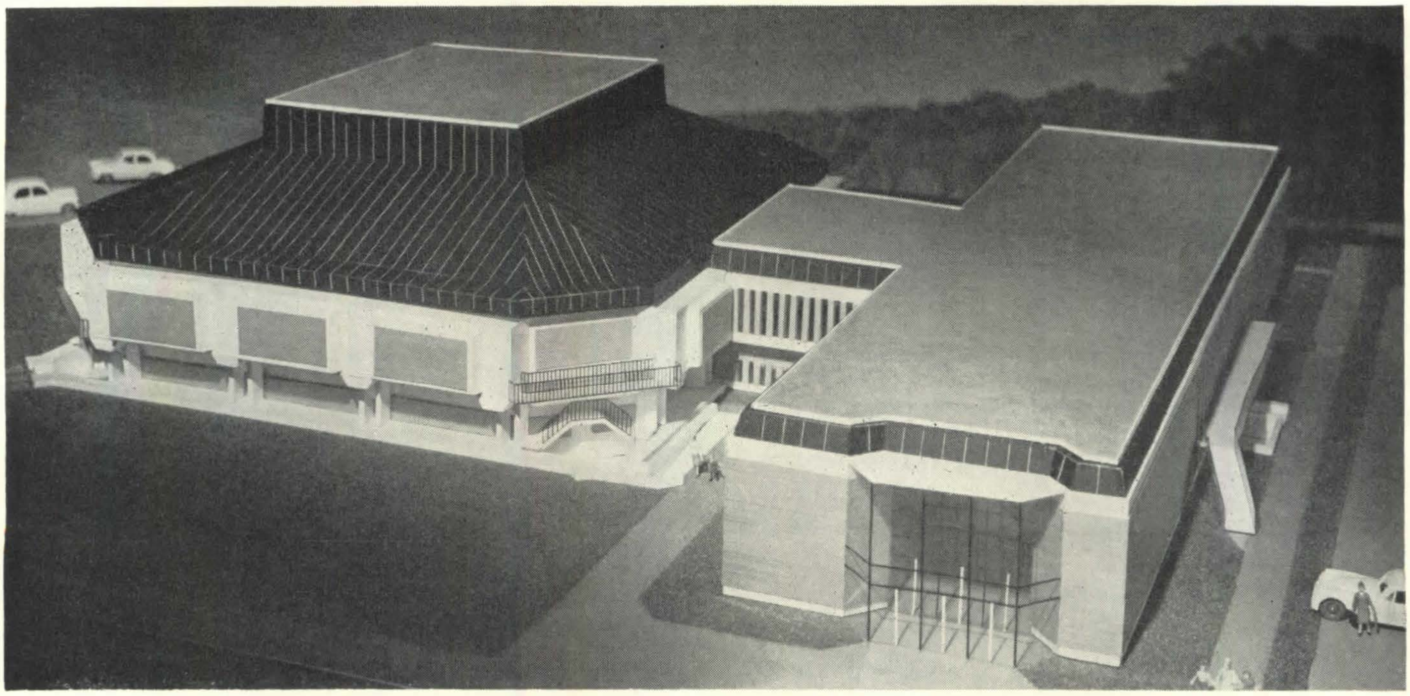
The National Library will be in a low, broad, pavilion-like building from which will spring the four towers of the book storage building.



1 *library,* 2 *storage,* 3 *offices,* 4 *Aurelian Wall,* 5 *parks,* 6 *art museum,* 7 *labs,* 8 *high-rise building,* 9 *auditorium,* 10 *Praetorian garrison site,* 11 *pools,* 12 *restaurant,* 13 *commercial center.*



Distribution room of National Library has pavilion atmosphere.



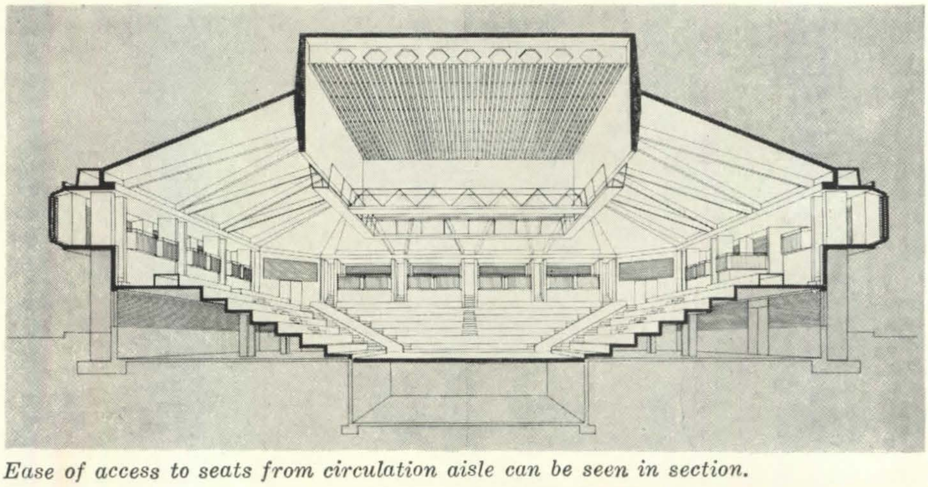
Arena Theater Designed for D. C. by Harry Weese

Project Will Enhance Capital's Redevelopment

WASHINGTON, D. C. The newest project in Washington's ambitious Southwest Redevelopment Area soon will begin construction on the waterfront. It is a new theater for the decade-old Arena Stage, the capital's major permanent haunt of Thespis. Currently producing in a building donated by a brewery, the repertory group will move to its handsomer, if less thirst-quenching, quarters in time for its Fall, 1961, season.

The theater element of the project will be distinctly separated from its supporting activities, following the wishes of Architect Harry Weese, Chicago. A connecting element—doubling as foyer and office space—will attach the theater to a two-story building containing lobby, ticket offices, lounge areas, shop, costume room, prop room, storage areas, dressing rooms, green room. The basement of this wing may eventually contain classrooms, a small workshop theater, and additional office space.

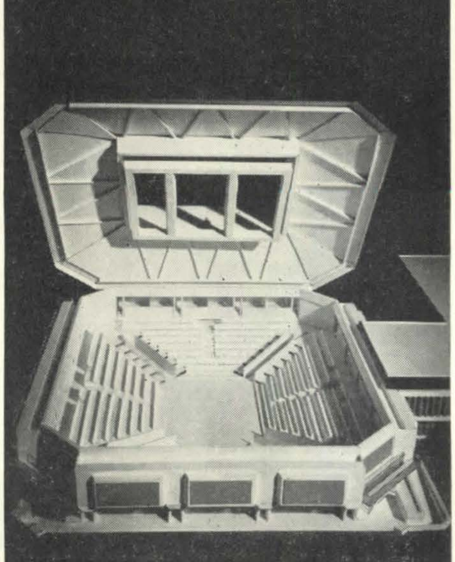
In the theater, the playing area will be 30′ x 40′, with an access aisle from each corner for actors and scene- and property-changers. Above the stage will be an arrangement of catwalks for servicing and supporting lighting equipment. Spaces in between will be used for "flying" set pieces. This grid will be adjustable between 18′-27′ above the stage, and will overlap the playing area by 6′ on all sides. The stage will be subdivided into a system of traps measuring about 3′ x 6′ each. These will be raised or lowered independently or in combination by a method of screw-jack adjustable shores with removable stringers. A great variety of effects thus will be obtainable.



Ease of access to seats from circulation aisle can be seen in section.

Theatergoers entering the theater across the bridge from the lobby will find themselves on a circulation aisle above the eight-row-deep tiers which enclose the stage. A ring of boxes will be on the other side of this aisle, from which access to any seat will be simple. One tier of seats will be removable, permitting an extension of the stage approximately 20′ deep x 40′ wide, to allow mounting of three-sided productions.

The auditorium will have its activities expressed structurally on the exterior, with boxes appearing as precast, bricked elements, and overstage mechanical equipment showing as a rectangular cupola.



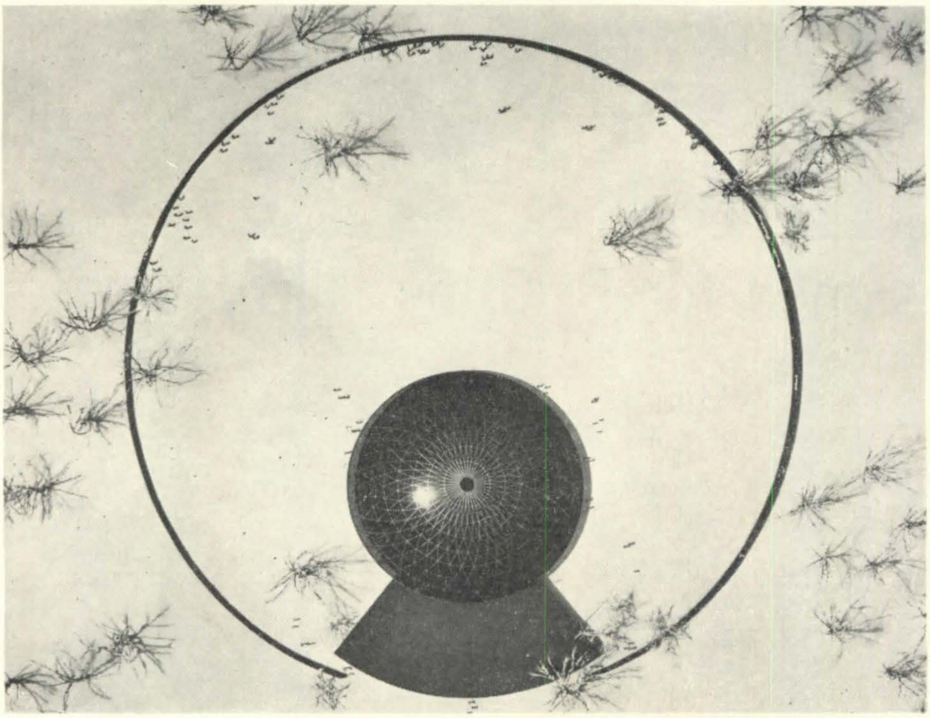
Open model expresses ceiling grid.

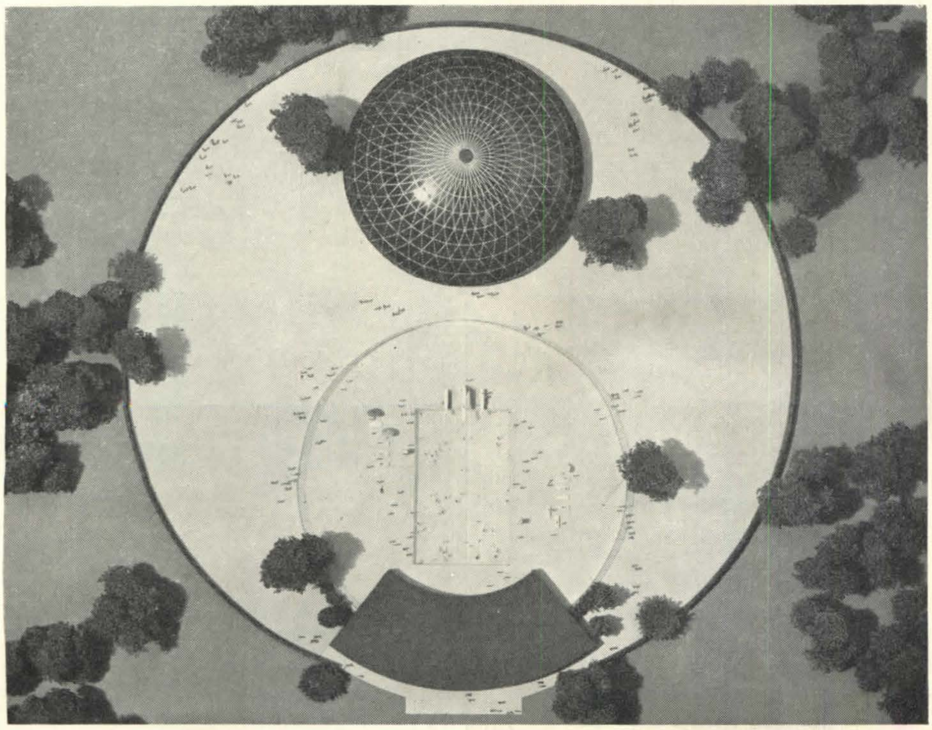
Convertible Pool for Montreal

MONTREAL, CANADA An indoor-outdoor swimming pool whose dome will serve double duty has been proposed by Alfred Caldwell, professor in Department of Architecture and City Planning, Illinois Institute of Technology.

The project will consist of a moving aluminum dome, which would shelter a standard swimming pool in the winter (*below*). In the summertime, the dome will be rolled back, creating an outdoor pool. The dome would then be used as a summer theater (*bottom*). Span of the dome—which will be moved by a winch—will be 120 ft; it will be supported on six isolated points. Montrealers should be swimming before long — working drawings and specifications are complete, and work will start soon.

According to Professor Caldwell, "The purpose of the installation is to save about a quarter of a million dollars over and above conventional installation of both summer and winter pools, since one does for both."

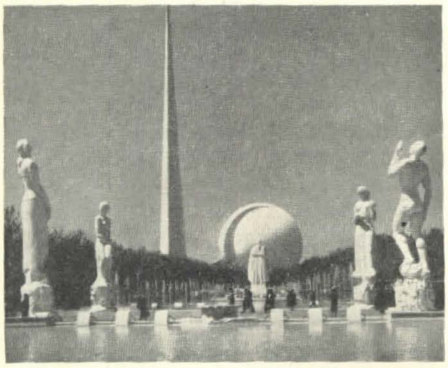




World's Fair—Return to 1939?

NEW YORK, N. Y. A study titled "Preparation of the Site for the World's Fair 1964-65" has been released by the Department of Parks here, bearing in its introductory letter to Mayor Robert F. Wagner from Robert Moses, the chilling admonition that ". . . the essential character of the Meadow [site of the Fair] as modified and molded for the Fair of 1939-1940 must still be a controlling factor in the building of the Fair of 1964-1965."

The report, prepared by Landscape Architects Clarke & Rapuano and Richard C. Guthridge and Engineers Andrews & Clark, is replete with aerial photographs, site plans, and utility plans of the Beaux-Artsy 1939 Fair site, which will have to be returned to the city virtually in its original condition after the festivities. Unlike Victor Gruen's imaginative and practical proposal for creating a Fair in Washington, to become a planned community afterward, the New York Fair will have to fold its tents like the Arabs and silently steal away. The report states: "We are of the opinion that no consideration be given to proposals to turn the Fair, when it ends, into an international university or an enterprise of similar character." Existing large trees, planted for the old fair and today describing its antique planning patterns, may not be removed without permission of the Department of Parks. Emphasis is given to utility lines and subsurface conditions still existing from 1939—the implication being that 1964's planning should be along these same old lines—including the use of some existing buildings.

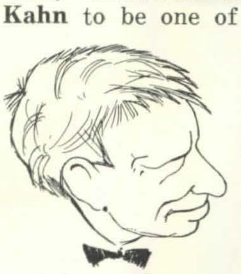


Again?

Fair President Moses (who recently fired the man who was instrumental in getting it for New York), Design Chairman Harrison, and the rest are confronted with the choice of creating a great fair or—if present indications persist—a great goof.

PERSONALITIES

Many architects consider **Louis I. Kahn** to be one of the most important architectural thinkers of our day. Minoru Yamasaki, speaking of him recently, said "During the judging of the Golden Gateway contestants, Lou Kahn and I stayed awake talking until three o'clock one morning. Once started, Lou is so full of ideas that it is hard to connect all his thoughts at once—but when full understanding comes, as it does, it's like a great light being turned on. He's an *important* force!" Similarly, architects and others who have followed the progress of his medical research building (pp. 59, 61) at the University of Pennsylvania report that this will be one of the great buildings of the century. Recently the recipient of the 1960 Brunner Award from the National Institute of Arts & Letters, Kahn was born in 1901 on the island of Ösel in Estonia. His parents settled in Philadelphia in 1906, and he has always been identified with that city, receiving his degree from the University of Pennsylvania in 1924, and doing work with Paul Cret, George Howe, and Oskar Stonorov. He has taught at his alma mater, Yale, and MIT, and was Resident Architect at the American Academy in Rome, 1950-51. An exponent of the philosophy that "a building must express its function," Kahn is one of the most vocal men we have, expressing his *own* function—that of a truly dedicated architect.



Developer ERWIN S. WOLFSON was named to Board of Directors of Ford Foundation's Educational Facilities Laboratories, Inc. . . . Allied Masonry Council honored Rep. JOHN E. FOGARTY (D., R. I.) for his work as chairman of House Appropriations Committee Subcommittee on Health, Education, Welfare & Labor. . . . KENNETH M. NISHIMOTO announces that his sixth annual architectural tour of Japan will leave Los Angeles for a 24-day stay on October 5; those interested may address him at 263 S. Los Robles Ave., Pasadena, Calif. . . . MINORU YAMASAKI receives a scroll this month from the University of Washington proclaiming him *Alumnus Summa Laude Dignatus*—"Most Distinguished Alumnus for 1960". . . .

Winners of 1960 Francis J. Plym fellowships in architecture and engineering have been announced by University of Illinois; RICHARD E. CARLSON, Chicago, received architectural award, and engineering fellowship went to HERBERT SCHNEIDER, New York. . . .

WALLACE K. HARRISON, Harrison & Abramovitz, New York, received honorary Doctor of Letters degree from Clark University, Worcester, Mass. New Assistant Professor of Construction at Harvard Graduate School of Design is SIDNEY J. GREENLEAF of Brighton, Mass.

Words like "geodesic," "dymaxion," and "tensegrity" have become part of the architectural lexicon as a result of the efforts of one extraordinarily inventive man, **Richard Buckminster Fuller.** Known mainly to the structural avant-garde as recently as 1947, when the military saw the practicality of his geodesic domes, Fuller (and particularly the domes) now enjoys almost what television performers call "overexposure." Subject of a new book, *The Dymaxion World of Buckminster Fuller*, by Robert W. Marks (REINHOLD), he has a long-run exhibit at New York's Museum of Modern Art and another show currently at Walker Art Center in Minneapolis. In addition, he recently created a "geoscope" for Princeton's Graduate School of Architecture. This is a geodesic globe intended to provide a better understanding of world geography through elimination of latitudes and longitudes and the substitution of spherical triangles. The geoscope will also, according to its inventor, permit architects to conceive their works in a larger perspective.

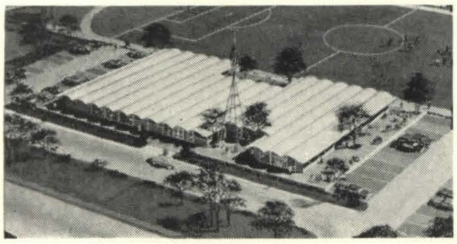
EFRAHIM MURATI of Bermudez, Hernandez & Murati, San Juan structural engineers and consultants, writes that credits on the San Juan hotel featured in February *P/A News Report* (p. 72) should be expanded to include Architect Angel Avilés, Mechanical & Electrical Engineers Fred S. Dubin & Associates, and his own firm as Structural Engineers. Juan J. Otero is "owner and promoter." . . . E. TODD WHEELER of Perkins & Will is Midwest Chairman of Architects and Engineers Division of National Fund for Medical Education. . . . A study of co-operative housing and housing for the aged in Stockholm and Copenhagen will be made by THOMAS L. HANSEN, Professor of Architecture at University of Colorado, under a grant from the university. . . . 1st annual award for Minneapolis urban renewal and redevelopment has gone to S. L. STOLTE, St. Paul, who has been chairman of Minneapolis Housing and Redevelopment Authority for past eight years. . . . WALTER A. GRANT, Vice President and Director of Engineering at Carrier Corporation, is president of American Society of Heating, Refrigerating and Air-Conditioning Engineers. . . . CHARLES LUCKMAN, Charles Luckman Associates, Los Angeles, was visited by the "Person to Person" TV show April 22 . . . . WORLEY K. WONG, Campbell & Wong, San Francisco, has been named by Governor Edmund G. Brown to California State Board of Architectural Examiners. . . . New President of Architectural Photographers Association is SCOTT HYDE. . . . GEORGE I. SMITH of Celotex Corporation is new president of Acoustical Manufacturers Association.

Rare indeed is the architect who has a head of state say, "Start from scratch and create for me the most beautiful national capital you can!" While that is not exactly what happened to **Oscar Niemeyer,** the effect has been the same, as anyone not completely unconscious has been able to see. With the recent dedication of Brasilia (on which work, of course, still proceeds) the world saw the fruition of one of the dream commissions of the century. Niemeyer first burst on the international architectural consciousness with his Brazil Pavilion for the 1939 New York World's Fair (with Lucio Costa). Just four years before, his friend Costa (who did the plan for Brasilia) had not seen a phenomenal future for Niemeyer. Costa says that after a three-month period in 1936 working under Le Corbusier on the plan for the University of Rio de Janeiro, "his true stature was revealed." "Previous to this decisive experience," Costa says in *The Work of Oscar Niemeyer* (REINHOLD, 1950), "there was not the slightest indication foreshadowing his imminent trajectory." Niemeyer promptly showed that his plastic imagery could be breathtaking in projects at Pampulha, Rio, and elsewhere. Brasilia would seem to be the acme of the career of an architect so intimately indentified with his country. But Niemeyer is only 53, and certainly not through yet!

Sketches by Raniero Corbelletti

Port of New York Sets Recreation Center

A barrel-vaulted seamen's center will be built at the Port Newark (N. J.) Station of the Seamen's Church Institute, according to announcement by the Port of New York Authority and

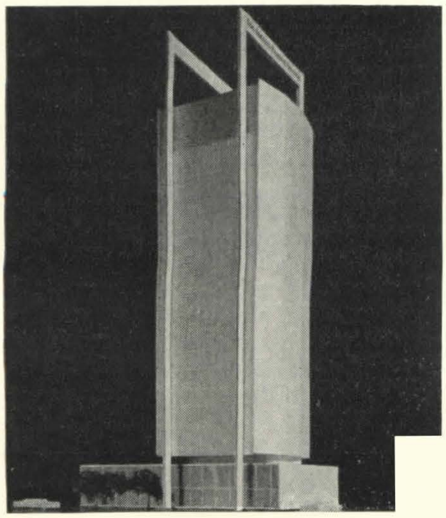


the Institute. The center, to be built in two stages, will eventually include lounge, snack bar, chapel, chaplains' offices, recreation rooms, dressing rooms, and showers. A soccer field will adjoin the building. Architects: Ives, Turano & Gardner, New York.

Bank Will Appear to Hang From Its Own Sign

Design of Los Angeles Federal Savings Building in San Fernando Valley, by Douglas Honnold & John Rex, Los Angeles, features a tall octagonal office tower rising above a rectangular ground floor for banking facilities. Tower was designed to fit in with the San Fernando Valley skyline without violating height limit allowed by zoning ordinances. Four exterior columns will rise above the top of the tower, gaining additional height and forming a cross-bar sign panel.

East and west sides of the tower and bank elements will be sheathed with exposed aggregate precast concrete panels. North and south sides will consist of curtain walls of dark anodized aluminum members, gray plate glass, and tempered gray glass

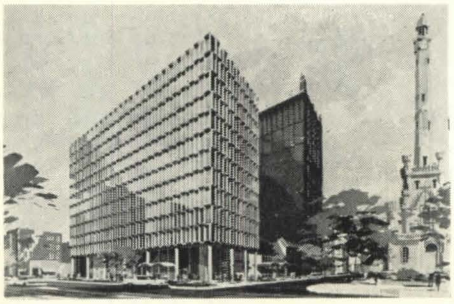


spandrels. The four exposed columns will be sheathed in light anodized aluminum.

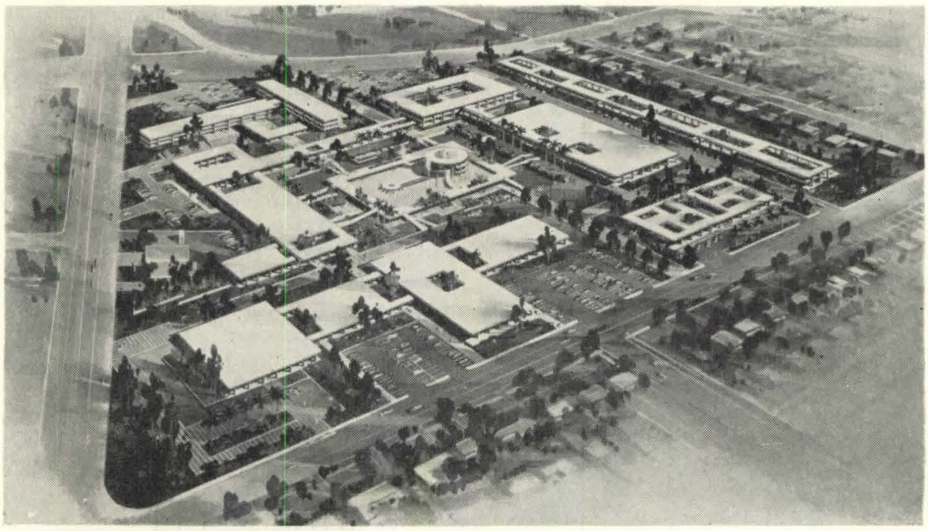
Each floor in the tower will be rented to one tenant, thus eliminating lobbies and corridors and creating prestige office suites with elevators opening directly into reception rooms. The bank will have teak and formica walls and counters; front wall of the vault will be stainless steel.

NEW HOTEL FOR CHICAGO

The new hotel to rise across the street from Chicago's famous old water tower, survivor of the Mrs. O'Leary's cow incident, will be named, appropriately enough, the Water Tower Hotel. The 13-story structure, designed by Hausner & Macsai, will have its two bottom floors set back to include lobby, restaurant and cafeteria on the first floor and offices and banquet rooms on the second floor. Top floors will have an interesting window-framing system of precast concrete with projecting "lids" for sun control alternating each floor up the height of the structure. A three-level garage at the rear will be



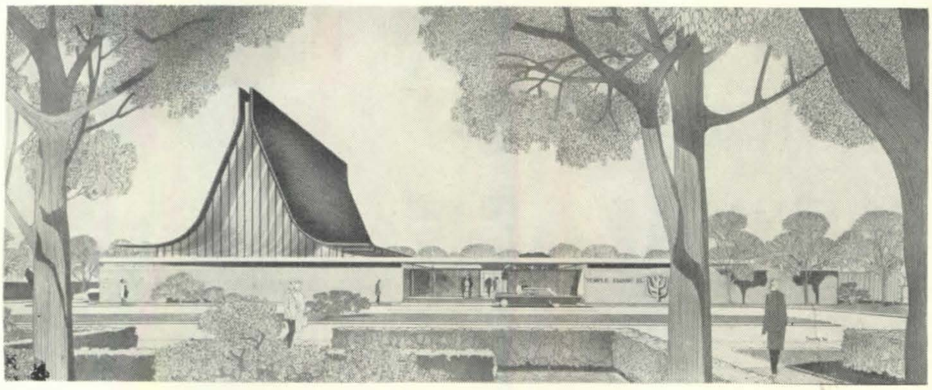
surmounted with a swimming pool. Structural Engineers: Paul Rogers & Associates, Inc.; Consulting Engineer: William Goodman.



Widespread Functions Proposed for Town Center

The town center designed for Santa Fe Springs, Calif., by William Pereira & Associates, will incorporate not only civic functions, but also commercial, religious, medical, and recreational facilities. The 20-acre site will be divided into four general areas. The northwest quadrant will be devoted to the civic center including a building with city administrative offices, library, meeting rooms, judicial facilities, and police building. Just to the east will be a federal post office. In the northeast sector will be located financial and professional offices and a medical center. A commercial center to the south will include shops, restaurants, coffee house, motor hotel, theater, and other recreational facilities. A church will stand in the center of the site, and the south and southwestern sections will be largely occupied by town houses. The center will be elaborately landscaped, with tree-lined promenades, malls and planting areas; vehicular traffic will be prohibited in the town center, but parking around the perimeter of the site will provide easy access for employes and visitors.

By creating the heart of this growing city, Pereira is attempting to avoid the historical trend of decentralization in our cities which he describes has set in, ". . . today the so-called civic center has become merely an agglomeration of nine-to-five offices that are deserted at the end of the day, leaving the central city an empty, echoing ghost town after sunset." By including commercial, dining, and recreational facilities, the town center will continue to function at night as a meeting place. Plans for this unique town center may provide the prototype for other young cities in the U. S., Pereira claims.

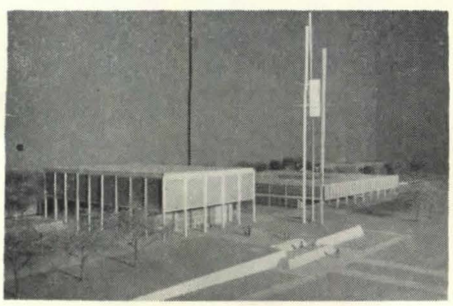


Dramatic Roof Form to Announce New Jersey Temple

New York architects Peter Blake & Julian Neski have created a design for the congregation of Temple Emanu-El of West Essex, Livingston, New Jersey, which Neski says solves three basic needs, "religious, social and educational." The sanctuary-social hall wing will be under a soaring roof which will proclaim itself to the neighborhood. Across a court-like entrance link will be the school wing containing six classrooms, a kindergarten, and service facilities. There will be clerestory-windowed expansion space in the basement. A court at the rear of the project will accommodate social gatherings and outdoor services. Parking will be provided for 67 cars.

New Campus Announced For Texas Girls' School

The Hockaday School, a well-known girls' preparatory school in Dallas, will move from its present, Colonial-style campus when a new campus designed by Harwood K. Smith & Partners of Dallas is completed in the fall of 1961. Auditorium of the new school will be connected with the classroom building housing art, drama, and music. Joining the major classroom building and two three-story dormitories will be the administration wing. A memorial hall, cafeteria, and room dedicated to Ella Hockaday will be in the dormitory area. Behind the main classroom building will be the gymnasium, elementary education building, amphitheater, and mechanical services building. The entire complex of buildings will be built on a rolling, 30-acre site.

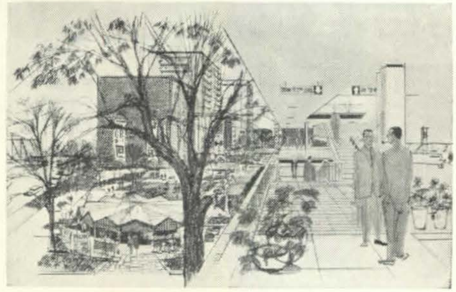


CALENDAR

New Jersey Chapter AIA has 60th annual convention in Asbury Park, June 9-11 . . . Historic preservation of older cities, particularly Annapolis, will be subject of conference June 24-25 in Annapolis; sponsors are Historic Annapolis, Inc., National Trust for Historic Preservation, and Washington Center for Metropolitan Studies, in co-operation with Committee for Annapolis, Inc. . . . American Craftsman's Council holds its Northeast Regional Conference at New Paltz, N. Y., June 10-12 . . . MIT's 1960 summer session on "Theory and Criticism in Architecture and City Planning" is scheduled for July 11-15 . . . Professor M. G. Barr of University of Colorado and Rod Replogle, directors of Apex-2 design workshop, announce this year's session will take place at Rancho del Rio, New Mexico, June 17-August 27; guest instructors will include Richard Neutra, Buckminster Fuller, Harry Bertoia, David Siquieros, Joseph and Anni Albers . . . Standards Engineers Society meets in Pittsburgh, September 26-28; American Welding Soc., Sept. 26-29.

Producers' Council Probes

The Producers' Council has announced an industry-wide study of channels of distribution for building materials. Research begun in 1958 indicates continuing need for such a study, according to PC officials, and a poll of the membership has resulted in an affirmative vote to proceed. Marketing authorities headed by Dr. Reavis Cox of American Marketing Association and Dr. Charles Goodman of Wharton School of Finance and Commerce will conduct three-year study.



GREEN BAY PLAN DONE

Victor Gruen announces that his plan for the revitalization of downtown Green Bay, Wis., has been completed and enthusiastically accepted by Gregby, Inc., the non-profit organization set up to handle the redevelopment. Rendering shows Washington Street Mall of the project, with proposed parking structure and four-level development. Ben Southland is Partner-in-Charge for Victor Gruen Associates, and Larry Smith & Company, Washington, D.C., is economic consultant.

Suburban Bank Will Act as Own Advertisement

The proposed bank of Highland Park, Highland Park, Ill., will be all glass-enclosed under a reinforced concrete hyperbolic roof to exhibit its wares to passers-by. Alfred Alschuler, Jr., partner in Friedman, Alschuler & Sincere, designers of the bank, says that it will be "telling its story of service to everyone in the street." The roof, to be supported at four points, will be covered with white gravel on the outside and acoustical plaster on the in-

side. To give the greatest sense of open space, all ducts and grills for heating and cooling will be concealed in the floor and at tops of partitions separating offices. There will be a 40-car parking lot and a driveway up to multiple drive-in banking windows.

OOPS!

Apologetic letter from U.S. Plywood states that material on Weldwood acoustical door (p. 90, MARCH '60

Continued on page 72

New locking service for commercial buildings

®SCHLAGE© PROTECTED

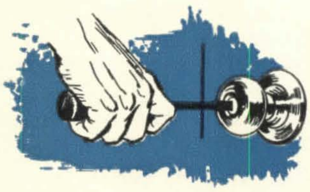
Schlage's unique PSI service uses temporary cylinders to provide these benefits:

- POSITIVE CONTROL OF MASTERKEYS
- FLEXIBILITY IN DECIDING KEYING ARRANGEMENTS
- SAVING ON CONTRACTOR'S HANDLING COSTS

HERE ARE THE PSI BENEFITS

Locks delivered without permanent cylinders

Locks have a temporary plastic plug, which may be turned by a screwdriver. These locks are used to provide free passage through any door.



Color-coded aluminum cylinders provide on-the-job security

For doors requiring locking during construction, anodized aluminum cylinders can be installed temporarily. Keys in matching colors are issued; for example, a blue cylinder and blue keys for electricians. The color-coding immediately tells a worker which door his key unlocks.

This program simplifies the contractor's work because he can install any plastic-plug lock of the proper function without regard for ultimate keying. In addition, the aluminum cylinders are replaced before occupancy with permanent cylinders which have not previously been exposed on the job, thereby insuring close control over all keys.

Masterkeys never issued during construction

Since only temporary cylinders are used on the job, masterkeys are not needed. Keys are shipped with the permanent cylinders and installation is made under the supervision of the owner's representative, who keeps all keys under his control.

Schlage PSI Costs Nothing

This is a service of the world's leading manufacturer of cylindrical locks, offered at no charge.

SCHLAGE
SCHLAGE PSI
Decisions on keying can be made at any time at the owner's convenience.
No possibility of accidental invasion of security. No masterkeys on job.
Installation of locks is speeded and simplified as contractor need select only proper functions from case stock.
No need to build a keyboard. Schlage shipping carton serves as *temporary keyboard*.

®SCHLAGE©
CYLINDRICAL LOCKS

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SI

SECURITY INSTALLATION

provides positive, easy-to-maintain security at every stage of building...and beyond

ADVANTAGES

OTHER SYSTEMS

All detail on keying must be included in original factory order so the complete lock, with key, can be shipped.

During construction masterkeys are used or permanent cylinders employing a form of temporary keying that still allows permanent keys on the job.

Each lock must be itemized and laid out to find the exact lock for a specific door.

Contractor must build a keyboard and tag all keys.

AMERICA'S MOST DISTINGUISHED LOCK BRAND

SCHLAGE

Shipping carton is a temporary key-filing cabinet

All cylinders are shipped complete with the key and packaged in a key-control envelope for storage and easy access until actually needed. No need to build a keyboard.

No problem of matching keys to locks

Permanent cylinders and keys are packed together and, when the cylinder is installed, the key is placed back in the file envelope and returned to the shipping container for easy identification and future incorporation into a key-control filing system.

CONTINUING SECURITY

The unique Schlage PSI system has these features which assure the continued integrity of the building's security system:

Security in factory handling

The job name is omitted from factory orders; material handlers know the job by number only. Thus, there is no possibility of anyone retaining a masterkey for future invasion of security.

No unauthorized masterkeys made

Schlage will not issue masterkeys for any existing job without written authorization from the existing owners.

Continued control of keying system

The final decision on keying can be delayed an indefinite time, subject to the decisions of the occupant. When a tenant moves in and determines his keying requirements, cylinders will be shipped from the factory, untouched by construction personnel. Subsequent tenant changes can be handled in the same way.

SEE HOW SCHLAGE'S PSI CAN WORK ON YOUR BUILDING

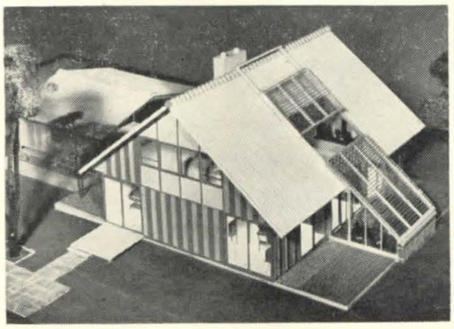
For complete information on this unduplicated service, contact your Schlage representative or write P.O. Box 3324, San Francisco 19, California.

Continued from page 69

P/A) indicated certification by American Society for Testing Materials of door over competitive doors. USP amends this, since Society "certifies nothing itself," to "the door was tested by the Riverbank Acousitcal Laboratories of the Amour Research Foundation . . . (the report states) 'the method used in making these measurements . . . meets explicitly the standards of . . . the American Society for Testing Materials.' "

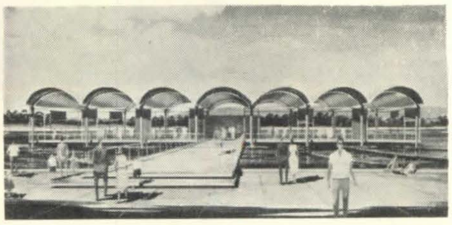
Research House Rehearsal

Mock-up, half-size section of Ferro Porcelain Enamel Research House now going up in Cleveland, Ohio, provided problem-solving unit on which roof and wall panels, window and door sections can be mounted to facilitate construction of full-size house. It was erected at U.S. Steel's Research Center, Monroeville, Pa. Research House is designed to test revolutionary ideas in residential construction; it will be used to explore methods of adapting residential housing components to the techniques of mass production, as well as serving as a proving grounds for advances in plumbing, heating, and wiring systems. Roof, exterior walls, interior walls in the kitchen, bathroom, and utility areas will be finished in porcelain enamel in a variety of colors and textures. More than 20 companies are involved in the project, which was designed by Carl Koch & Associates.



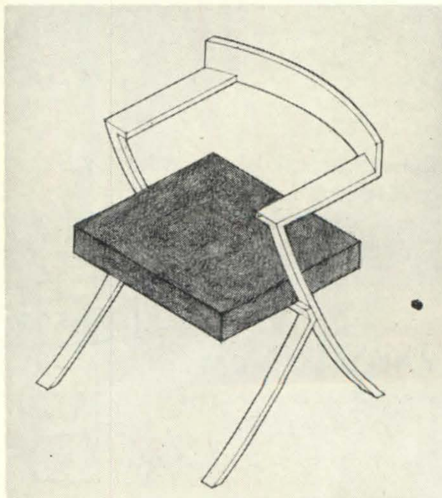
Water-Ski Pavilion Will "Float" on Georgia Lake

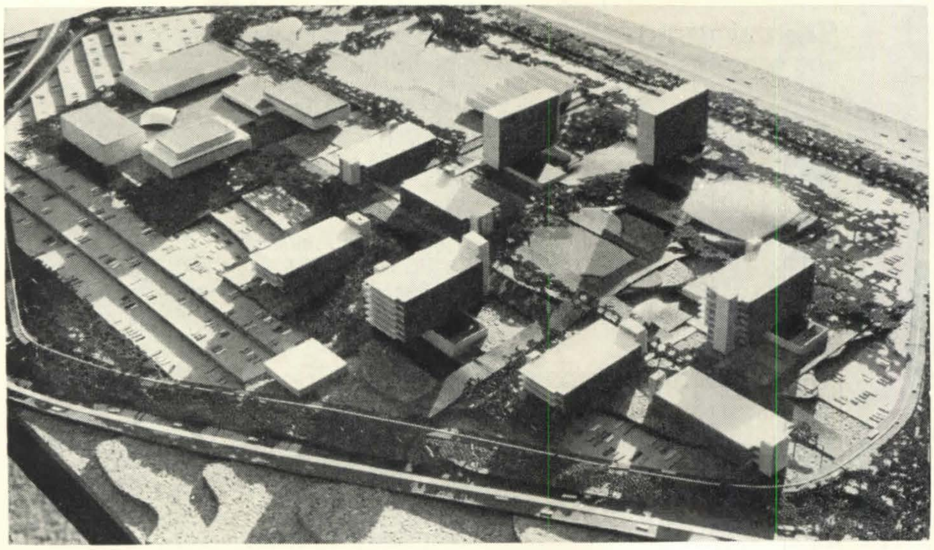
Pavilion on Robin Lake Beach in Ida Cason Callaway Gardens, Pine Mountain, Ga., is expected to be completed in time for the Masters Water Ski Tournament later this month. Built 120 ft into the water, the pavilion will rest on concrete piles and seem to float in the lake. The roof structure of seven concrete barrel vaults supported by tapering columns will be independent of the floor structure. A skeleton steel frame will support blinds for shelter from sun and weather. The center section will have a press mezzanine cantilevered toward the lake. Portable bleachers will be set up in the pavilion for special events such as the ski tournament. The building will be reached over a 19-ft bridge consisting of five separated concrete squares, each resting on its own column. C. B. Curry of Atlanta designed the pavilion in consultation with Walter Harris of New Haven, Conn. Drake & Funsten, Atlanta, are consulting engineers. Design consultants for the Gardens themselves are Tunnard & Harris, New Haven.



VWSS&Hers Design Furniture

Eugene Hetman, a 24-year-old draftsman with Voorhees, Walker, Smith, Smith & Haines, has won a competition for design of steel furniture conducted among members of the firm's staff. Strength of the material allowed the designer to eliminate vertical back supports. Steel used was exposed hollow rectangular sections. Jurors were Olga Gueft, *Interiors* Editor; Betty Pepis, author on interior subjects; William Johnstone, Vice President of Bethlehem Steel Company; Professor Esmond Shaw of Cooper Union; and the firm's recently-retired partner, Ralph Walker.





U of C Plans Science and Engineering Campus

First development stage for the University of California's School of Science and Engineering in La Jolla consists of a master site plan, created by Los Angeles architects Risley & Gould. Project includes seven buildings for teaching and research, two residence halls, dining commons, recreational building, playing field, and parking lots. Buildings will vary in height from one to seven stories. Specific plans for first new science building include classrooms, laboratories, and academic offices of the six initial disciplines: chemistry, earth sciences, engineering, life sciences, mathematics, and physics. Building will also include administration, service shops, library, and scientific shops. Design will feature utility core that will permit optimum flexibility of arrangement and rearrangement of laboratory spaces. Modular partitions will further facilitate flexibility. In addition to the nucleus of the 11 new buildings, others are being planned in the future.

Continued on page 74

Dorm Is Latest Element in Temple University Growth

Temple University Men's Dormitory is said to be first masonry curtain wall on Philadelphia's skyline. Building is most recently-announced unit in university's $50 millions master plan by Philadelphia architects Nolen & Swinburne. The 11-story building will have a full-height, dark glass sunscreen on its west elevation, to project eight ft from the wall. First of two men's dormitories, the building will consist of ten residence floors subdivided into five two-floor units, each with its own lounge, study, and laundry areas for 90 students. First floor will contain a student lounge, dining room, and kitchen. Students will be able to sunbathe in a glass-roofed penthouse. Design won a Citation for Excellence from Philadelphia Chapter AIA.

Engineers Get Building On UN Plaza

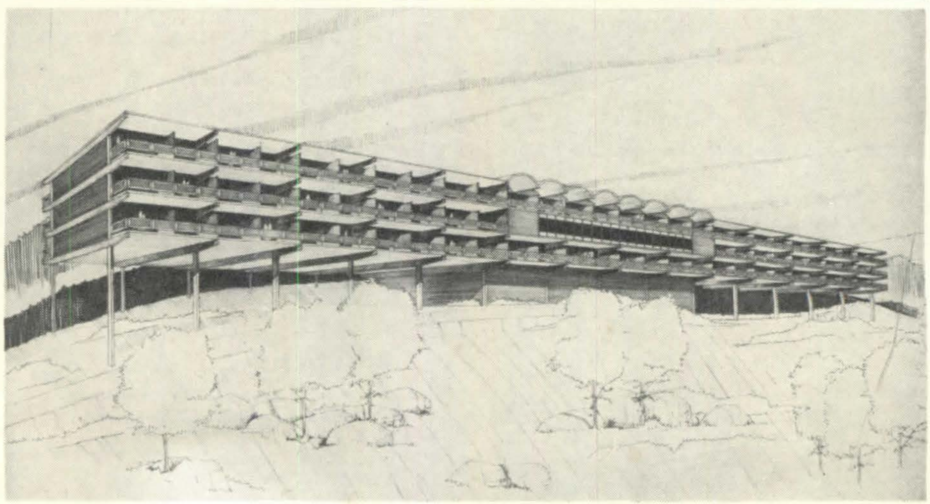
Twenty-story United Engineering Center, rising opposite the United Nations Building, will be occupied by 18 leading American engineering organizations. Center will house executive offices for engineering societies and joint organizations, plus the world's most complete engineering library. The structure will be owned and operated by United Engineering Trustees, composed of representatives of the American Society of Civil Engineers; American Institute of Mining, Metallurgical and Petroleum Engineers; The American Society of Mechanical Engineers; American Institute of Electrical Engineers; and the American Institute of Chemical Engineers, all of which will occupy the new structure. The curtain wall building was designed as a basic glass and stainless steel grid system with fixed windows, glass spandrels, and a masonry service core. Completion is expected in mid-1961. Shreve, Lamb & Harmon Associates are the architects; Turner Construction Company, general contractor.

New York's Finest Break Ground for Academy

New York's new Police Academy by Kelly & Gruzen, for which ground was recently broken, will contain facilities for the Academy, the combined 13th and 14th Precinct Stations, Medical Bureau, and Crime Laboratory. Low structure at left will house physical education, drill hall, swimming pool, and firing range. The roof will be used as a muster deck. First floor of main building will be a "covered campus," except for elevator and stairway lobbies. Academy will occupy second through sixth floors; medical bureau and investigation unit the seventh floor; and crime laboratory the eighth. The rear wing, which will face on the next street north, will house the precincts. Structural Engineers: Weinberger, Frieman, Leichtman & Quinn; Mechanical Engineers: Muzzillo & Tizian.

Film-Book-Record Produced by Allied Masonry Council

A film, Man and Masonry," has been released by the Allied Masonry Council. Directed by Bernd Foerster, Assistant Professor of Architecture at Rensselaer Polytechnic Institute, the film is a handsome paean to past and present uses of masonry in many forms. A book and record derived from the film are being distributed to architects by members of the masonry industry.



We Will Build a Cabin in the Sky, Baby

Mountain top living for site seekers will be provided at the new "Motel-in-the-Sky" which will rise above Yonkers, N.Y. Motel, designed by Samuel L. Malkind, will consist of 76 units, each with private patio overlooking the mountain valley and expanse of New York State Thruway. Efficiency units will have individually controlled heating and air-conditioning and radio and TV installations. Motel will feature health club containing indoor swimming pool, pine scented steam rooms, and outdoor pool with children's wading pool and playground. Public spaces will include restaurant, cocktail lounge, coffee shop, and large, glass-enclosed terrace.

Precast concrete beams and girders, and prefabricated roof and floor elements were assembled at factories and trucked to the mountain site.

Proposed Bill Poses Professional Restrictions

Other Item: BNA Predicts Slight 1961 Recession

By E. E. Halmos, Jr.

Professional societies in Washington are hunting for the reasons behind a new bill introduced in Congress that would set up a new registration classification: "Federal Engineer." It would affect all engineers working for the federal government, either directly, or as Architect-Engineers, and would actually set up another form of registration machinery in addition to that already maintained by the states. Architects would also be affected.

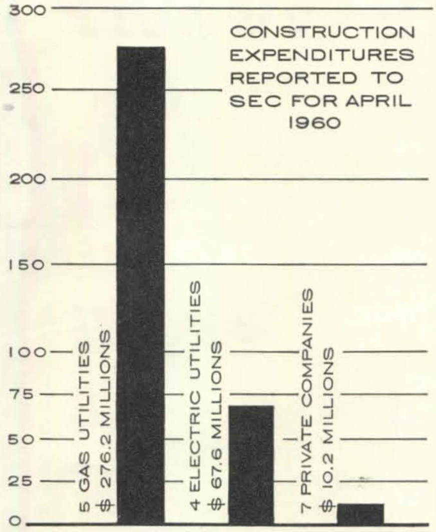
Actually, the bill is rated no chance of passage. But the fact that it was introduced (by Rep. Foley, D., Md.) is some cause for concern if it reflects any substantial sector of Congressional thinking. Foley himself is careful to explain that he introduced the bill (HR 11916) "by request"—which is a nice way of saying he doesn't really care, but did it to satisfy a constituent.

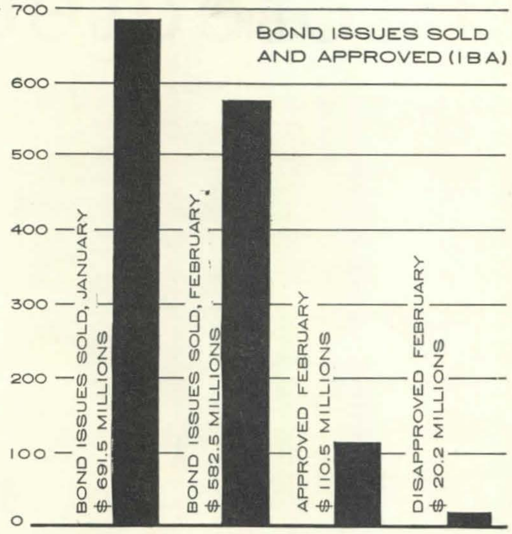
Labeled "a bill . . . to establish a system for public and legal recognition of engineers and scientific personnel engaged in the practice of their art for . . . the federal government," the bill has these main provisions:

1 It sets up a 7-member registration board (including civil, mechanical, electrical, and chemical engineers) with power to register, give examinations, enforce compliance;
2 Makes it illegal for anyone to practice the profession on government projects without registration;
3 Provides for licensing of "technicians" who are designated as "candidates for registration as a professional federal technician, who have been schooled or completed an apprenticeship in the useful mechanical arts—one who is skilled in technique."

This last point—plus the imposition of yet another registration requirement—is what's bothering the societies now. They say no technicians should be registered.

As nearly as can be discovered, backers are mostly federal employes.





BOND ELECTION RESULTS – FEBRUARY 1960 BY USE OF PROCEEDS

USE OF PROCEEDS	APPROVED		DISAPPROVED	
	AMOUNT	NO	AMOUNT	NO
EDUCATION:				
ELEM. & SEC.	$ 73,378,000	82	$ 13,511,000	14
ROADS & BRIDGES	2,765,000	5	200,000	1
WATER & SEWER	11,964,000	25	3,907,000	7
OTHER UTILITIES	5,200,000	1	100,000	1
HEALTH & WELFARE	7,565,000	5	2,500,000	1
RECREATION	6,073,000	3	———	0
PORTS & AIRPORTS	500,000	1	———	0
INDUSTRIAL	2,730,000	5	———	0
UNCLASSIFIED	302,000	5	20,000	1
TOTALS	$ 110,477,000	132	$ 20,238,000	25

BOND ELECTIONS SCHEDULED AS OF MARCH 1, 1960

MONTH	AMOUNT
MARCH	$ 122,551,000
APRIL	51,265,000
MAY	66,325,000
JUNE	15,956,000
AUGUST	4,000,000
NOVEMBER	12,893,000
NO DATE SET	9,630,000
TOTAL	$ 282,620,000

USE OF PROCEEDS	AMOUNT
EDUCATION:	
ELEM. & SEC.	$ 142,751,000
OTHER	350,000
ROADS & BRIDGES	52,825,000
WATER & SEWER	30,621,000
OTHER UTILITIES	6,512,000
HEALTH & WELFARE	6,620,000
RECREATION	11,730,000
PORTS & AIRPORTS	5,816,000
REFUNDING	2,332,000
ADMIN. & OFFICE BLDG	500,000
UNCLASSIFIED	22,563,000
TOTAL	$ 282,620,000

$1 Billion for FNMA

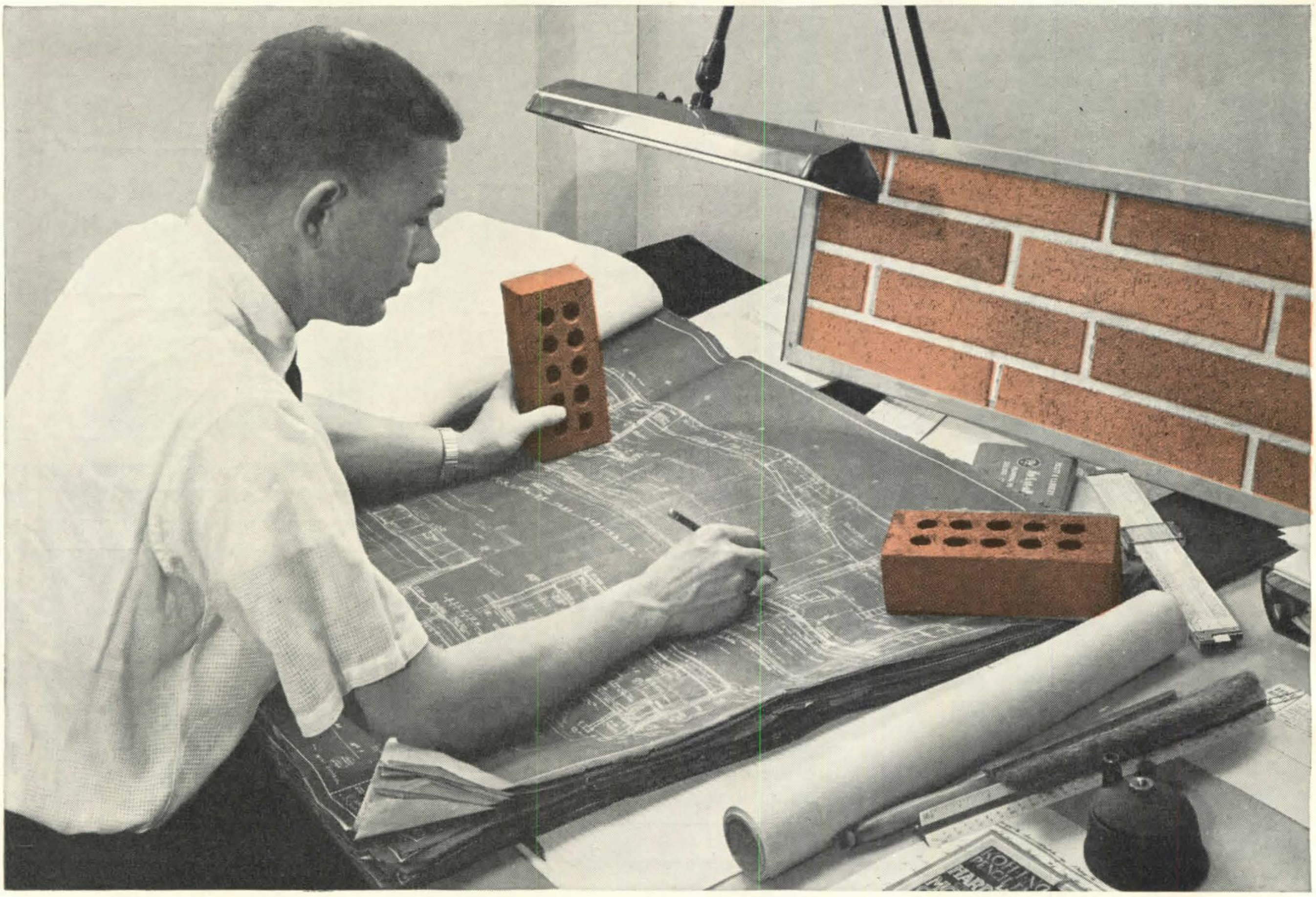
On legislation in general, it was getting harder to make comments as the month of May proceeded. Congress was finally back to work, after clearing the Civil Rights measure—and it was living up to estimates that it would shove through needed appropriations and some politically-good matters, and little else.

Of direct interest to architects was passage in the House of HR 10213—the Rains bill—to provide an extra $1 billion of authority to FNMA to buy mortgages, after some unusually bitter debate on strict party lines (Republicans called it "$1 billion worth of baloney"). Rep. Rains (D., Ala.) insisted it would not cost any money, since the fund would be revolving, and brushed off the half-hearted attitude of the National Association of Home Builders which wasn't too eager to back the bill. In view of the

Continued on page 82

NEWS from Dow Corning

Protected With Silaneal



New Treatment Keeps Brick Beautiful, Keeps Owners Happy, Speeds Construction

Now there's a treatment that protects the natural beauty of the brick in your building designs. It's inexpensive, too. Just specify *Silaneal®* protection when you specify brick. Applied by the brick manufacturer, this sodium siliconate treatment minimizes efflorescence . . . makes brick water-repellent . . . keeps stains *out* where they rain-wash away. Result: brick stays clean in storage . . . stays beautiful in and after construction. Most important, *owners stay happy!*

Here's More Information to Help You Evaluate Brick Protected with Silaneal

1. Silaneal Bulletin, AIA File No. 3F.
2. Full color, descriptive movie.
3. List of manufacturers offering brick treated with Silaneal.

Write today. Address Dept. 7306

Specify

SILANEAL®
keeps brick clean

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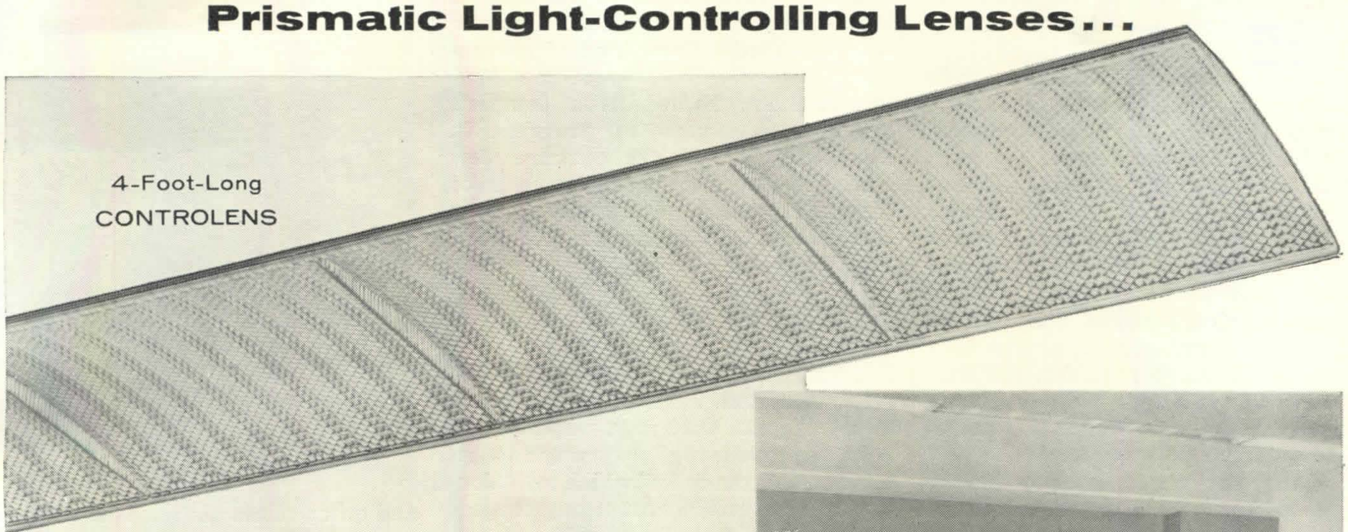
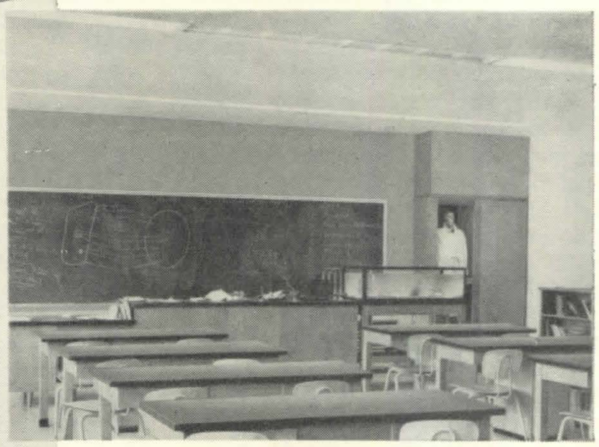
ACRYLIC PLASTIC...The Proven Material for Modern, Prismatic Light-Controlling Lenses...



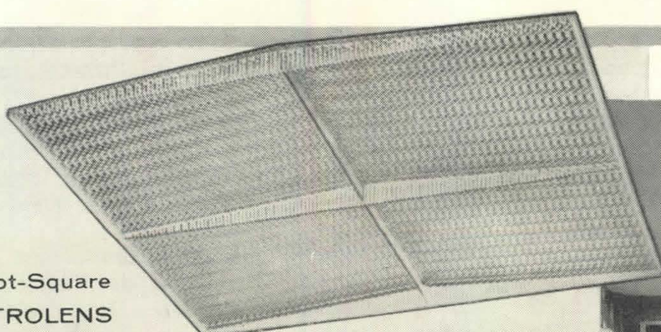
4-Foot-Long CONTROLENS



4-Foot-Long CONTROLENS, singly or in continuous runs, are advantageously used in classrooms, offices, banks, showrooms, libraries, stores, lobbies and laboratories.

Wherever the PRISMALUME CONTROLENS has been used it has delivered consistently superior performance: high level illumination with the utmost visual comfort. Its prismatic construction provides effective light control with the best "hiding-power" to conceal light sources. The use of crystal-clear acrylic plastic produces a CONTROLENS that is light in weight, shatter-resistant, free from discoloration and altogether different in its distinctive, quality appearance. Reinforcing struts assure great dimensional stability... Available in a variety of shapes for a wide range of fluorescent applications.

HOLOPHANE PRISMALUME® CONTROLENS®



2-Foot-Square CONTROLENS

The flexibility of the 2-Foot-Square CONTROLENS makes it adaptable in many ways, such as: • Geometric groupings (one or more lenses)... • 2-ft-wide continuous troffer runs... • Large luminous panels.

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Continued from page 77
political situation, there was no indication of what the Senate would do with the legislation—beyond cutting it substantially.

Various school-aid measures were still hung up in committee hearings; there were no bets available on when they'd come out for debate.

And there were two perennials that are of interest, but have little chance of action: HR 11711, which would require (on pain of fines and jail sentences) that prime contractors name their subcontractors and use them as named on federal contracts; and bills that would remove requirements that the head of the Navy's ship design organization be a registered naval architect.

On the also perennial question of common-situs picketing on construction jobs, Labor officials privately had about given up hope this year. As you know, they want present bans lifted, want all contractors on a job considered as one employer, for purposes of picketing.

Special Session?

But before you wrap up your thinking on Congress, take note that there's now serious talk, on both sides of the aisles, of a special session after the political conventions.

Reason: too much to do now, in too little time. Most Congressmen don't like the idea—they'd rather be free for purely political activities. But the leadership is worried over probable criticism from the public, if Congress winds up too fast, kills too many pet projects.

Better Building Data

Under heavy pressure from industry (and Congress) the Census Bureau is pushing plans to improve reporting of construction statistics. You'll recall that Census somewhat unhappily took over reporting of these statistics (including housing starts and machinery shipments) from the Bureau of Labor Statistics more than a year ago. It has been struggling with them ever since.

In partial answer to some of the critics, Census has made public an interim progress report that indicates it will be ready with a new series on housing starts within a couple of months. Steps include: a new and broader definition of housing starts, to include farm housing and seasonal and low-quality housing; extension of the reported total of building permits to include a larger number of permit-issuing areas; new data on the time-lag between permit and start of construction; continuing and broader field surveys of non-permit issuing areas.

Census wasn't alone in attempts to keep up with housing. HHFA issued what it called a "new kind of government report"—*Housing Accomplishments, 1959*. Hailed as a compact, easy-to-read review of progress in this field, the report contains few statistics, touches various aspects of federal programs. You can get a copy from HHFA, Washington 25, D.C., for 15 cents.

On "Degree Mills"

Although the Department of Health, Education and Welfare doesn't want to say it quite that way, response has been disappointing to its campaign against "degree mills" which sell "doctorate" degrees in almost any subject for fees of as little as $50 and no residence requirement.

HEW had publicly hoped that professional societies (rather than educators) would leap into the battle of publicity to expose these so-called "schools," since the federal government is in fact almost powerless to stop them, excepting on grounds of mail fraud or ficticious pricing or other reprehensible trade practices (both very difficult to prove, since most of the "schools" are legally-enough chartered in their home states).

Officially, the professional societies have expressed polite interest, but added they would wait for publication of official lists by HEW. First installment of such a list was published early in April. Response: so far, very little.

The Fight Goes On

Tradition and the Washington Fine Arts Commission have ganged up on Washington Architect Vlastimil Koubek, AIA, in his attempts to put up a modern office structure on a downtown Washington corner opposite the White House.

The triangular site—now occupied by a few nondescript old buildings—is actually opposite the garish old brick-and-sandstone structure that was built as the original Corcoran Gallery and now houses the U.S. Court of Claims, and the equally rococo old State-War-Navy Building. Both of these are slated for eventual demolition.

Acting for the International Bank of Washington (a private corporation) Koubek planned a building with generous areas of gray window glass. mullions of gold-anodized aluminum, and areas of white marble (see rendering), with setbacks at the corner and on each side street to provide covered pedestrian walkways under a third-floor overhang. A bank would occupy the street floor, with insurance

and other offices above. Interior parking would be provided (for 200 cars). But the Fine Arts Commission objected strenuously and publicly to "all that glass," insisted it wanted more marble, said the building would be "out of character" in the area—even though a next-door structure now under construction (the Penn-17 building) will present just about as much glass in its façade.

Koubek was instructed to rework his plans. Fine Arts disapproval has almost the force of law, though it cannot legally block issuance of a building permit. In the past, though, refusal of Fine Arts approval usually results in no permit.

Worry Warts in Washington

In other architectural matters, Washington's growth as an office-center city continued to bring conflicts with "federal" architecture styles and tradition. For instance, a District of Columbia proposal for zoning changes to conceal "warts" on the low-lying skyline caused by rooftop air conditioning, elevator housing and other structures, got a mixed reaction at zoning board hearings.

The District wants to encourage architects to place such rooftop equipment in penthouses that will hide them and harmonize with the building itself. Only the National Capital Planning Commission gave *full* support to the idea—all others wanted to qualify the changes, most by giving architects freedom to "design a decent termination to the building."

Significant was Engineer-Commissioner Brig. Gen. C. A. Welling's retort to that suggestion: "In other words, you would leave it all up to the very people who have created the situation." Welling has been prime mover in attempts to clean up the

Continued on page 86

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Continued from page 82

skyline, and is head of the zoning commission.

On other fronts in the Capital, the fate of a $65 millions, three-building program that would permit the removal of eyesore "temporaries" now housing some 63,000 employes remained in the air as May began, with Senate committees debating approval of the plan; and the Bureau of the Budget—by coldshouldering appeals for $500 millions for highway money, gave a powerful push to burgeoning plans for an integrated rail rapid-transit system to serve the District and its satellite communities.

The continuing good market for architect's services provided by the nation's educational institutions is sharply demonstrated by recent reports of the Department of Health, Education and Welfare.

Said HEW: Total expenditures (by 2000 colleges and universities alone) for additions to plant were $686 millions in 1955-56; $1.1 billion in 1957-58. Expenditures at near these levels are expected to continue.

Anti One Code

Although the subject has been dormant for several years, a Washington trade association official took occasion recently to warn against any attempts to establish a single building code for the entire United States.

The official was Douglas Whitlock, board chairman of the Structural Clay Products Institute. His forum was a building code meeting sponsored jointly by AIA, Associated General Contractors, National Society of Professional Engineers and NAHB.

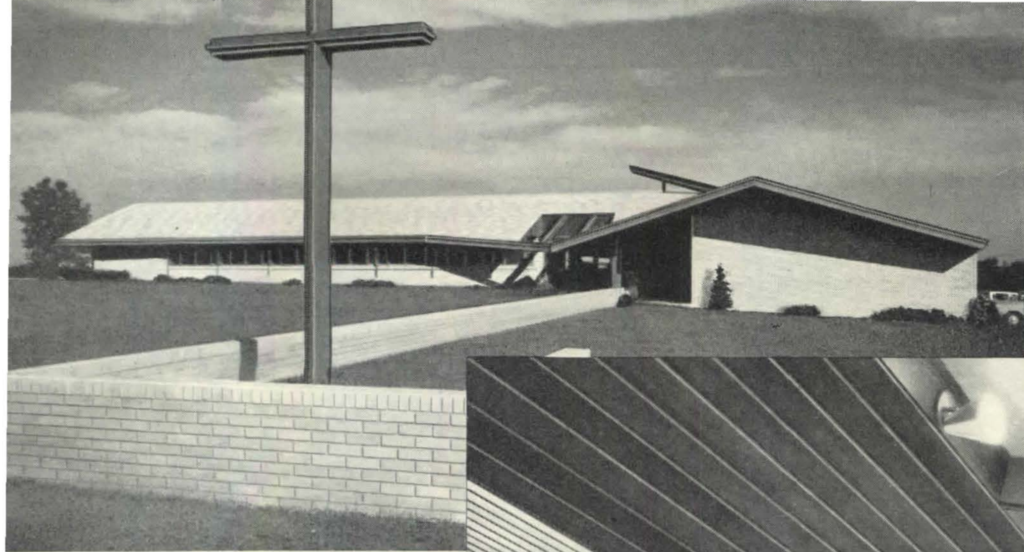
Said Whitlock: Certain segments of the building industry, as well as government officials, have at times advocated a single national building code. But such a code would weaken the advance of code modernization, make it even more difficult to obtain changes. He espoused model codes now being sponsored by the Building Officials Conference, National Board of Fire Underwriters, International Conference of Building Officials and Southern Building Code Congress as a better answer.

Health Now; Recession 1961?

On financial matters, there was one warning of trouble ahead in Washington, despite continuing evidence of a surging economy that was being led by construction work.

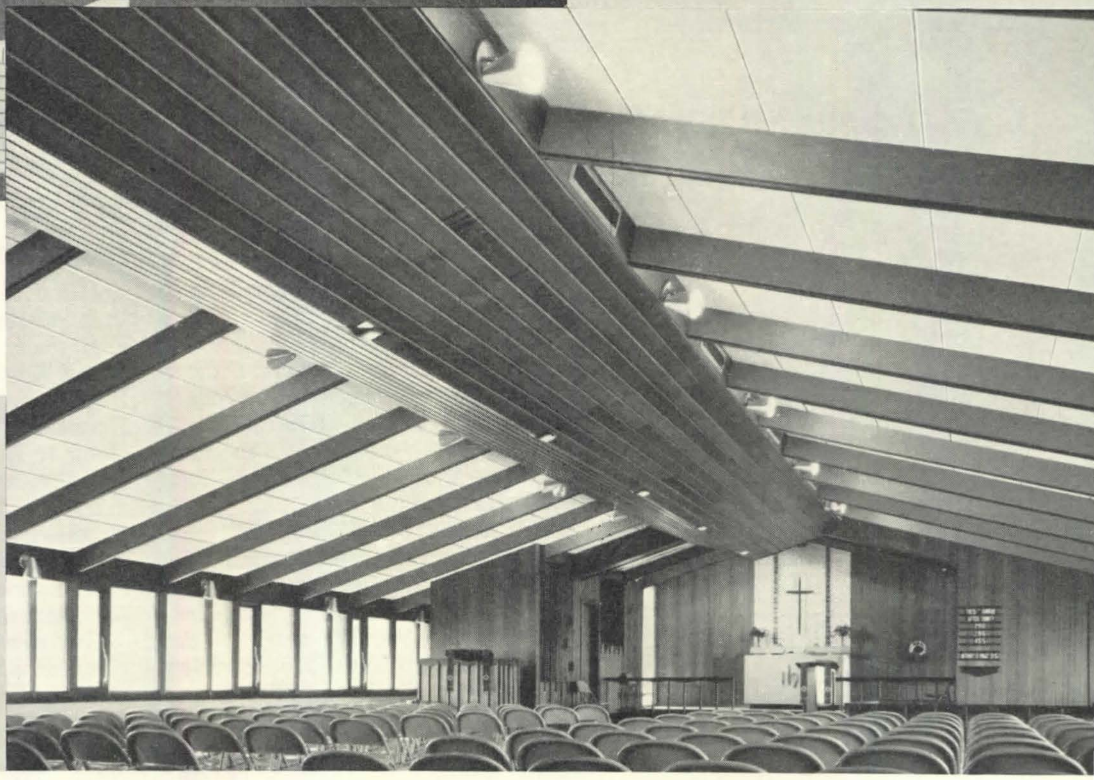
The warning came from the respected Bureau of National Affairs (a Washington newsletter service) in its

Continued on page 90



Vast roof areas enclose the combined church and school. Wing at left is the temporary sanctuary. With congregation expanding rapidly, space can later be converted to added schoolrooms or other usage.

ARCHITECTS:
H. Harold Tarleton, Jr., & Assoc.
Greenville, S. C., A. I. A.
Triangle Construction Co.
Greenville, S. C., Church
Wade McKinney—Contractor
Greenville, S. C., Home



Bright, airy sanctuary wing is also notably quiet and cool . . . thanks to special qualities of Insulite Roof Deck. These thick fiberboard panels have the necessary strength for decking; yet highly efficient insulating value and sound absorption. *No ceiling painting is needed.* Tough, washable interior finish is applied at factory.

Versatile 4-in-1 Insulite Roof Deck helps build handsome low-budget Church . . . adds striking beauty to Architect's Home

At Greenville, S. C., the Lutheran Church of Our Saviour faced a difficult—yet fairly common—problem. To launch a long-term master plan, there was only a modest budget on hand to construct a sanctuary, school, offices and meeting hall. The architects achieved all this in the attractive L-shaped structure shown above. A key element in the plan was use of rugged Insulite Roof Deck . . . the interlocking 2′x8′ panels which are decking insulation, vapor barrier and pre-finished ceiling, all in one. This fine building gives the congregation 7,200 sq. ft. of handsome, efficient space . . . *at a cost just slightly over $10 per foot.* Subsequently, the chief architect designed his own home (shown at left) using Insulite Roof Deck with equally pleasing results. Want literature on this famous 4-in-1 material? Write directly to us—Insulite, Minneapolis 2, Minnesota.

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Continued from page 86

publication "Report for Business Executives."

Said BNA: "The next recession in business will get under way by the middle of 1961, and will be mild and short. That's the nearly unanimous prediction of a score of the nation's top government and business economists. They expect capital outlays to run out of steam (in 1961); a slowdown of spending by consumers; and that the federal government will be running at a substantial surplus through 1961—taking out more than it puts in."

You could take that comment at face value or not, for 1961. But there's no doubt that business is good now, and that prospects for the rest of 1960, at least, continue to be bright.

Item: Government reports showed that the gross national product reached a half-trillion ($500 billions) rate in the first quarter of the current year—a gain of $14.5 billions over the last quarter of 1959.

Item: There should be plenty of business upcoming in modernizing industry that would be concerned if a war should come. Said a Johns-Hopkins University report: much of the "war industry" of the U.S. is aging and becoming obsolete, will have to be replaced with new buildings, new machine tools.

Item: Municipal bond sales and approvals (see charts on page 77) continued at a high rate through February—though February totals in dollars were much smaller than in previous months. But the significant figure, for architects, was that voters OK'd 84.5 percent of all bond-issue proposals put before them. (As you know, bond proposals vary with the month—lots more will be presented in November than any other time.)

Item: At a point near midyear, proposals for construction for 1960 by utility companies were beginning to slacken off, with electric utilities falling behind gas for the first time by a considerable amount. Private work, however, continued to be planned at a good level. It is interesting to note, on private work, that the Securities and Exchange Commission reported increasing financing plans for relatively expensive "motels"—just two of these, reported during April, will account for more than $6.1 millions.

Item: State legislators continued to appropriate more money for public schools, according to latest figures (1957-58) available to the Office of Education. The total for 1957-58 was $4.5 billions, with individual state amounts ranging from $2 millions in New Hampshire to $534 millions in California.

However, there were some indicators in the many financial reports that gave some strength to the prediction issued by BNA for 1961: for instance, average interest rates on conventional first mortgages for the first quarter remained at an all time high of 6.30 percent, to indicate continuing tight supplies of money.

Over-all, it looks as if the best investment architects could make, for the future, is to devote more time to seeking work in schools and public buildings.

New Highway Bill Looms for 1961

You'll note that Congress is disposed to go along with the President—until next year, anyway, when there'll be a new Chief Executive in the White House—on highway spending. The House Public Works Committee went along so far as to hold appropriations for the so-called ABC system (primary, secondary, and urban roads) at the current year's level of $925 millions, didn't boost the figure $25 millions more, as it has done over the past several years.

Real reason, in this case, isn't politics, for a change, but rather the fact that Congress expects to substantially rewrite the highway laws in 1961, when it gets a series of reports on costs, taxes, and the like, from Bureau of Public Roads. Works Committee Chairman George Fallon (D. Md.)—a real friend of the highway program—doesn't want to rock the highway boat right now.

But note also that Representative Blatnik's special subcommittee studying the federal-aid program has started studying federal tax returns for the years 1950 through 1959—one of "several areas" in which the committee staff is working. That could mean an attempt to see if architects, engineers, and contractors really did make any excessive profits out of highway work.

And note two other developments on highways: everyone thought toll roads were dead a couple of years ago. But now, Maryland is studying the possibility of building its long-projected Northeast Freeway from Baltimore to the Delaware line as a toll project, in order to get funds for a quick start.

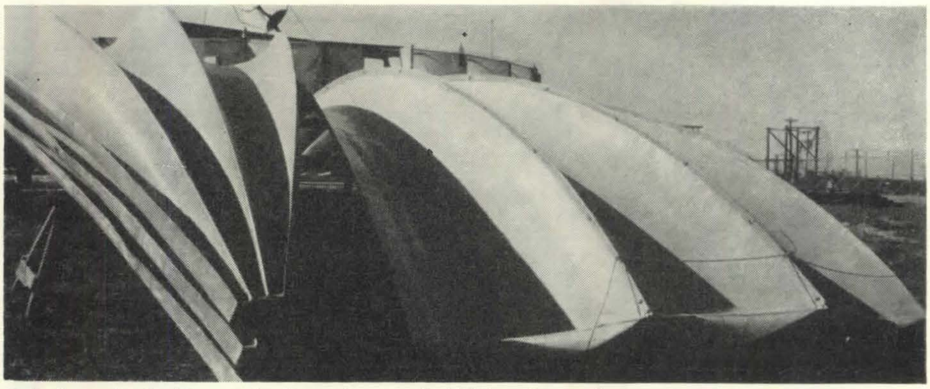
And the long-awaited Commerce Department study on transportation contained only one real surprise (and is sure to create ample opposition): it suggested that toll stations might be erected at highway "gateways" to major cities, as a means of discouraging motorists from driving downtown, forcing them off the roads onto public transportation.

STRONG STRUCTURE IS REINFORCED PLASTIC

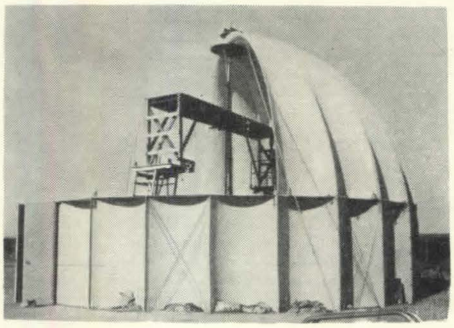
EUGENE, ORE. A high-strength, lightweight structure of reinforced plastic, designed for classified purposes, indicates the structural properties of the material. The circular building, assembled on the job site from large, tapered segments 24′ in length, has a diameter of 36′. It weighs 2000 lb, and can be picked up by a single lifting eye at the center. It successfully met requirements that it support a 2000-lb capacity rail hoist from the shell skin, and withstand 100-mile winds. Thin shells are critically engineered and derive strength from reinforcing fibers in the laminate. Originally produced in translucent white in the form shown, shapes are now being produced in varied forms and colors, either as complete structures or as components of structures. Costs may vary from \$3 to \$10 per sq ft of floor in single skin forms, and from \$8 to \$25 in sandwich shells.

Company collaborates in design, engineering, and production of plastic shells, plates, or structures, in conjunction with architects. Architectural Plastics Corporation.

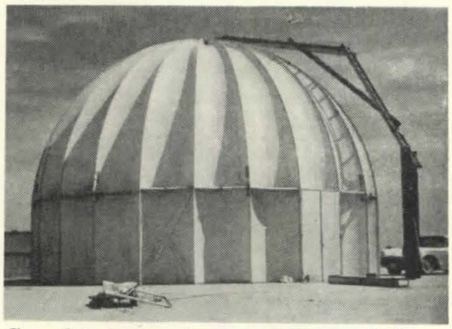
On Free Data Card, Circle **100**



Reinforced plastic roof elements await lifting into place.



During erection, roof is fastened to concave sections of wall.



Completed structure can be used for a number of purposes.

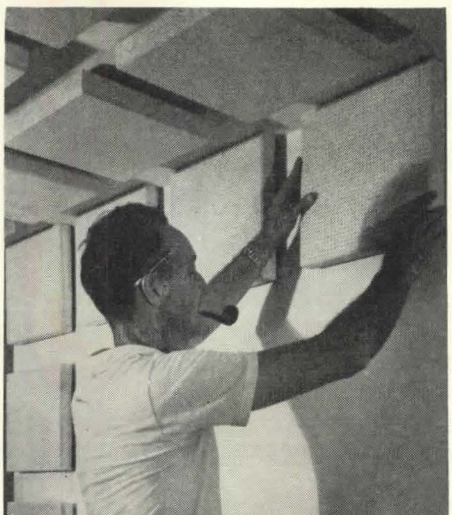
Foamed Glass Makes "Patch" Absorption Feasible

PITTSBURGH, PA. Development of acoustical cellular glass—or foamed glass—units has made the principle of "patch" sound absorption more practical than before. This principle makes control of room acoustics by architect and engineer more accurate, since absorptive devices may be placed where they will do most good, rather than having to depend on whole wall or ceiling "blankets" of acoustical material.

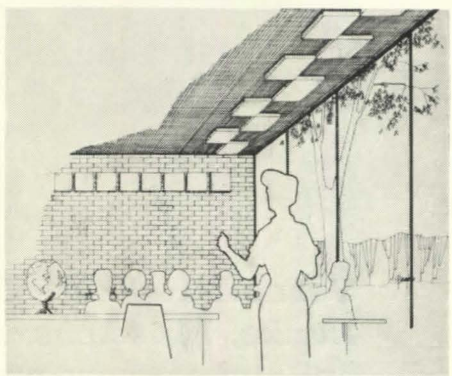
The product, called "Geocoustic," is now being produced in 13$\frac{1}{2}$-in. square, 2$\frac{1}{2}$-in. thick units weighing two pounds apiece. Approximately 2400 sound-control holes $\frac{1}{16}$-in. in diameter are pressed into front and back surfaces of the block, which is mounted on four square pads to make it sit out from ceiling or wall, creating a resonant chamber.

High absorption efficiency of Geocoustic, it is said, makes it possible to achieve desired results with both smaller patches and fewer patches than were previously necessary. Units are said to be most efficient when placed at or near corners of a room. Next most effective position is along edge of walls or ceiling. Units are normally mounted with special acoustical cement on dry, smooth, clean surfaces. Best results are obtained with surface temperatures between 60 and 100 degrees F. Pittsburgh Corning Corporation.

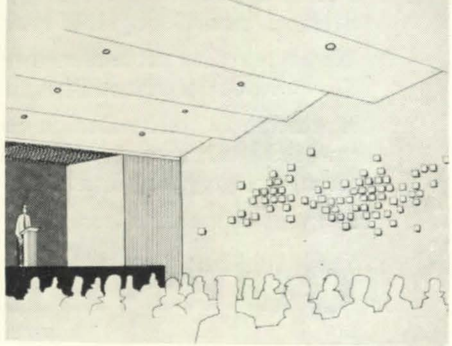
On Free Data Card, Circle **101**



Workman mounts Geocoustic units away from wall, creating resonant chamber.



School application shows small number of units needed for good atmosphere.



Possibility of unique design with units is shown in auditorium application.

Light and airy as a butterfly in appearance

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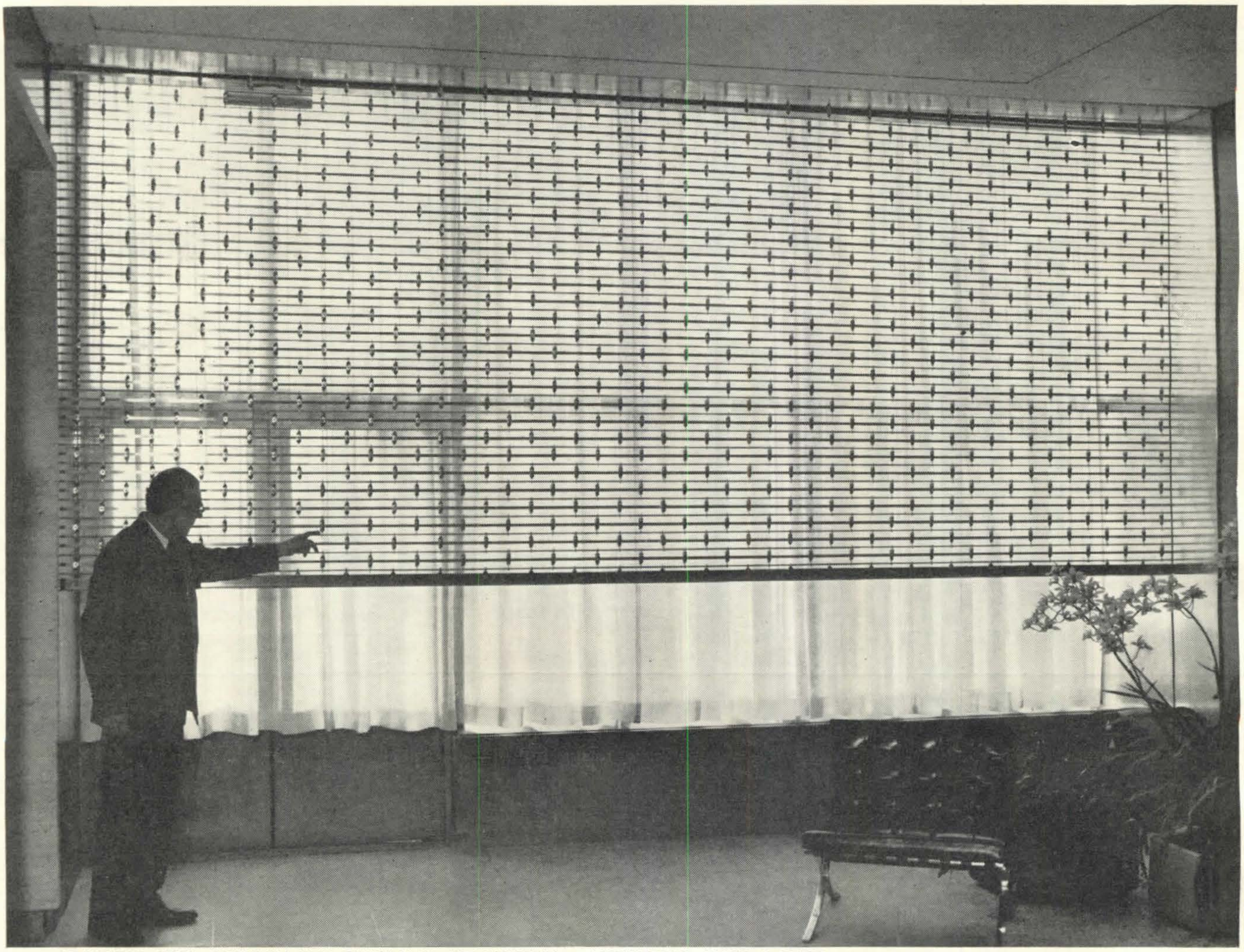

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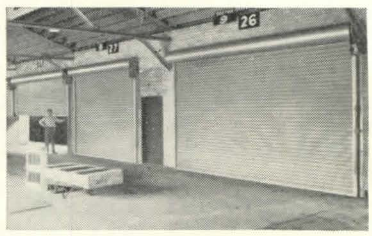
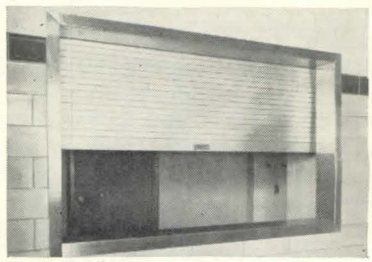


ROLLING STEEL DOORS



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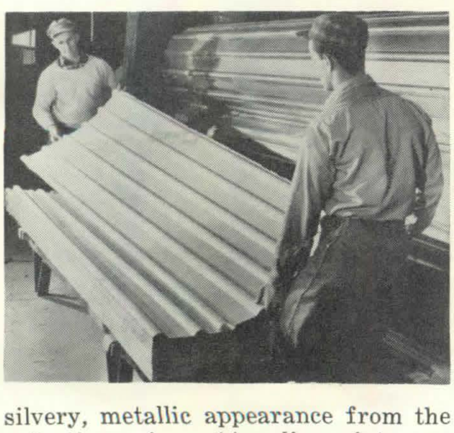
Aluminum Siding Has Plastic-Bonded Finish

A virtually indestructible plastic finish that is permanently bonded to heavy-gage Reynolds aluminum forms an advanced new siding product. Guaranteed for 20 years, "Plasticlad Aluminum Siding" eliminates need for frequent exterior repainting, provides additional long-run economies by its superior insulative qualities. Other features are hidden-nail construction, improved tension lock, and inside protective mica coating. Finish is a deeply-etched wood-grain pattern, available in eight colors. Solmica, Inc.

On Free Data Card, Circle **103**

Mica-on-Plastic Protects Sheet-Steel Panels

Sheet-steel roofing and siding is thoroughly protected against weathering by an integral coating of mica particles on heavy asphaltic plastic. Mica protects plastic from the sun's rays by reflection, thus preventing drying or cracking of the surface. Unpainted, the coating retains a

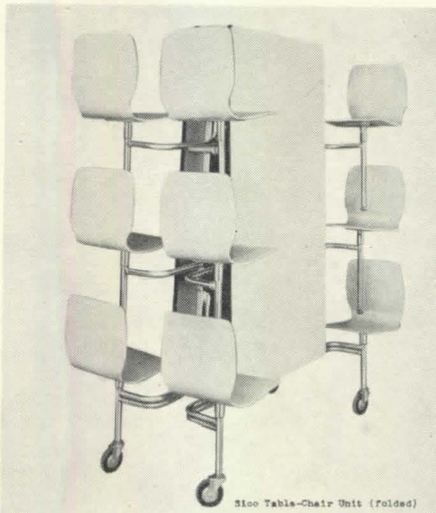


silvery, metallic appearance from the reflective mica. (Acrylic paints are available if coloring is desired.) Plastic is applied in several layers (with mica added to the final layer); roller process assures uniform thickness. Finished sheet can then be rolled into corrugated, V-beam, mansard, or fluted patterns. Steel, 18 to 24 gage, is by Jones & Laughlin Steel Corporation. Plasteel Products Corporation.

On Free Data Card, Circle **104**

Table-and-Chairs Unit Folds for Storage

Table with attached chairs features walk-to-your-seat design and folding portability. Chairs are anchored to table by structural-steel pedestals that are set to one side to provide unobstructed approach and seating. Table, 10′ long, folds at center to be rolled to storage areas and through doors. In accommodating 12 persons



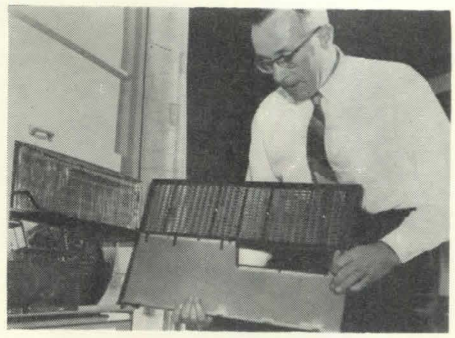
Sico Table-Chair Unit (folded)

per table—2 more than at table of same size with separate chairs—"TC-65" gives further space economy. Keeping standard orderly aisles is another dividend. Seating is either contoured plywood or molded plastic; table tops are melamine bonded to particle board; framework is welded steel with zinc coating. Sico Manufacturing Company, Inc.

On Free Data Card, Circle **105**

Open-Pore Urethane Foam For Long-Lasting Filters

Washable, permanent filters — with germicidal and air-freshening properties achieved by chemical additives—have been developed for use in air conditioning. Filters are made of "ScottFoam," an open-pore polyurethane foam that consists of a series of urethane strands closely connected in a mesh-like structure; the open-pore arrangement frees 97 percent of total volume for trapping and holding



airborne particles. Filters can be washed in soap and water, and replaced immediately; they are non-shrinking and almost indestructible. Even after repeated washings, foam does not mat or reduce filtration. ScottFoam has been adopted for all models of the 1960 Westinghouse "Mobilaire" line of air conditioners. Scott Paper Company.

On Free Data Card, Circle **106**

Pencil for Use on Polyester-Based Films

A new pencil, created specifically for making tracings on polyester-based film, has been developed. Called "FTR" (for film tracing reproduction), its lead is compounded of new resins, super-fine graphites, and plasticizers that block out light to make copy prints of black-ink clarity. (Until this development, conventional pencils have been unequal to the superior new translucent films. Excessive rate of lead wear, erasures, and variations in line thickness on prints have been particular problems.) Package, containing 12 pencils, is also newly designed; box is a desk tray that can be anchored to drafting board to keep pencils handy. Six degrees of lead hardness are available. Joseph Dixon Crucible Company.

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New Cellular Insulation On Cooling-System Pipes

New expanded-cell tube and pipe insulation is designed for refrigeration and air-conditioning lines. The preformed insulation is an expanded neoprene consisting of millions of tiny cells filled with inert gas. Material successfully prevents condensation (under normal design conditions), makes excellent insulator against heat loss, and provides effective vapor barrier. Easy to install, "Presst-O-Cel" hugs pipe or tube closely, even at bends. It can be applied to new

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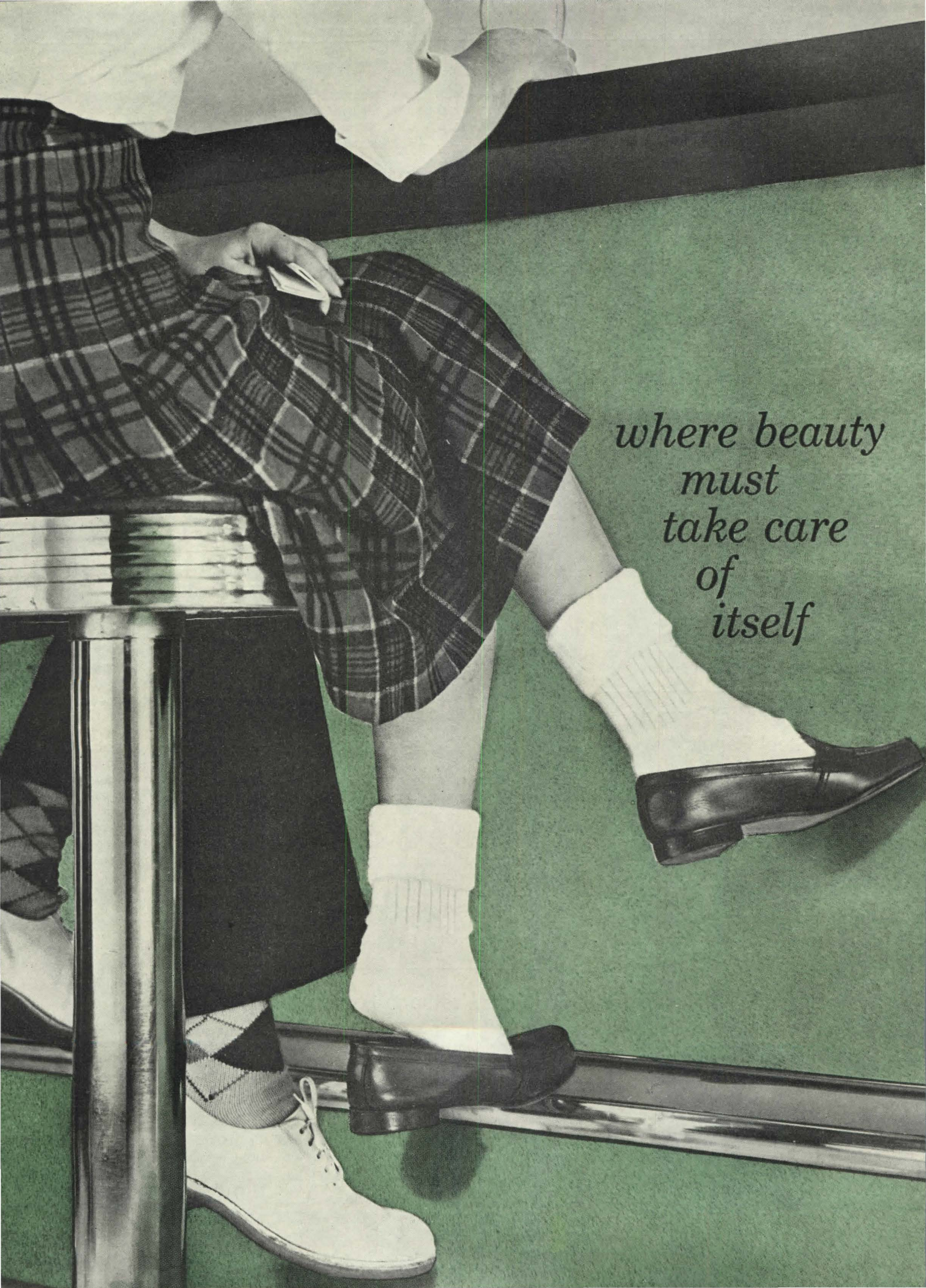
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Continued from page 99
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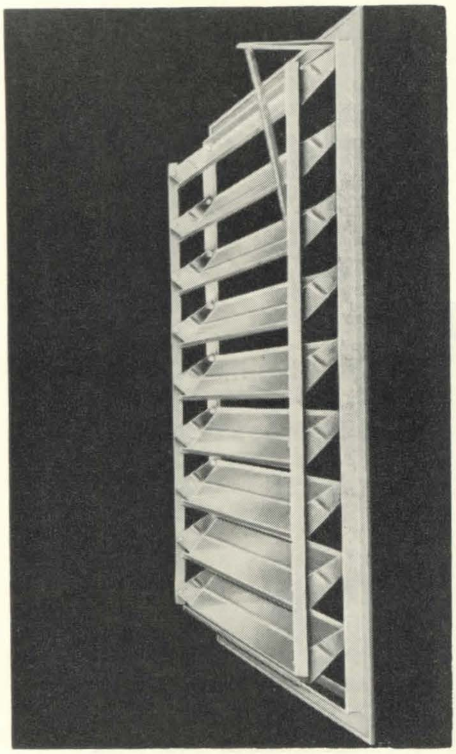


Attic Ceiling Shutter Is One-Piece Plastic

Increased structural strength and completely noiseless operation are claimed for new model of "Windmaker Alumattic" ceiling shutter. Pivot and spacers are molded into a one-piece tie bar of plastic, precluding use of metal rivets and nylon sleeve, and giving completely flutter-free performance. Shutter frame is of heavier, thicker construction, reducing possibility of damage in handling and shipping. Phil Rich Fan Manufacturing Company.

On Free Data Card, Circle **109**

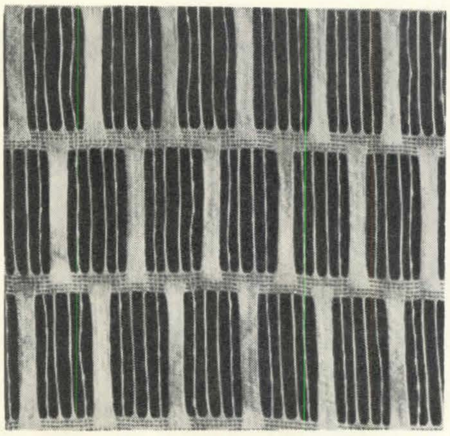
Compact Bathroom With Complete Facilities

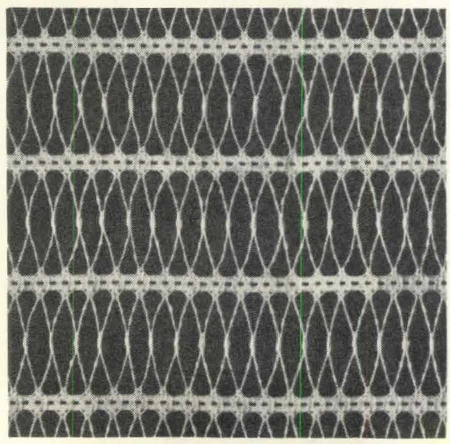
In a space less than 3′ x 4′, revolutionary bathroom facility provides shower, foldaway toilet, washbasin, medicine cabinet, light fixture, and exhaust fan. "Model 236 V" is shipped knocked-down, assembling and connecting easily at installation. Fixtures are stainless steel; interior wall panels and ceiling are vinyl-coated plastic bonded on steel; exterior panels are finished in vinyl. Unit is suggested for apartment conversions, hospitals, offices, motels, and wherever a compact, yet complete, facility is needed. Travel-Lav Division, Angelo Colonna, Inc.

On Free Data Card, Circle **110**

Casements Are Reinforced With Plastic Fiber

Two examples of Vision Net, a new imported line of lace casement fabrics, are shown. Available in a selection of patterns, the lace casements are made of cotton reinforced with Terylene (a Dacron-like fiber) to give strength





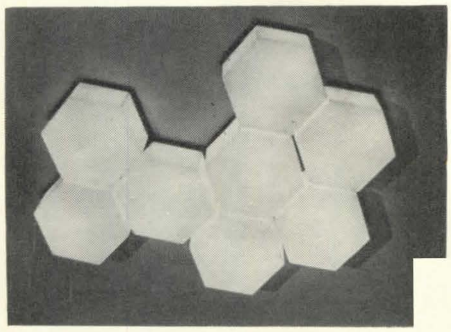
and stability; easily maintained, the laces are washable and drip dry. In white or biscuit, as well as a wide range of colors, they are 48″-wide and retail from $3.90 per yard. Kagan-Dreyfuss, Inc.

On Free Data Card, Circle **111**

Strength, Insulation, In New Roof Board

Development of a new board combining high thermal efficiency and superior structural strength promises major advantages in insulation for flat, built-up roofs. New "Aloyglas Coprfibre" roof insulation is a dense, fine-fiber, plastic-bonded board with high resistance to puncture, crushing, and damage from foot traffic. Aloyglas fibers create a greatly increased number of dead air cells for maximum insulating value. Heavy asphalt-kraft vapor-barrier facing is carried over long edge of 2′ x 4′ board to facilitate handling and minimize damage during application. Rigidity is added by lengthwise edge binding. Maximum weight of one pound per board foot permits lighter and less expensive roof structure, while providing increased insulating efficiency. Forty-Eight Insulations, Inc.

On Free Data Card, Circle **112**



Lighting Fixtures May Be Variously Arranged

Individual hexagonal lighting fixtures of acrylic plastic can be used singly or combined to make any pattern on ceilings or walls. The acrylic hexagons clip on and off black metal framing for easy installation and maintenance and may require only one electric outlet for an indefinite number of fixtures, depending upon wattage used. Each fixture, 4½″-deep by 11″ in diameter, contains two sockets, accommodating up to 50 watts per socket. Available in white, fixtures can also be ordered in choice of 24 colors. Approximate retail price: $60 each. Lillian Ross.

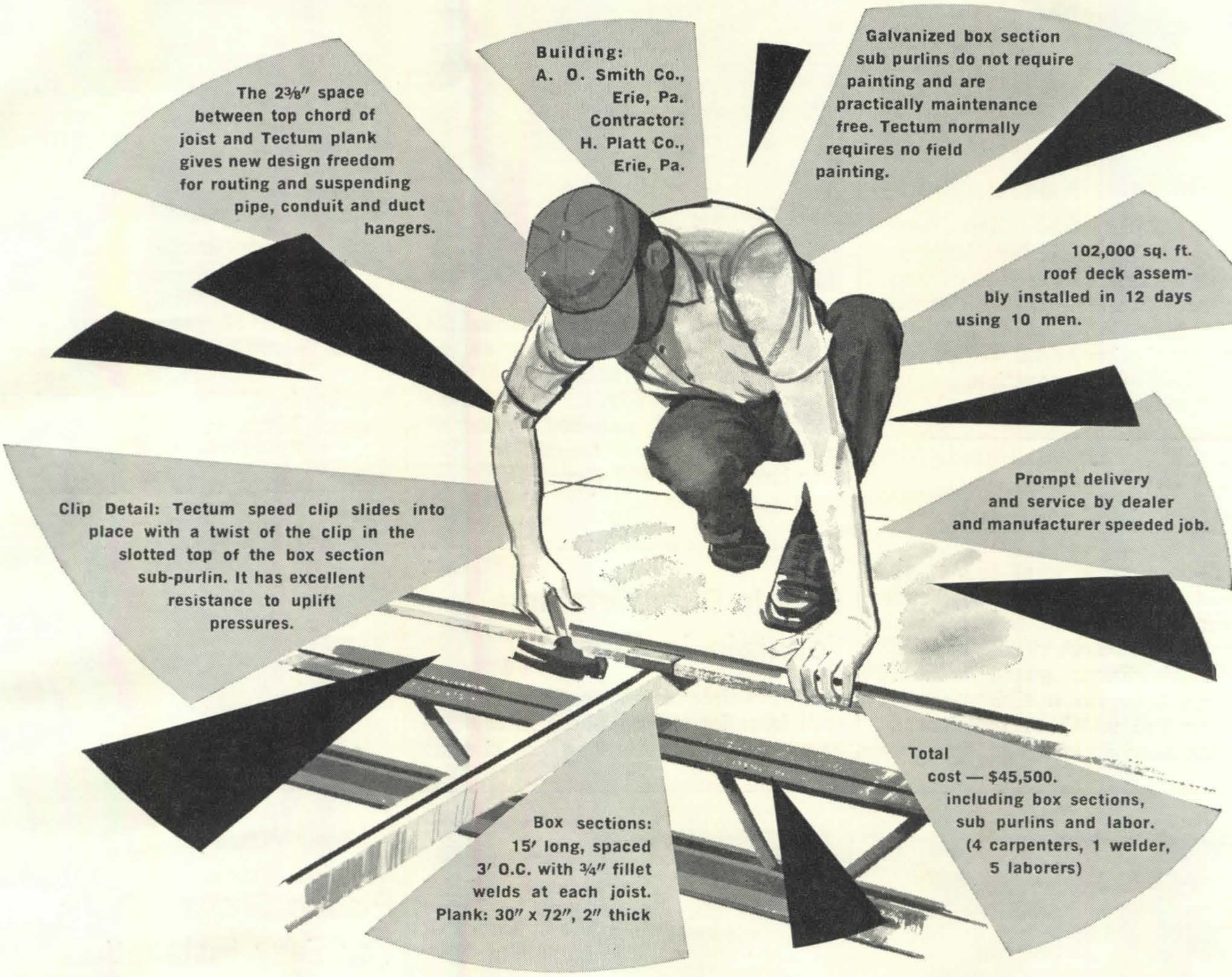
On Free Data Card, Circle **113**

New Coating Offers Panel Protection

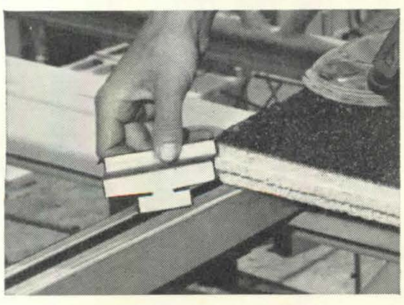
"Tigaclad," a new concept for laminating panels, offers protection against wear, stains, and burns. A special sheet, impregnated with a diallyl-phthalate resin is bonded by head and pressure to a veneered panel. The overlay becomes transparent and fuses with the wood, giving protection and enhancing the beauty of the real wood. "Tigaclad" is ideally suited where there is a need for protection against heavy wear; such as wainscotting for

Continued on page 104

GREATER DESIGN FREEDOM-FASTER ERECTION



with Tectum Box Section Roof Deck Assembly



Mechanical clips afford positive anchorage and high resistance to uplift pressures. Speeds erection and prevents thermal transfer.

The outstanding features listed above were typical of the statements from the well known Erie, Pennsylvania, contracting firm of H. Platt Co. This was their first experience with the new Tectum Box Section Roof Deck Assembly. In addition to the savings reported in construction time and materials, this type of roof deck gives extra ceiling height. The deck also furnishes continuous beam strength in both Tectum plank and box section sub purlins.

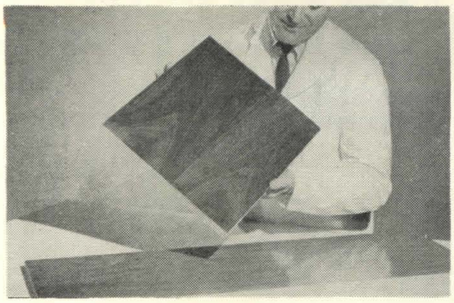
Small wonder this new concept is attracting architect and contractor interest everywhere. For the complete story, as editorialized in Building Construction Illustrated, March issue, send for a reprint of the article. We'll be happy to see that you receive your copy, immediately.

TECTUM CORPORATION, 535 East Broad Street, Columbus 15, Ohio

THERE'S A MATERIAL DIFFERENCE IN TECTUM

Tectum®

Continued from page 102

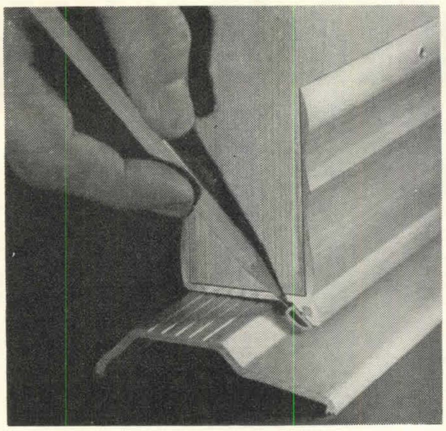


banks and elevator interiors. Panels are also well suited for furniture and store fixtures. All species of wood veneer are available in thicknesses ranging from $\frac{9}{16}''$ to $1\frac{3}{16}''$ with largest panel size being 48″ x 96″. Roddis Plywood Corporation.

On Free Data Card, Circle 114

Scuff Plate Easily Installed, Maintained

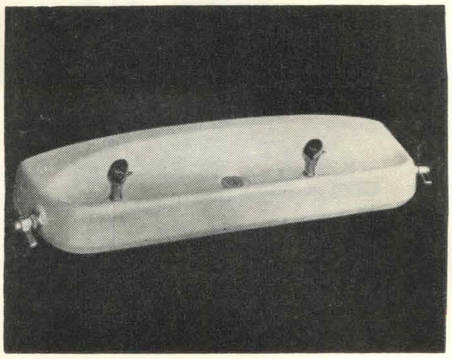
New all-aluminum scuff plate and threshold design providing efficient door weatherstrip and insect seal is easy to install and maintain. The high strength aluminum guard is fitted with vinyl tube for a tight pressure seal along full width of the door. It can be installed on either side of door for in or out opening. The threshold has a rounded surface allowing no dirt-collecting undercuts and no heel- or toe-catching edges. Product is available in mill, polished, satin, or gold anodized finish to match other door hardware. Skuff Guard Inc.



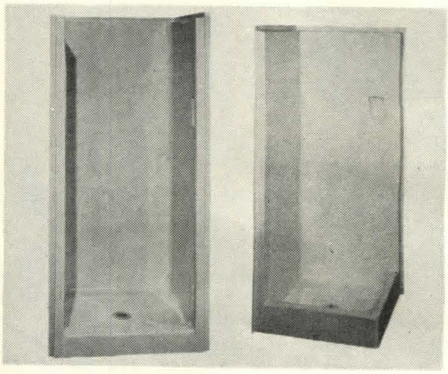
On Free Data Card, Circle 115

Double-Duty Drinking Fountain in Plastic

New multiple drinking fountain for wall installation is molded in colorful fiberglass. Fountain has two chrome plated brass angle steam heads mounted on a receptor of vacuum molded, lightweight fiberglass plastic. A selection of permanently bonded colors is available at no extra cost. Over-all length is 39½″; shipping weight is 27 lbs. Haws Drinking Faucet Company.



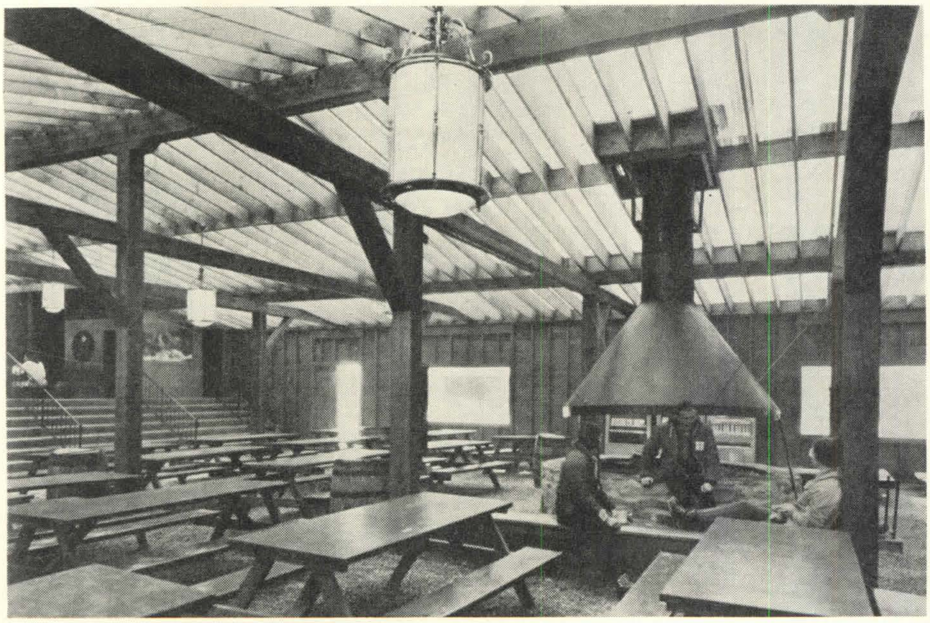
On Free Data Card, Circle 116



Plastic Shower Stalls For Easy Installation

New "Fibersheen" shower stalls offer ease of installation and maintenance. One-piece, lightweight, seamless unit is made of glass-fiber-reinforced-polyester-resin. "Fibersheen" shower will not leak, rust, chip, or rot out. It has a hard non-porous surface which is easily cleaned with soap or detergent. Three-wall stall is for standard installation and two-wall corner stall is ideal for remodeling. Each is available in shades of white, gray, green, tan, pink, and sun yellow with gold flecks. Denver Metals & Chemical Corp.

On Free Data Card, Circle 118



Ski Lodge Brightened by Glass Fiber Roof

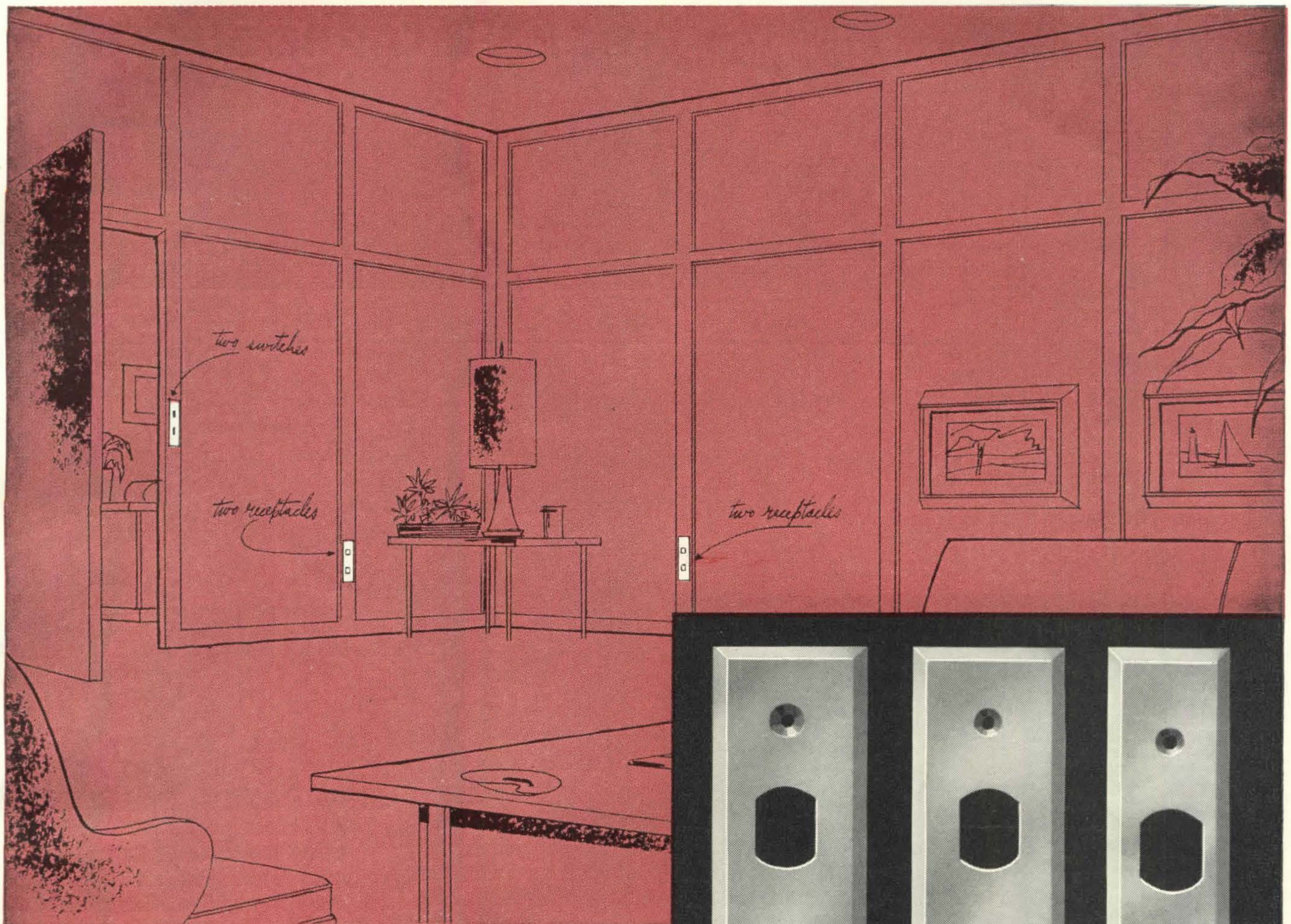
"Barclite" glass fiber roof in Bousquet Ski Lodge in Pittsfield, Mass. enhances interior atmosphere and requires no repairing or replacement. Cheery, temperate interior is created by translucent panels which allow the sunlight to pass through but block out infrared or heat waves by special additive. Roof withstands moisture, snow loads, and winds. It is easily cleaned by rain wash or simple hose spray. By replacing the shingle roof with this glass fiber roof, leakage, maintenance costs, and damp, dark interior space are no longer problems for Bousquet Ski Lodge. Barclite Corporation of America.

On Free Data Card, Circle 117

Vinyl Roof Coating Resists Weathering

The vinyl roof coating on the Winter Olympics Blyth Arena at Squaw Valley, Calif., gives excellent durability and weatherproofing. Coating was applied in two basic steps. A vinyl

Continued on page 108



new

trim-line, narrow wall plates of stainless steel —

Ideal for use in movable partitions in commercial and industrial installations. Made of high quality, high nickel 302 stainless steel (18% chrome, 8% nickel). *Will not rust.* High resistance to most organic chemicals and have passed the well-known Salt Spray Tests. Arrow-Hart's H&H Specification Grade Interchangeable Wiring Devices fit these neat, durable wall plates. Available with 1, 2 or 3 openings, or blank.

you cannot specify better wall plates!

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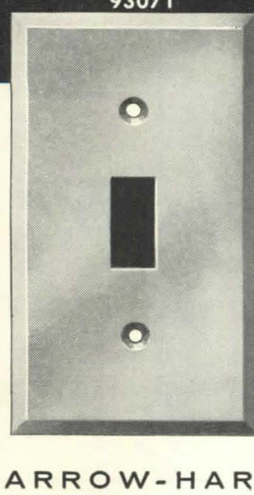
STANDARD STAINLESS STEEL WALL PLATES

Made of the same high quality 302 (18-8) Stainless Steel, these new standard wall plates are attractive and maintenance-free. Available in a complete line, 1 to 3 gangs.



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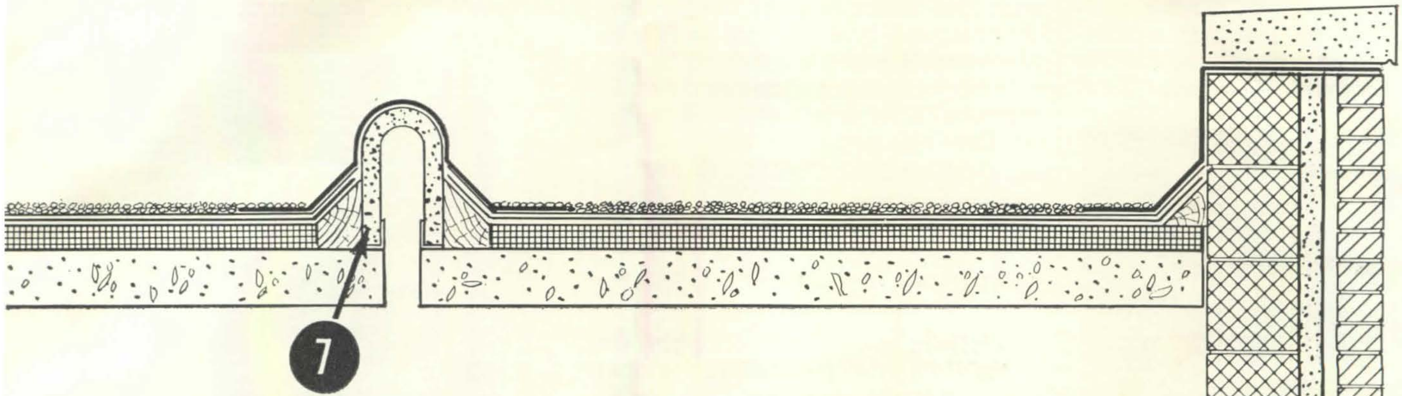


PROTECT A BUILDING AND WEATHER

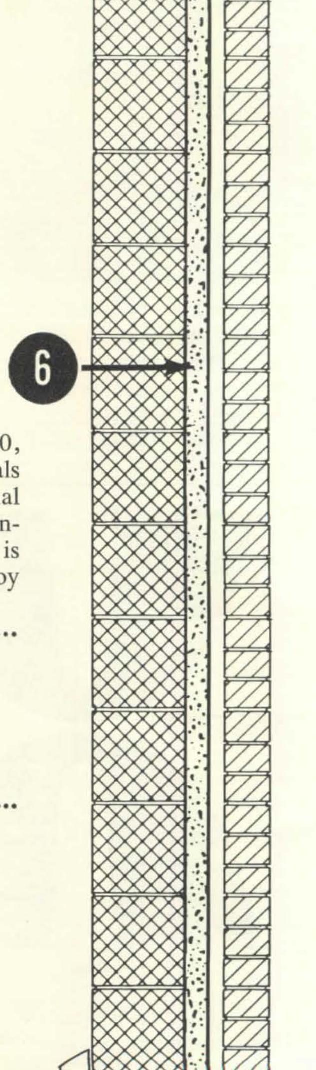
exclusive scored "snap-off" feature, effectively insulates foundation perimeters–keeps moisture out, heat in. New thicknesses and pre-scored widths make it easy to meet the new FHA-MPS requirements with Scorbord.

5. MOISTURE BARRIER. Polyfilm®, Dow's high quality polyethylene film, makes an ideal moisture barrier under floor slabs. Also excellent for use as temporary enclosure, curing blanket, and moisture barrier for walls and roofs.

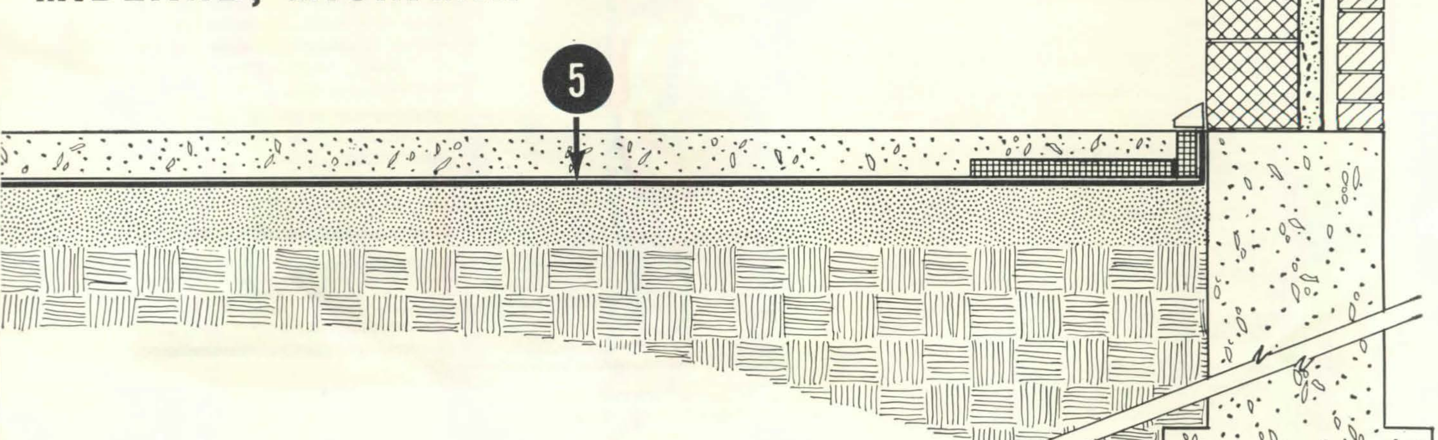
6. CAVITY WALL. Styrofoam, Dow's expanded polystyrene, keeps heat in and moisture out *permanently*. Its low "K" factor, unyielding water resistance, durability, and high mechanical strength make it a superior cavity wall insulation.

7. EXPANSION JOINT. Saraloy 400, a new elastic sheet flashing, *permanently* seals expansion joints. Saraloy 400 has exceptional elastic recovery, making it expand and contract along with the materials to which it is bonded. Pliable and easy to install, Saraloy 400 can be readily cut and fitted on the job.

FOR MORE INFORMATION
including other application suggestions, contact your nearby Dow sales office or write to THE DOW CHEMICAL COMPANY, Midland, Mich., Dept. 1707EB6.



MIDLAND, MICHIGAN



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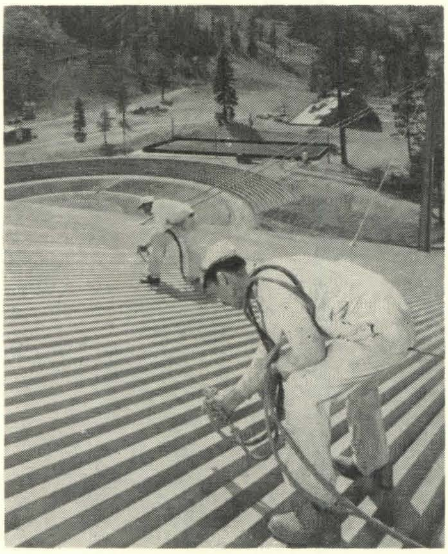
primer containing phenolic resin was applied as a cold-spray, air-dry coating. The finishing coat was a minimum two-pass spray, applied hot for fast and thorough bonding. Total



minimum film thickness for vinyl topcoat was 6 mils, with an 8 mil thickness over jointed areas. Coating is an effective barrier against water from rain and snow; its toughness provides assurance of a tight roof, preventing cracking from snow and ice pressure; it is flexible, expanding with roof under extreme temperature changes; and it is resistant to fading. Single application is expected to provide protection for a minimum of 10 years, with no touch up needed. Ply-On Coating, Inc.

On Free Data Card, Circle **119**

Color Finishes Brighten Stainless Steel

"ColorRold," the new coating process in stainless steel production, features color harmonies resulting from application of color finishes to stainless steel sheet and strip. New system is a complex organic coating formula developed by the American Marietta Company. Proprietary resins are dissolved in organic solvents of ketone and ester type, and when baked at moderate temperatures, a thermosetting film of exceptional durability is produced. Excellent adhesion to the stainless steel is achieved because the components are reactive in nature and are specifically designed to bond well with stainless steel. When size and hue of stainless are selected, sheet is fed through high-speed coating equipment and then proceeds through high-speed heating ovens. "ColorRold" retains durability, brightness, and high

corrosion-resistant quality. It is available in 11 standard colors—3 metallics and 8 non-metallics. All colors can be produced with either high or low gloss. Washington Steel Corporation.

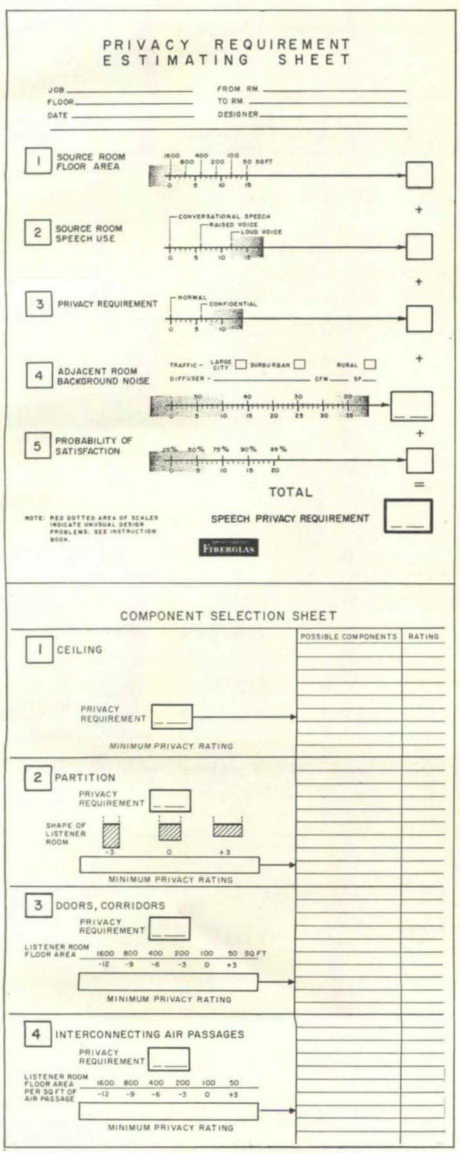
On Free Data Card, Circle **120**

ACOUSTICS

Speech-Control Analyzer Developed by Consultants

Nationally-known acoustical consultant firm, Bolt, Beranek & Newman, Inc., has developed a "Speech Privacy Design Analyzer" for use in quickly specifying materials to control predetermined noise levels for insuring acoustical privacy in rooms from 50 sq ft to 1600 sq ft. The unique acoustical design tool, culminating two years research work sponsored by Owens-Corning Fiberglas Corporation, will be ready for the architectural market in the near future. The "Analyzer" will be a ring-binder portfolio containing easy-to-use estimating sheets (shown) for use with component cards on related materials such as Ceilings, Partitions, Doors, and Ventilating Equipment. A wide variety of manufacturers' products will be included. Pre-calculated mathematical formulas on each product will greatly simplify the task of calculating acoustical stability for many areas. Refills will be prepared and mailed to owners of the "Analyzer" as new products are announced. A price to cover research, preparation, and mechanical handling will shortly be established for this aid. Owens-Corning Fiberglas Corporation.

On Free Data Card, Circle **200**



AIR/TEMPERATURE

Reduced Weight Achieved In Tapered Cooling Tower

New reduced weight of "Keystone Lo-Line" cooling tower is achieved by stronger and lighter materials. Laminated-wood panels are impregnated with cellulose fibers; fanstack is one-piece glass-fiber-reinforced plastic, giving thermal stability and resistance to corrosion. Canted collecting pan washes debris into depressed sump, assuring exclusive self-cleaning operation. Fact sheet, 4 pages, gives capacity tables, general information. J. F. Pritchard & Company of California.

On Free Data Card, Circle **201**

Easy Chemical Treatment In Water-Cooling Systems

Without constant mixing and handling of chemicals, "Chemicator" feeds balanced chemical treatment into circulating-water systems of cooling towers and evaporative condensers. A small, lightweight reservoir, it is mounted on the side of the equipment, a portion of the recirculating water flowing through it. A sleeve on upper portion of Chemicator holds weather-sealed plastic tube containing sequence of variously-formulated chemical briquettes that prevent scale, rust, and slime. Chemicator has no moving parts, feeds required chemicals into system at predetermined rate. Folder, 6 pages, introduces product. Erlen Products Company.

On Free Data Card, Circle **202**

Neoprene Cushioning For Quiet Fan Operation

Extra-quiet operation is assured for "Windmaster" attic fans by neoprene-cushioned wood frame and neoprene-mounted motor. Thermal cut-off switch, with automatic reset, prevents motor from burning out or causing fires. Other items presented in 8-page *Catalog 59-A* are louvers and roof ventilators. Consolidated General Products, Inc.

On Free Data Card, Circle **203**

Snap-In Device Installs Aluminum Registers

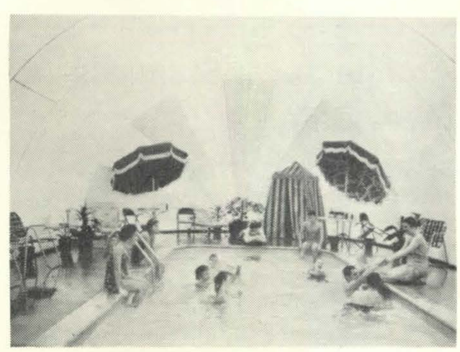
New extruded-aluminum grills, for heating, cooling, and ventilating, are presented in 6-page folder. Snap-in feature of "Decoraire" line makes installation simple, eliminates screw holes. Units, available in several border styles, are suitable for wall, sill, and floor locations. Folder includes performance data for easy selection. Air Devices Inc.

On Free Data Card, Circle **204**

CONSTRUCTION

Inflatable Nylon Houses Serve Many Shelter Uses

Case studies of several "Air:Seal Airhouses" are presented in 4-page folders. Durable and flame-resistant, these vinyl-impregnated nylon houses are designed for a variety of uses—enclosing construction sites, swimming



pools, exhibitions, and playgrounds. A typical airhouse, 40′ x 80′, will in-

Continued on page 112

Continued from page 111
flate in approximately 15 minutes. When properly secured, it can withstand winds of almost hurricane force, temperatures ranging from −60 to 100 F, and heavy ice or snow loads. Cost/sq ft is a low $1.50. Seattle Tent & Awning Company.

On Free Data Card, Circle **205**

Curtain-Wall Panels Of Plastic Face and Core

Laminated curtain-wall panels, faced with glass-fiber-reinforced polyester resin, and insulated with polystyrene foam, are described in 4-page folder. Panels are light in weight, cutting costs in handling, shipping, and installation. They have high impact resistance and are unaffected by temperature changes. Variety of other insulating or non-insulating cores, as well as other facings, is available. Haskelite Manufacturing Corporation.

On Free Data Card, Circle **206**

Poles for Structures Go Up Fast

Booklet documents types of commercial and industrial buildings of wood-pole-type construction. Costs of permanent structures are reported to be close to temporary shelter erection costs. Poles are adaptable to variety of designs, and to future expansion—roofs can be flat, gable, monitor or hangar type; since the poles themselves constitute the complete supporting members, additions may be made by simply removing sheathing and insulation from frame. Poles are preservative-treated for permanence. Some specific areas of cost savings include elimination of foundation work, pre-framing, on-the-job engineering. Koppers Company, Wood Preserving Division.

On Free Data Card, Circle **207**

Architectural Stainless-Steel Data

Folder describes four architectural stainless-steel grades, with composition, mechanical properties, available widths, lengths and thicknesses, finishes, approximate costs-per-sq-ft, and table of comparative gages for stainless steel and aluminum. Stainless-steel application, design and fabrication are covered. Product Development Department, Washington Steel Corp.

On Free Data Card, Circle **208**

Field-Assembled Sandwich-Wall System

Booklet explains end-welded stud erection system for field-assembled aluminum sandwich wall. Shown are a number of field-assembled curtain walls installed on buildings with Setlock fasteners. Advantages cited include low first cost, speed of assembly, high insulating value, light weight (approximately 1½ lb per sq ft), maintenance savings, easy dismantling for relocation. Chart lists specific types of wall recommended for various conditions; detail drawings demonstrate application of studs to building framework. Gregory Industries, Inc., Nelson Stud Welding Division.

On Free Data Card, Circle **209**

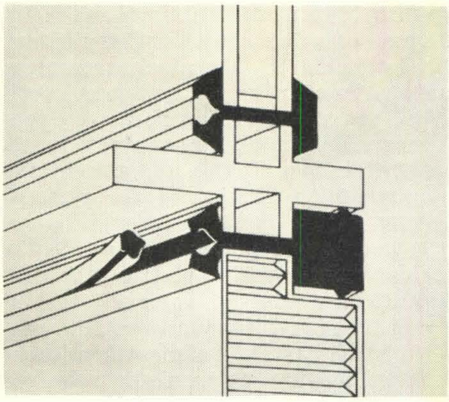
New Dimension in Architectural Glass

Bulletin discusses benefits of laminated architectural glass (consisting in its simplest forms of a layer of polyvinyl butyral plastic sandwiched between two sheets of glass, with the three elements bonded permanently under heat and pressure)—explains physical properties, manufacture of the glass; how decorative effects are achieved; how plastic interlayer is tailored to obtain light control, glare reduction, ultraviolet exclusion, and solar-energy control. Installation techniques are shown. Monsanto Chemical Company Plastics Division.

On Free Data Card, Circle **210**

Neoprene Gasket Makes Permanent Leakproof Seal

One-piece "Inlock Neoprene Structural Gasket" provides a permanent and leakproof sealing method for glass or panels up to 2″ thick. Natural resilience of neoprene eliminates need for cements, clamps, and calking compounds. Detailed 28-page booklet gives



complete information on test results, cross-section properties, method of size determination, and procedures for installation; several typical installations are fully detailed. Inland Manufacturing Division, General Motors Corporation.

On Free Data Card, Circle **211**

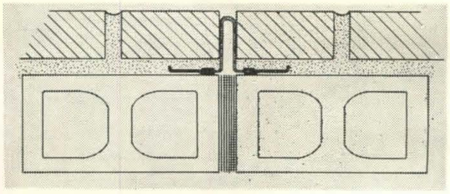
Plastic-Faced Block for Finished Bearing Wall

New glazed-concrete masonry unit, making possible the erection of a completely-finished load-bearing wall in one operation, is described in 8-page brochure. Called "Aristocrat Block," product is a standard concrete block with a terrazzo-like plastic face, created by patented process that combines marble or other natural aggregate with plastic, and molds the combination to concrete in an integral permanent bond. Brochure describes test-proven qualities, shows some typical applications, gives standard sizes and specifications. Aristocrat Association of America.

On Free Data Card, Circle **212**

Neoprene/Metal Strip For Roof Joints

"Expand-o-flash" for watertight seals and expansion joints combines a resilient neoprene-rubber strip with a metal edging. Flexibility of neoprene



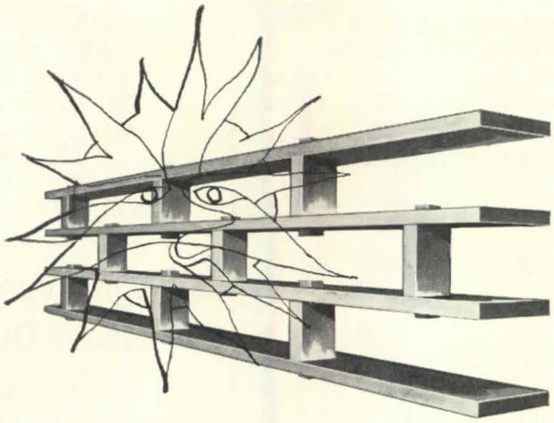
eliminates metal fatigue prevalent in conventional all-metal joints, and permits relaxed installation without tension inherent in molded or extruded joints. File folder contains 21 sheets illustrating joints for walls; decks, parapets; curb, corrugated, or flat roofs. Lamont & Riley Company.

On Free Data Card, Circle **213**

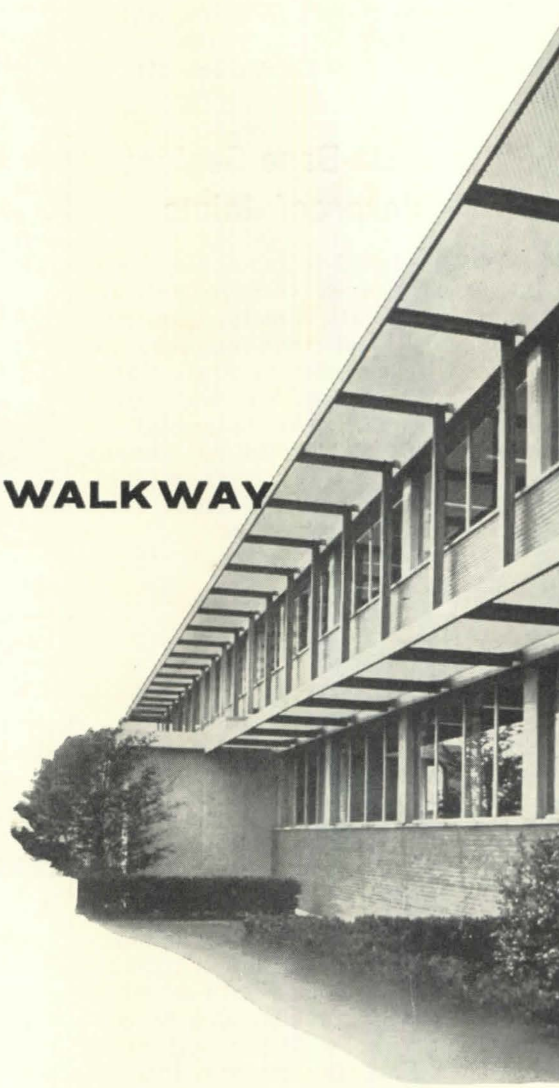
Special but Limited Use For Vinyl Waterstops

Waterstops of rubber, neoprene, or vinyl—for sealing construction joints and expansion joints in concrete—are illustrated in 4-page folder. Cross-sectional details are given for typical joints in building, bridge, and high-

Continued on page 114



ANOTEC* AS A SOLAR SCREEN AND WALKWAY



Truly a new dimension in freedom of design . . . Anotec applied to the new Bodine Electric Company building in Chicago.

As a solar screen, there is all the full glory of light, but the glare of the sun's rays are deflected by ANOTEC.

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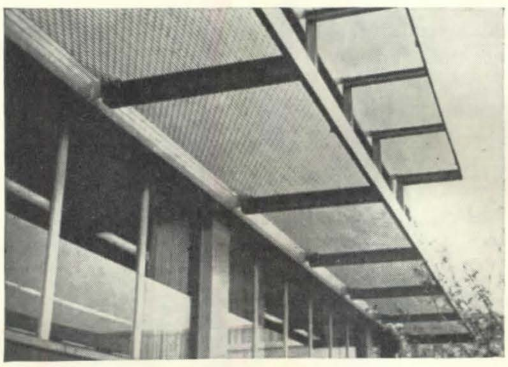

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Continued from page 112

way applications. Vinyl waterstops are advocated for limited use because of the material's imperfect recovery after elongation; however, it has a distinct advantage in its resistance to acids and other chemicals that are destructive to rubber. Williams Equipment & Supply Company, Inc.

On Free Data Card, Circle **214**

Polysulfide-Base Sealant For Waterproof Joints

Polysulfide-based sealants, the elastomeric compounds that permanently waterproof joints in metal, glass, concrete, wood, and stone, are discussed in new 4-page bulletin. Applied as a liquid synthetic rubber, these compounds chemically cure to long-lasting cushioning seals. Typical applications include curtain walls, roofs, copings, sidewalks, and geodesic domes. Thiokol Chemical Corporation.

On Free Data Card, Circle **215**

Modular Panels Are Foam-Cored

Dylite Panels: Modular Components, 33 pages, details methods of using new panel product to permit greater design freedom and construction economy. Panels have an inner core of expanded polystyrene that is bonded to facings of conventional building materials. Included in booklet is information on various sizes and types of panels available. Also shown are study houses which are adaptable to construction with Dylite panels. Plastics Division, Koppers Company, Inc.

On Free Data Card, Circle **216**

DOORS/WINDOWS

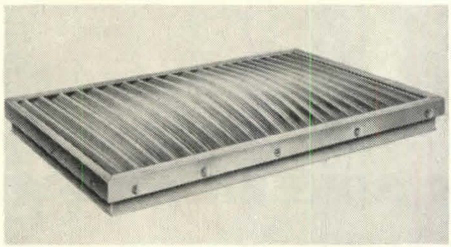
Durable Folding Doors Are Vinyl-Covered

"Custom Magic-Fold" doors are a deluxe heavy-duty room divider for commercial, institutional, and residential installations. Available in widths up to 25′ and heights up to 16′ for single-door application; wider openings can be accommodated with center-opening pairs of doors. Heavy-gage embossed-vinyl covering resists fading, moisture, mildew, and flame; solid-core "Masonite" acoustical panels reduce sound transmission between rooms. Other long-wearing materials are injection-molded-nylon glide wheels, vinyl-covered cornices, molded-polystyrene door handles, and extruded soft-vinyl bumper strip. Folder, 8 pages, gives full specification data. Clopay Corporation.

On Free Data Card, Circle **217**

Plastic Skylights Of Various Types

Up-to-date information on complete line of "Marcolite" skylight products is given in 4-page catalog. Glass-fiber-reinforced translucent-plastic panels diffuse light evenly over a large area;



they are flame-resisting and dimensionally stable up to relatively high temperatures. Frames are aluminum, for maximum strength with minimum weight. Models include roof scuttles, monitors, and self-curbed skylights. The Marco Company.

On Free Data Card, Circle **218**

Neoprene Weatherstrip Assures Low Infiltration

"StanSeal" neoprene weatherstripping and "DrafTite" wool-pile weatherstripping are presented in 12-page brochure. The neoprene weatherstrip is readily adaptable to pivoted windows and stationary panels in curtain-wall systems. Air infiltration and surface friction are minimal with this flexible, long-lasting material. Typical installation details at quarter-full scale are given for all cross-sections. Custom shapes will be designed for special requirements. The Standard Products Company.

On Free Data Card, Circle **219**

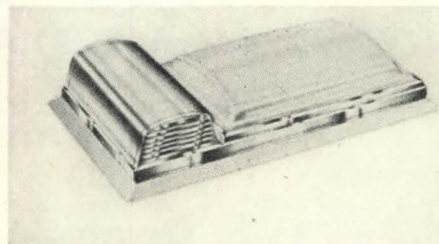
Sliding Doors Fit Same Opening as Swinging Door

With "Unitrack" track-and-header combination for sliding doors, it is possible to build a pre-hung, prefabricated sliding-door unit that fits in same rough opening as swinging doors, yet maintains same door height, trim height, and opening. Nylon rollers with self-lubricating bearings provide smooth, long-lasting door control. Fixed nylon door-guide eliminates scraping sounds and marring of door finish; grooving bottom of doors is unnecessary. Data sheet, 2 pages, includes detail drawings. American Screen Products Company.

On Free Data Card, Circle **220**

Skylight/Ventilator For Heavy-Duty Use

New skylights, ventilated and non-ventilated, are presented in 8-page *Bulletin 60 LV*. "Astro-Lites" feature a one-piece acrylic-resin dome and are available in square or rectangular shapes from 14″ to 115″ in length. "Astro-Vents" are said to be first combination skylight/ventilators suitable for heavy-duty commercial, institu-



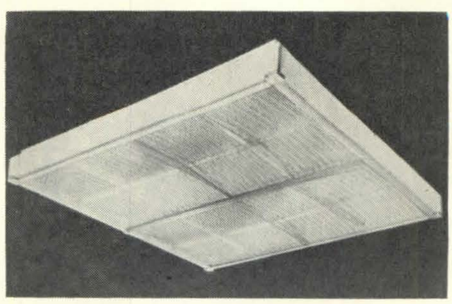
tional, and industrial requirements. They are available with air-moving capacities up to 4400 cfm. Installation drawings and specifications are given. Jenn-Air Products Company, Inc.

On Free Data Card, Circle **221**

ELECTRICAL EQUIPMENT

New Luminaire Gives Improved Performance

New surface-attached 4′ x 4′ luminaire is described in 4-page brochure. Sides of the unit, which also serve as carrying rails for the lenses, are integral parts made of glass-fiber-



reinforced luminous plastic. This construction assures physical rigidity and mechanical stability. The use of

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REINHOLD PRESENTS

Shopping Towns USA

The Planning of Shopping Centers

by Victor Gruen and Larry Smith

Homo americanus suburbanus et automobilensis is getting out and walking, and liking it. Merchants are liking it, too. Shopping center owners are liking it, three. From four, five and six on, everybody who has been bemoaning the fate of communityless modern man now sees that shopping centers are the answer-to-it-all.

Naturally there will be lots more shopping centers built and lots more architects dreaming up charming pedestrian walks, cantilevered extravaganzas—in short, the full, frolicsome ambiance of the modern shopping town.

The authors of *Shopping Towns USA* appreciate your imagination and idealism. They have written this book, however, to cover all the practical problems that confront you. How far to proceed lacking proper zoning . . . how to help city officials justify a new public approach . . . how to achieve a balance of tenants that will satisfy the credit qualifications of investors and still yield good percentage returns over guaranteed rent . . . how to present the case for art in a selling environment.

And more. Much more! For in shopping center planning every problem of your teammates, the client-developer and the economist-real estate consultant, is your problem. Every line you draw is the vector of a myriad legal, financial, merchandising and traffic considerations as well as of your educated guess as to future growth and competition within the trading area.

Never in history has the architect needed so much interdisciplinary knowledge for a single building type. Not until now have the right time and the right talents come together to supply this knowledge.

Shopping Towns USA is the complete planning guide to the shopping center era. Included is every planning function that might arise in projecting small, medium or large centers. Here is the first reliable formulation of planning principles as most typically exhibited in completed major shopping centers. And here are the methods and procedures crystallized by Mr. Shopping Center himself, Victor Gruen, and his distinguished economist teammate of many projects, Larry Smith. This book puts an end to the early trial-and-error phase of shopping centers. No architect or planner can afford to overlook it.

Some chapter headings: The Planning Schedule, Planning the Site, Planning Surrounding Areas, Planning for Growth, Planning for Traffic, Planning for Merchandising, Designing the Shopping Center, Engineering the Shopping Center, Leasing the Shopping Center, Budgeting the Shopping Center, Opening and Promotion.

A Progressive Architecture Library book. 288 pages including a lengthy chapter on Case Studies. Size 8¼ x 10¼. 350 photographs, drawings and plans besides other schemata, a glossary and bibliography. Price $13.50.

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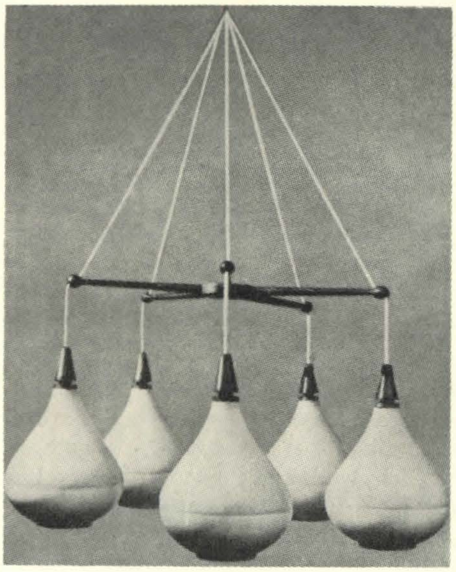
Continued from page 114

a prismatic acrylic T-bar, which runs across center of fixture supporting each lens, provides a luminous center-strip of same brightness as lenses and frame. Ease of installation and maintenance are further improvements of the new design. Holophane Company, Inc.

On Free Data Card, Circle **222**

Plastic Light Globes In Various Colors, Forms

Newest concept in line of functional and decorative lighting is "Rotaflex," a discovery in plastic that is applied and developed in this country exclusively by Heifetz. Material diffuses light more uniformly than other materials, is washable and non-yellowing,



lightweight and strong. Unlimited possibilities in color and form are possible. Catalog, 20 pages, shows new collection of clusters, ceiling pendants, and ceiling pull-downs—each with Rotaflex globes in various (elongated, tear-drop, and spherical) shapes. The Heifetz Company.

On Free Data Card, Circle **223**

New Process Forms Vinyl Diffusing Louvers

New process in thermo-forming and electronically fusing vinyl sheeting is responsible for "Circlgrids," rigid non-burning vinyl louvers for lighting applications. Thousands of circular cells give a distinctive texture with a subtle directional effect. Substantial open area is allowed while optimum shielding is maintained; units thus meet new IES recommendations while giving complete visual comfort. Brochure, 6 pages, contains mechanical and engineering data comparing illuminating efficiencies with other diffusers. Cirvac Plastics.

On Free Data Card, Circle **224**

Wiring Devices Resist Corrosion and Chemicals

Complete new line of rugged wiring devices, to resist corrosion and chemical action, is presented in 4-page bulletin. "Chem Marine" line uses special insulation materials ("Insulprene" and melamine) to withstand oils, greases, extremes of temperature, heavy impact, and most acids; and special metals (Monel and heavy nickel-plated brass) to resist severe atmospheric conditions. Devices include switch plates, cover plates, receptacles, and grounding units. Harvey Hubbell, Inc.

On Free Data Card, Circle **225**

Extruded Lens Panels Provide Low Glare

"K-Lite" prismatic lens panels, giving low brightness and low glare to fluorescent lighting, are presented in 4-page brochure. A variety of pyramid patterns in extruded acrylic or clear-polystyrene is offered. Enclosed extruded-plastic shapes for fixture side-panels are available for use with lens panels to give rigid assembly. A panel-area calculator to determine square footage necessary for any lighting job is included in catalog. KSH Plastics, Inc.

On Free Data Card, Circle **226**

PROTECTORS/FINISHERS

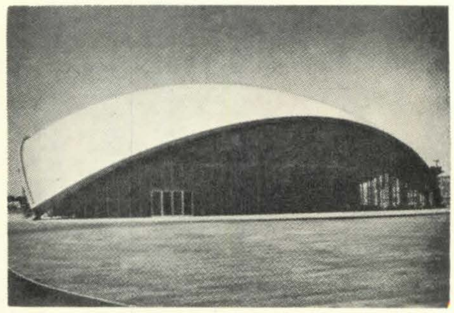
One-Coat Protection Against Rust, Chemicals

Described as a fibrated epoxy mastic, "Prufcoat Primastic" coating uniquely combines rust-inhibitive primer properties with resistance to organic and inorganic chemicals. It makes one-coat protection possible for equipment and structures under severe exposure. *Bulletin 540A* is a 2-page data digest containing information on chemical and physical properties of Primastic as well as on application methods and costs. Prufcoat Laboratories, Inc.

On Free Data Card, Circle **227**

Plastic Cement Finish Gives Unusual Protection

"Orostone" plastic cement, having the permanence and appearance of stone, is described in 4-page booklet. Material is manufactured with colorful, crushed stones and a specially-formulated clear-acrylic plastic that gives flexibility and resistance to cracking. Desired colors and texture are ob-



tained by careful selection of stone; no pigments are used in the binder. Finish is completely impervious to water, with "breathing" character of acrylic materials allowing for escape of vapor pressures from within. Additional properties aid in thermally insulating the surface and in absorbing sound. Factory-mixed, material is in semi-paste form, ready to apply at the job. Early building finished with Orostone was Saarinen's Kresge Auditorium at MIT. California Stucco Products of New England, Inc.

On Free Data Card, Circle **228**

Plastic-Faced Hardboard In Range of Finishes

New 8-page catalog illustrates entire line of "Marlite" plastic-surfaced hardboard paneling. Products included are 4'-wide panels, 16"-wide planks, and peg board. Finishes are new "Trendwood," marble patterns, and star motifs, as well as standard solid colors in varying lusters. All products are ¼" thick and can be

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installed over solid backing or furring strips. Marsh Wall Products, Inc.

On Free Data Card, Circle **229**

INTERIOR FURNISHINGS

Notable Collection of Scandinavian Furniture

1960 catalog of *The Lunning Collection of Scandinavian Design* is a 72-page presentation of the finest Scandinavian work in furniture, lamps, rugs and textile design. Designers included in the collection, among others, are Hans Wegner, Finn Juhl, Poul Kjaerholm, and Alvar Aalto. Emphasis in all these pieces is on the skilled craftsmanship, handsome materials, and special quality of originality within a basic concept that are the hallmarks of Scandinavian design. Accompanying the catalog is a price list that features line drawings and

detailed specifications. Frederik Lunning Inc.

On Free Data Card, Circle **230**

SURFACING MATERIALS

Special Applications And Specs for Formica

Recommended specifications and details for a number of special "Formica" applications are provided in 52-page *Application Data.* Areas discussed are wall surfacing on plywood or gypsum plaster, shower/tub enclosures, laboratory and school desk tops. Companion literature discusses custom-design treatment of Formica by methods of inlay, artlay, mural, or hand-painting. Formica Corporation.

On Free Data Card, Circle **231**

Continued on page 122

For more information, turn to Reader Service card, circle No. 332

A Few Lighting Fixtures from the **PRESCOLITE** *NEW PRODUCT PARADE*

Group "A" "Satellite"—a new departure in beautiful, hand blown "Thermopal" glass used with pendant fixtures or on recessed housings.

Group "B" A new concept in recessed lighting for specific use in concrete construction.

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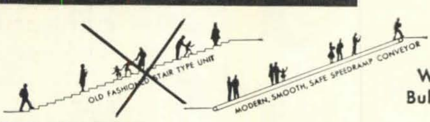

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S-A
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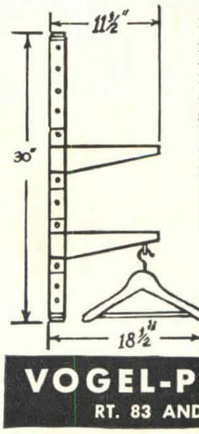
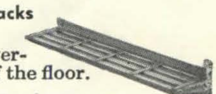


Mount directly on any wall-shelves adjustable for height on permanently fixed columns to accommodate any age group 3'2" and 4'2" long. Units fit in anywhere or interlock to make continuous racks of any length or desired capacity. Double rails below double hat shelves take coat hooks or coat hangers. Holds wraps spaced apart in orderly, healthful manner, 5-6 hooks or 3-4 coat hangers per running foot.
Fireproof, vermin-proof, strong beyond need. Lifetime construction—welded heavy gauge steel, baked enamel finish.

Matching Overshoe Racks
Mount on wall at baseboard—keep overshoes paired, and off the floor.



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A tunnel test fire spread rate just *one-tenth* that of the ASTM comparison material (red oak) has qualified Modernfold fabrics for the coveted Class A fire rating . . . a first in the folding door industry.* Modernfold "27" and "45" fabrics proved conclusively they will not support flame. You're assured of complying with all fire codes.

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*Number shows ounces per lineal yard. All Modernfold fabrics are designated by weight, i.e., "27" "30" and "45."

Tests made under ASTM standards	Standard Industry Fabric	**Nuca-tex 45 by Modernfold**
Weight	27 oz./Lineal yd.	45 oz./Lineal yd.
Tear Strength	5 lbs.	13 lbs.
Abrasion	1000 cycles	2000 cycles
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New Patterns in Ceramic Mosaics

Ceramic Mosaics Patterns and Blends gives ideas for colorful wall and floor treatments in residences and other buildings. Full-color plates of 22 new patterns and designs in ceramic mosaics are presented. Accompanying text explains how to vary basic patterns by substituting alternate colors, textures, sizes, and shapes from the standard line. Also included in 8-page Booklet 550 are photographs of typical patterns shown in their actual installations. American Olean Tile Company.
On Free Data Card, Circle **232**

Vinyl-Coated Fabrics In Variety of Weaves

Swatch book of "modern-cote," vinyl-coated fabric for wall covering, gives complete samples of its three lines. Heavy-duty wall-covering line has increased resistance because of protective shield of clear vinyl. New line "55" has flexible wood veneers laminated to fabric. Special weaves available in regular line include grass cloth, shoe grain, burnished antique, burlap, and linen. Bacteriostatic tests by two research labs have indicated "excellent antibacterial qualities" for vinyl and fabric sides, making hospital use advisable. New Castle Products, Inc.
On Free Data Card, Circle **233**

Epoxy Masonry Coatings And Floor Surfacings

Epoxy-Based Masonry Materials, 12-page glossy brochure, describes characteristics of epoxy resins used in construction, rehabilitation, and maintenance. Versatility of uses is suggested by brief paragraphs on interior and exterior concrete-block protection, masonry repair, floor surfacing and retopping, high-friction coatings for roads, and concrete sewer-pipe coatings. Although not providing detailed information in immediately-usable form, the brochure is helpful in giving a concise picture of the scope of this material. Companion piece of literature is an 11-page non-illustrated fact sheet on flooring and topping compounds. It discusses areas of use, preparation of surfaces, and tests on resistance. Ciba Products Corporation.
On Free Data Card, Circle **234**

Uses and Installation Of Plastic-Faced Panels

"Micarta"-surfaced wall panels are described in 8-page folder. Panels are 16" x 96" and are made by bonding a decorative plastic laminate to a fire-resistant, compressed-cellulose core. Photographs show procedures for installation; swatches depict complete range of 11 patterns and colors. Micarta Division, Westinghouse Electric Corporation.
On Free Data Card, Circle **235**

Complete Line of Industrial Finishes

Finishing Materials for Every Industrial Purpose is an annotated color-card offering one of the most complete lines in the industry. Some 64 shades are available in lacquers, epoxies, vinyls, and specialty finishes in a six-

Continued on page 124

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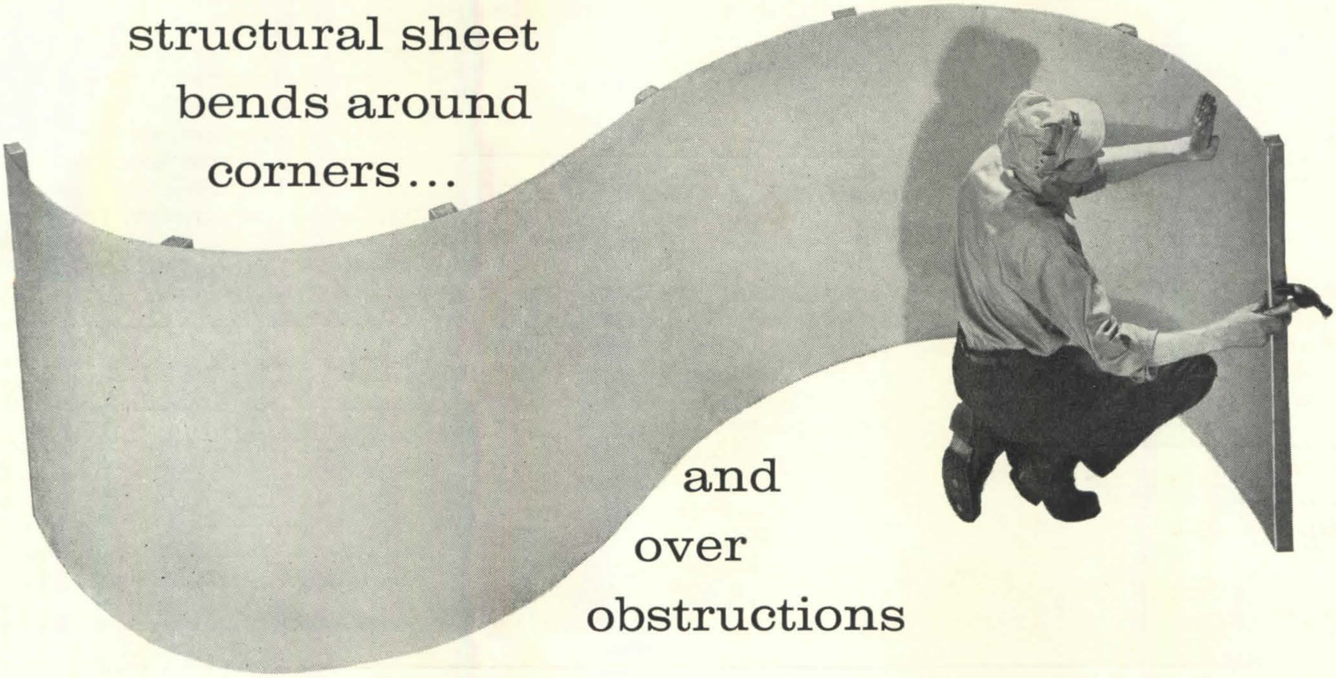
asbestos-cement
structural sheet
bends around
corners...



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over
obstructions

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- Saws with an ordinary hand saw or scores with a knife
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No other asbestos-cement structural sheet has ever had the qualities of KAMWALL. Remarkable new KAMWALL is unique!

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Versatile new KAMWALL covers all conventional asbestos-cement applications—and then some! It's ideal for soffits, as underlayment for tile floors, for interior partitions, for finishing off sides and ceilings of recreation rooms, for fire barriers, plus many other uses you'll probably be telling us about.

Write today for a sample of KAMWALL and a comprehensive illustrated brochure. Get all the facts for consideration on future jobs. Keasbey & Mattison Company, Ambler, Pa., Dept. B-4060.

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KEASBEY & MATTISON at Ambler

Continued from page 122

level scale of lusters. Advice is provided for unusual requirements. United Lacquer Manufacturing Corporation.

On Free Data Card, Circle **236**

Sound-Absorption Coefficients

Bulletin contains comprehensive data on sound-absorption coefficients of acoustical materials. Includes explanation of tables and terms, types of mountings used for test samples, summary tables, producers' tables, installation recommendations, coefficients of general building materials. Also gives member companies and addresses, and alphabetical list of trade names and marks. The Acoustical Materials Association.

On Free Data Card, Circle **237**

Sound Conditioning With Carpet

Brochure points out functional and decorative advantages of carpeting as floor covering—presents results of scientific study made on its acoustical value. Tests reveal that carpets and rugs have equal airborne and impact-noise sound-absorption with most standard sound-conditioning materials, reduce airborne noises slightly over 50 percent. Methods of testing, findings on impact noise reduction considering pile structure, density and depth, fiber content, with and without underlay are fully discussed, with graphs. Carpet Institute, Inc.

On Free Data Card, Circle **238**

Catalog Shows Full Line Of Ceramic Tiles

New 32-page catalog offers concise presentation of complete line of ceramic tiles. Special emphasis on new product developments shows new line of brilliant decorator colors in 1⅜" "Tile Gems," designed to give rich decorative accents. Also shown are additions of new colors to glazed-tile line and new basic patterns in ceramic mosaics. Full-color photos of actual installations demonstrate the design versatility of tile; designer sketches suggest decorative treatments with large-size glazed tile. American Olean Tile Company.

On Free Data Card, Circle **239**

Builders' Hardware

Condensed catalog of architectural hardware presents information on four major lock lines, rectangular and standard liquid type door closers, exit devices, and miscellaneous builders hardware. Designed for easy selection of material, book features selector charts of functions and designs for Integralock, Mortise Lock, Sentrylock, and new Magnalock. Specifications, application data, product features are also included for each of the lines. Sargent & Company.

On Free Data Card, Circle **240**

PROGRESSIVE ARCHITECTURE NEWS REPORT

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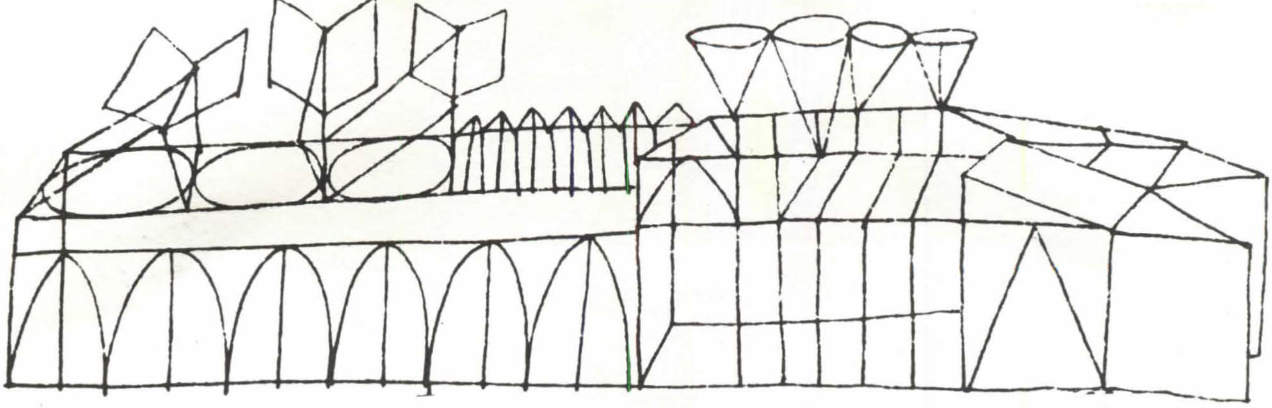
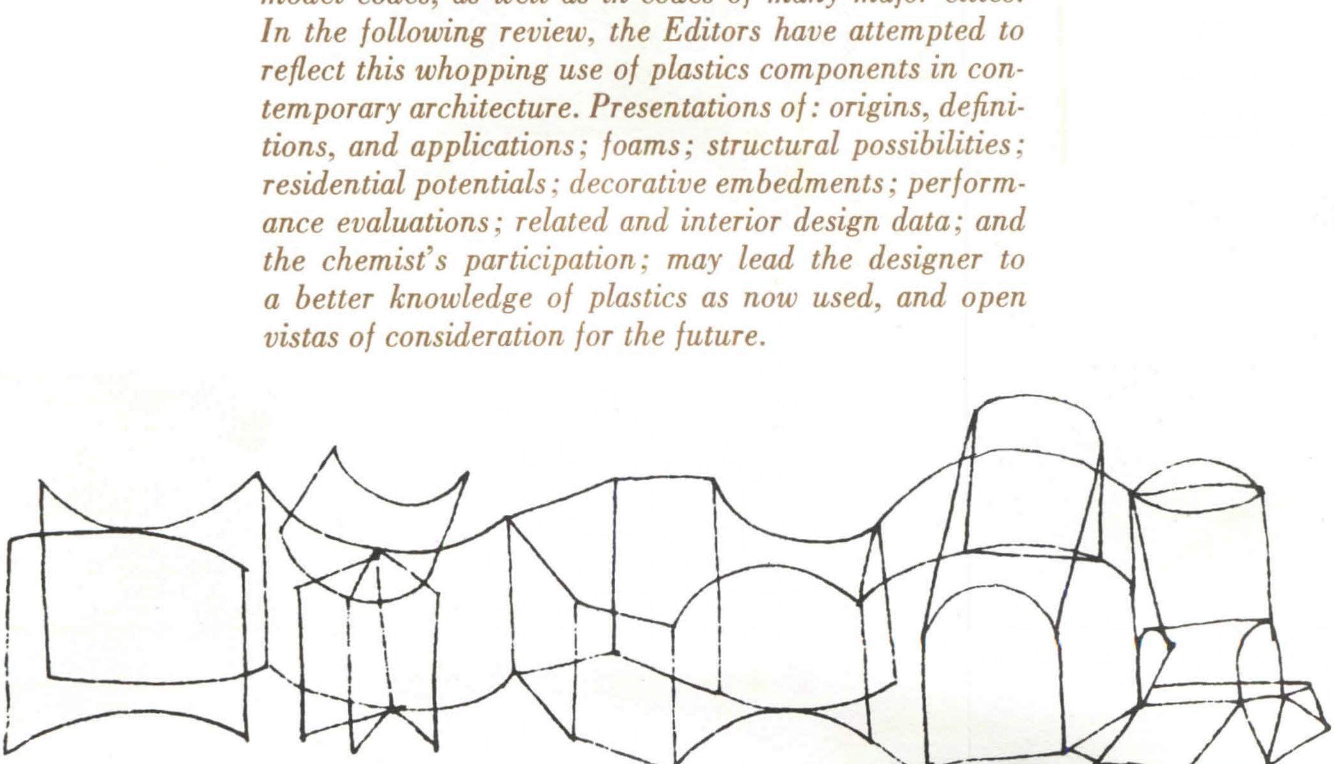


PLASTICS IN ARCHITECTURE

Ninety-two years ago, not a single commercial plastic existed in this country; in 1868, cellulose nitrate (Celluloid) was created—according to legend—to help overcome a shortage of ivory, from which billiard balls were made. Not until 1909 was there a second man-made plastic — a phenolic (Bakelite) — that could be cast, formed under heat and pressure, and used in laminating. By contrast, last year's plastics production was 5,600,000,000 pounds—about one-fifth of which will find an end use in construction. To date, chief code problems have concerned uses of plastics for transmission or diffusion of light. From a safety viewpoint, plastics are shatterproof and will not add lethal flying fragments to other hazards resulting from fire, explosion, or collapse. This must be weighed, however, against the fact that they can catch fire, typically providing little by way of fuel, but perhaps creating smoke or introducing a means for the initial flame to spread and ignite other materials. The plastics industry has urged that building codes meet this condition by delimiting permissible areas of flammable translucent sheets, rather than by insisting on glass. Provisions of this sort have been incorporated in leading model codes, as well as in codes of many major cities. In the following review, the Editors have attempted to reflect this whopping use of plastics components in contemporary architecture. Presentations of: origins, definitions, and applications; foams; structural possibilities; residential potentials; decorative embedments; performance evaluations; related and interior design data; and the chemist's participation; may lead the designer to a better knowledge of plastics as now used, and open vistas of consideration for the future.



BY WILLIAM DEMAREST

Origins, definitions, and applications of plastics products in architecture, created through chemistry, are presented in this discussion by the Director, Plastics In Building, Manufacturing Chemists' Association. His principal intention is to demonstrate what plastics can be expected to perform, as well as what they cannot. A house and a small office indicate the extent to which plastics may be found in architect-designed structures today. These examples are followed by an array of illustrations showing plastics components which manifest the best uses that designers are finding for these materials.

Most architects will remember Demarest as former Modular Co-ordinator of The American Institute of Architects.

CHEMISTRY'S MAN-MADE PLASTICS

The impact of the chemicals industry upon building is just beginning to be felt. A few traditional materials have been radically altered; some new materials, recently created, are now widely used in building. Chemicals-industry creativity and productivity will surely accelerate this trend. Since materials constitute an integral element of architecture, influencing every form in man's surroundings, this technical revolution is of profound significance for the architect. The new materials that are coming, and the ways in which they will perform, promise to transform our environment. But it is the designer who will command this transformation.

The chemicals industry has long been the leader in privately-financed research. Its total research budget last year topped $600 millions, according to a survey conducted by Manufacturing Chemists' Association. Its bill, during the period 1959-1961, for the construction of laboratories will come to $220 millions. A dynamic industry, based upon science, chemicals puts its faith in fundamental research. With organic "polymers" such as plastics, chemists have now progressed to the synthesis of new substances—useful materials consisting of molecules that had never existed in nature. To accomplish this originally, genius was abetted by luck. But in recent years, chemists have been learning *how to construct polymer molecules* to obtain certain attributes in the material. An American authority in this field of chemistry, Dr. H. F. Mark, Brooklyn Polytechnic Institute, has observed: "It was a matter of great intellectual satisfaction to be able to reduce the behavior of these substances to orderly laws and predict it with mathematical precision. But no less stirring was the new creative power made possible by this knowledge. The technological progress of mankind has been largely a history of putting available materials to use. It is a considerable step forward to invent the materials themselves on order. And this is the stage we have now reached in polymer chemistry. Starting from a need for some material of specified properties, we are in a position to create a new material tailored to fill that need" (September 1957 *Scientific American*).

Synthesis of new materials or molecular modification of old ones is not limited to plastics or to the chemicals industry. Plastics simply lead an important trend in materials that, for the building industry, implies great changes to come. The architect has long since discovered the attributes of traditional materials and expresses them in design: the weight of stone or clay, the grain of wood, the vulnerability of steel, the fragility of glass. But his palette of materials is fast enlarging, while the limitations of materials diminish. For him to discover the essentials about any substance, it will soon be necessary for him to gain some understanding of its molecular structure. He must begin to speak in chemists' terms—in order to understand his materials today and, tomorrow perhaps, in order to call for the molecules his designs require.

Discovering Plastics' Essentials

"... American architects, inspired in part by modern science and technology, have developed many new techniques and principles which in turn have imparted special character to contemporary buildings. New materials, new structural systems, and new erection methods have so enriched our resources that we can now build far more safely, durably, and economically than was heretofore possible. . . . Building is already the largest user of materials, absorbing ... ⅓ of all copper, ⅙ of iron and steel ... and almost ⅔ of the lumber used in all industries, ... The need to discover ... materials, ... and to eliminate ... obsolete practices, ... will become more and more urgent." (*The Architect at Mid-Century*, The American Institute of Architects' E. & R. Commission—Reinhold, 1954)

Plastics have been around for a long time. Celluloid was developed about a century ago; the phenolics were introduced in 1909 (as "Bakelite," a trade name since expanded in scope by Union Carbide to include all their plastics materials). Since then, and at an ever-increasing pace, new plastics materials have been created by the chemicals industry, have gone into commercial production, and—in almost every case—have found a useful role in some phase of building. The only major kinds of plastics that an architect may not yet have encountered are the newcomers that were not even available to him before the 1950's: perhaps the fluorocarbons, or the epoxies, perhaps polyvinyl fluoride, the polycarbonates, or a few others. In any case, the importance of plastics in architecture cannot be denied: and it is growing rapidly. Learning to make the most of these oftentimes utilitarian, sometimes spectacular new materials, designers are discovering their intrinsic qualities. Their engineering properties differ from those of other classes of materials, as do their chemical, electrical, visual, tactile, and other characteristics that are architecturally significant.

Plastics' Giant Molecules

Without plunging rashly into molecular theory, it will do no harm to the designer who wishes to understand his materials to discover that plastics are grouped by chemists with the "high polymers." The reader may have noted that many of their chemical names carry the prefix "poly-": polystyrene, polyvinyl chloride, and so on. "Poly-," for "many," indicates that the molecule of which the material consists is a giant one, a long chain of little molecules linked together repetitively. Ethylene is commonly known as a gas; polyethylene is today among the most familiar of our plastics—a solid. The great number of ethylene units that are linked to form a polyethylene molecule is indicated by the difference in the molecular weights of the two substances: ethylene's is 28; polyethylene's is typically about 20,000.

Tangled, spaghetti-fashion, countless such molecules constitute an amorphous substance which, depending upon temperature, will be as solid as glass, or leathery, or rubbery—or, with much heat, will melt into a viscous liquid. Such plastics when in their solid state might be described, just as can glass, as supercooled liquids. This roughly describes the constitution of the "thermoplastic" family of plastics.

The other family of plastics, described as "thermosetting," does not rely merely upon entanglement of molecular "strands" to make the substance strong and keep it in a solid state. Instead, chemical crosslinks lock the giant molecules together so that the material makes no transition from the glass-solid state when heated, but remains rigid and hard at all temperatures below that of actual chemical decomposition. (Or "degradation," the term more generally used.) One can no more melt a melamine dinner plate, than he can melt a two-by-four. "How, then," one might ask, "can this thermosetting group of synthetics also be called plastics?" The answer is that, at least at the time of fabrication of the product, any plastic will flow and can be molded. The ASTM's formal definition says that "a plastic is a material that contains as an essential ingredient an organic substance of large molecular weight, is solid in its finished state, and at some stage in its manufacture, or in its processing into finished articles, can be shaped by flow." It is evident that the thermoplastics can be molded thus repeatedly. However, once a thermoset has been molded into shape and "cured," that's that.

This distinction between the two basic classes of plastics, even as sketchily as it has been explained here, should suffice to alert the designer to a relative difference between these two classes regarding a characteristic of plastics that can be very important to him: cold-flow, or "creep."

Creep is characteristic of all materials when subjected to prolonged stress. But for the structural materials used in building—steel, for example—the rate of permanent deformation is so slight as to be negligible in most instances. When using plastics as self-supporting elements (not to mention in load-bearing applications), this property must be kept in mind since it can be of considerable magnitude.

The so-called "linear" thermoplastics (linear polyethylene, polypropylene—both of which have been on the market for only two years or so) have especially neat, orderly molecules: long, regular, repetitive spirals with a minimum of random side-branches. Their improved molecular structure yields improved properties: greater strength, especially at elevated temperatures, and greater resistance to creep than other thermoplastics.

From the foregoing description of the make-up of their molecules, it will not surprise the reader to learn that the thermosetting plastics display much more resistance to creep than the thermoplastics, owing to their three-dimensional network of strong molecular cross-links.

Characteristics of Plastics As a Class of Materials

In learning about plastics, the logical starting point is to consider them as a class of materials—analogous to the metals, or the woods. It may be that steel and brass are very different materials, and that to characterize them only as "metal" is generally too vague for practical purposes. Nonetheless, the properties shared by them to a greater or lesser degree rationally group them both under "metals." So also with plastics materials. They share certain attributes, although with wide variance in degree and with some out-and-out exceptions.

To begin, plastics are generally *corrosion-resistant*. This property, of course, can be of overriding importance in certain construction applications. At least one plastics material can be found to resist practically any corrosive condition found in building. Certain plastics are selectively attacked by classes of solvents; the choice for any given condition should take this selectivity into account. Many instances can be cited—in industrial piping, for example—where plastics have far outperformed costly metals such as copper or stainless steel under corrosive conditions.

Plastics generally exhibit a *low modulus of elasticity* as compared with traditional structural materials *(Chart 1)*. The stiffness typical of the reinforced thermosetting plastics, as measured by modulus of elasticity, is roughly in the same range as that of wood or concrete; that of the thermoplastics is well below. Maximum stiffness is at present obtainable through the medium of reinforcement with (high-modulus) glass-fibers.

Plastics tend to be *good electrical insulators*. This has been an important property since the earliest of days of the plastics industry, back in the second decade of this century. It is probably safe to say that plastics came into widespread use in the electrical-equipment field before any other.

In building, an important characteristic of plastics is that, being organic materials, they *can be destroyed by fire*. One, cellulose nitrate, is generally outlawed under building codes, because it burns readily and rapidly. Others, once they can be set afire, will burn more or less as do other common organics, such as wood or paper. Still others will extinguish themselves after the igniting flame has been removed.

Plastics' *thermal conductivity is low*. In the form of low-density foams, they provide some of the most efficient thermal insulators known today. The conductivity ("k" value) of polymethyl methacrylate is near the median value for the common plastics; the following approximate figures compare solid plastics and glass with representative insulating materials, including foamed polystyrene:

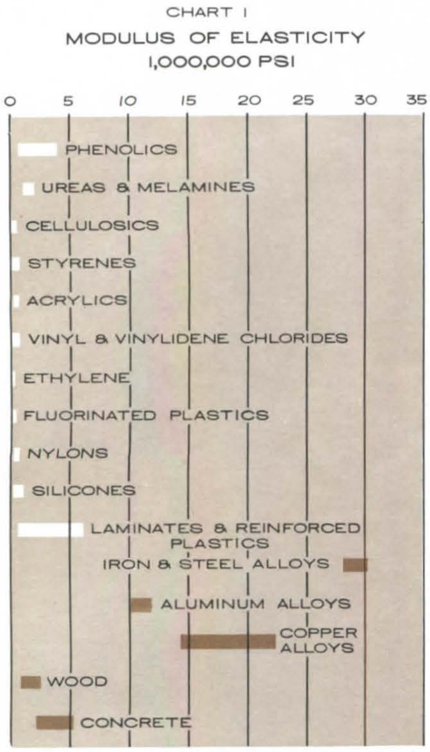
	Density lbs/cu ft	Thermal conductivity, "k"
Glass	156	6
Polymethyl methacrylate	75	1.4
Polystyrene	67	0.80
Corkboard	10	0.30
Mineral wool	12	0.27
Polystyrene foam	2	0.25

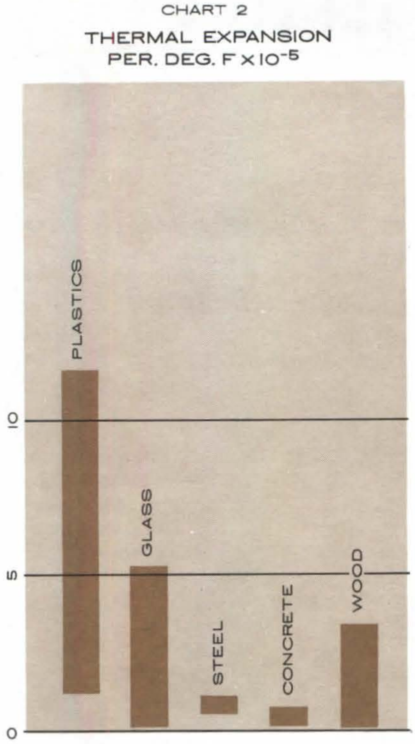
At the same time, the designer must keep in mind plastics' generally *high thermal coefficient of expansion*—several times that of the metals *(Chart 2)*. The thermoplastic materials, as a group, have higher expansion coefficients than do the thermosetting materials. Particularly when used in conjunction with metals, as with curtain-wall construction, special allowances must be made for this characteristic. This problem is a matter of good detailing; it has been solved successfully time and again. Another important reminder for the architect: certain plastics are too brittle to accept inserts of a material with widely differing thermal-expansion characteristics.

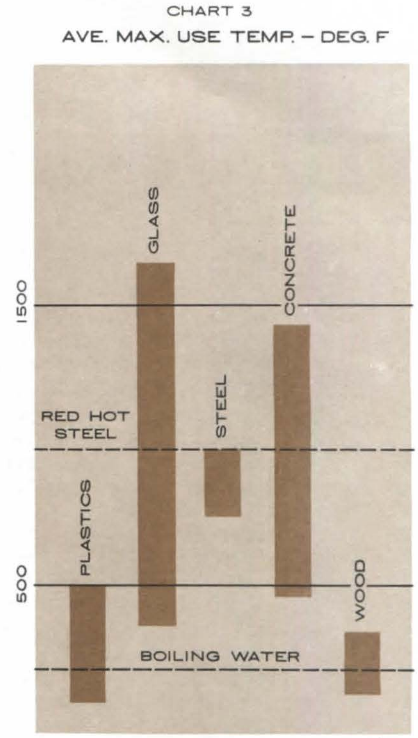
Maximum service temperatures are low for the plastics, as contrasted with structural building materials in common use. It is possible only to approximate such temperature limits, due to the varied conditions of actual use and to differing combinations of temperature-affected properties that may be relevant: tensile strength, creep, chemical stability, and the like. Plastics generally are best used at temperatures below the wood-char point of 380-400 F. The cross-linked molecules of the thermosetting plastics are more heat-resistant than those of thermoplastics *(Chart 3)*. Reinforced plastics may be highly resistant when the basic resin is heat resistant and the reinforcing agent is an inorganic material.

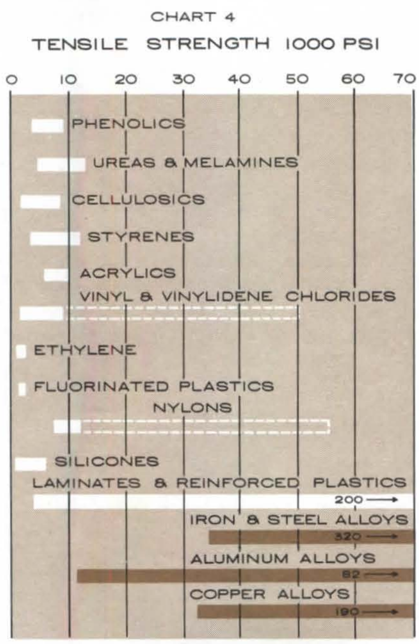
As already noted, many plastics exhibit time-dependent plastic behavior: deform, or *"creep," under load*. The amount will depend upon the stress and temperature, as well as time. But it will exceed, for example, that of steel which does behave elastically within a certain range of stress, or of concrete or timber, which do to a great extent. Thermoplastics are most "plastic," in this sense, with the linear thermoplastics somewhat less subject to creep. The thermosetting materials actually behave elastically when subject to low stresses.

Although in many design situations, stiffness is the controlling factor in the selection of a material, the generally *low tensile strengths* of unreinforced plastics









can be contrasted with those of the metals *(Chart 4)*. It should be noted, however, that plastics laminates and reinforced plastics can compare quite favorably.

Plastics of themselves all tend to be *light in weight*. Common unmodified polymers, or resins, range from a specific gravity of just under 0.9 for polypropylene, up to roughly 1.5 for polyvinyl chloride. In the face of the characteristic stated just previously, this makes possible favorable strength-to-weight ratios in comparison with other materials. If advantage can be gained through the geometry of the structural system, the fact that plastics materials are formed easily can make very lightweight construction possible: geodesic domes, sandwich panels, and so on.

Weathering is not just one process; it *is the combined result of* varying factors to which a material may be exposed outdoors. There is no easy numerical scale for comparing the weathering of building materials. Long-term resistance to weathering is bound to be one of the most uncertain qualities of new materials, such as plastics. As yet, accelerated weathering tests conducted by laboratories do not simulate all the combinations and variations of factors that may be brought into play. Some of the relatively long-established plastics, such as phenolics and acrylics, have acquitted themselves well for upward of 20 years. (Weathering of the former appears only as a dulling of gloss and color.) For many, however, there is no record of outdoor exposure extending over long periods. Plastics producers realize that the building industry thinks in terms of several decades' use at the least, and sometimes multiples of half-centuries. But, they have not yet been able to develop a short-term equivalent. Meanwhile, certain plastics formulations as used in actual building products in existing installations show great promise, upon the basis of a few years' observation, of long-term performance exposed to the weather.

Major Plastics Named

The plastics chiefly used in building today number only a dozen or so. Most of them are well known to everyone, although perhaps not by their correct generic names. Hewing to the basic distinction among plastics, the thermoplastics that the architect must know first are:

Acrylics Popularly known trade names are "Lucite" or "Plexiglas," but a chemist would say "polymethyl methacrylate." These materials can combine the transparency of glass (but not its scratch-resistance) with plastics' shatterproof

GLOSSARY

Plastics most commonly found in buildings are named and described in the text. Along with names of some other plastics that the architect may encounter, this glossary attempts to explain terms necessary to a basic knowledge of the subject.

ABS plastics: Compounds of acrylonitrile, butadiene, and styrene. Important characteristics are toughness, chemical resistance, non-brittleness at low temperatures.
Amorphous: Without crystalline structure.
"Butyrate": Cellulose acetate butyrate.
Cellophane: Regenerated cellulose; technically, not a true plastic. Lacquer-coated, moisture-proof, heat-sealable wrapping.
Celluloid: Thermoplastic material made by blending cellulose nitrate with camphor.
Cold Flow: See "Creep."
Copolymer: A long-chain molecule formed from two or more different monomers.
Creep: The change in dimension of a plastic under a load over a period of time. Does not include the initial instantaneous elastic deformation. Creep at room temperature is "cold flow."
Cross-linking: The chemical union of polymer molecules to form a three-dimensional network. Cross-linked polymers are usually infusible.
Crystalline: Like a crystal, i.e., a body having an internal structure in which molecules are arranged in a regular geometrical pattern.
Cure: Changing physical properties of a material by chemical reaction — usually to a harder or more permanent form.
Deflection temperature: Degrees Fahrenheit at which a plastics material under fixed stress distorts as temperature increases, according to standardized ASTM test procedure.
Degradation: Molecular change to the polymer, typically from exposure to light, fire or heat, becoming apparent as charring, discoloration, clouding of transparent plastics, embrittlement, or other loss of inherent properties.
"Delrin": Trade name of DuPont's acetal resin, the first of a new kind of thermoplastics to be produced commercially in this country: polymerized formaldehyde (embalming fluid, that is!).
Dielectric strength: Measure of the ability of a material to resist the flow of an electrical current.
Dispersion: A liquid with finely-divided insoluble particles scattered uniformly throughout. Called a "colloid," if particles are fine enough. "Dispersion" and "suspension" contrast with a "solution."
Elastomer: A material which at room temperature can be stretched repeatedly to at least twice its original length and, upon release of the stress, will return with force to its approximate original length.
Exothermic: Adjective indicating a chemical reaction that gives off heat.
Film: Sheeting of nominal thickness not greater than 10 mils.
Flash: Extra plastic attached to a molding along the parting line. It must be removed before the piece can be considered finished.
Fluorocarbons: A group of extremely inert plastics. As resins, dispersions, oils, greases, and waxes, they have high thermal stability and excellent resistance to chemical attack.
High-pressure laminates: Laminates molded and cured at pressures not lower than 1000 psi (commonly in the range of 1200-2000 psi).
Inhibitor: A substance that slows down chemical reaction — often used to prolong "shelf," or storage, life.
Latex: A suspension in water of fine particles of rubber (which today includes synthetic rubber compositions).
Linear: Adjective to describe a long-chain molecule with a minimum of side-chains or branches.
Low-pressure laminates: In general, laminates molded and cured in the range of pressures from 400 psi down to and including pressures obtained by the mere contact of the plies.
Mil: Linear measurement of 0.001 in.
Molecular weight: The sum of the atomic weights of all the atoms present in a molecule, with the weight of the oxygen atom set at 16.
Monofilament: A continuous thread made up of only one filament.
Monomer: A substance constituted of a simple molecule, of relatively low molecular weight, that is capable of reacting with (like or unlike) molecules to form molecular chains called "polymers."
Nitrocellulose: Same as "cellulose nitrate" or "pyroxylin."
Organic: Adjective to distinguish those compounds that, like plant and animal matter, contain the very prevalent carbon atom. "Inorganic" compounds are those that do not.
Plastic (n.): Any non-metallic material that can be molded or extruded, not including materials with rubber-like or ceramic qualities. Another definition (see text) limits "plastics" to moldable organic high polymers.
Plasticizer: Materials added to a plastic to improve flexibility or to facilitate compounding.
Polycarbonate: A new thermoplastic polymer offering outstanding impact strength, dimensional stability under varying humidity or temperature, and heat resistance.
Polymerization: The process by which polymers and copolymers are formed. (See text.).
Polymethyl methacrylate: "Acrylic."
Polypropylene: A thermoplastic material composed of polymers of propylene. The lightest of all commercial plastics, its properties compare favorably with those of similar materials.
Polyvinylidene chloride: "Saran" (see, under PVC, in text.)
Polyvinyl fluoride (PVF): A new plastics material, soon to be marketed as a transparent film with promise of outstanding resistance to weathering, combined with other desirable properties.
Postforming: Bending phenolic laminates or certain other thermosetting sheet materials into simple (substantially permanent) shapes by heat and pressure after initial cure.
PVC: Polyvinyl chloride.
Resin (synthetic): Polymeric synthetic products having some of the characteristics of natural resins. Some serve as base ingredients of plastics; some are important ingredients of finishes, adhesives, etc.
Resorcinol: Generic noun for a group of synthetic polymers, much like the phenolics, that are chiefly used as heat- and water-resistant glues.
Roving: A form of fibrous glass in which spun strands are woven into a tubular rope.
Suspension: A liquid with small, solid particles dispersed more or less uniformly throughout.
Thixotropic: Said of materials that are gel-like at rest, but fluid when agitated (desirable in paints).
"Urethanes," properly called polyurethanes: Newly developed thermosetting polymers, appearing as flexible and rigid foams and coatings, also as adhesives and as elastomers.
Vacuum forming: Method of sheet forming in which the plastic sheet is clamped in a stationary frame, heated, and drawn down by a vacuum into a mold.

quality. Their weathering performance has been better than other common plastics. In building, they are typically used for light transmission or control, or for vision (diffusers for light-troffers, "bubble" skylights, etc.); also they have many decorative uses—door handles and the like.

Cellulosics (Primarily cellulose acetate or butyrate. The original cellulosic was high-hazard cellulose nitrate.) "Acetate" is well known as photographic safety-film. These plastics are amazingly tough (one important use is tool handles). An interesting application of "butyrate" in building is as explosion-venting glazing of industrial sash.

Nylon Molded-nylon products have qualities as spectacular as those of the longer-known nylon fabrics. They are tough, have a low frictional coefficient, and they resist mechanical wear better than many metals. Hence, the rollers of this material for sliding doors and drawers; likewise, the advent of nylon moving parts in locksets. Nylon's high softening temperature is exemplified by its replacement of brass for mixing-valves in automatic washers. Although other thermoplastics cost less, this property makes it a potential candidate for domestic hot-water supplying piping.

Polyethylene Waxy and chemically inert, flexible even at low temperatures, this material is one of the most commonly known plastics. Polyethylene is a water barrier, of course, but it also retards the passage of water vapor. The plain, colorless substance is short-lived in sunlight, but telephone companies use carbon-black-pigmented polyethylene to insulate outside lines. (The improved "linear" polyethylene, incidentally, was first encountered by the general public in the "hula hoops" of 1958.)

Polystyrene Nonwater-absorbent, it is found in colorful, but brittle, wall tiles. Copolymers of styrene with rubber can be very tough. Polystyrene is one of several plastics used in electric-lighting diffusers. In foamed form, it has become an important thermal insulation.

PVC (polyvinyl chloride The resin itself is rigid; plasticizers are added for flexibility. Everyone knows this plastic as wear-resistant "vinyl" flooring. Self-extinguishing forms are used in luminous ceilings. (Saran should be grouped as a cousin of PVC, chemically as well as for its properties. Unlike PVC, which must be "stabilized" against degradation under ultraviolet light, saran performs well outdoors without special formulation.)

Pure thermosetting resins tend to be brittle and difficult to mold. Fillers are generally added to improve the material while reducing its cost: chopped fibers for toughness and strength, asbestos fiber for heat resistance, wood flour for better molding, mica for high electrical properties, and so on. Thermosets most used in building are:

Melamine and *Urea* Hard, durable, and dimensionally stable, these quite similar plastics are resistant to chemicals, electrical potential, and heat. This last property makes lower-priced urea useful for incandescent-light diffusion. With a wider color range, melamine is well known to the public in the form of molded dishes.

Epoxy Relatively new and still quite expensive, epoxy is already used in building because of its remarkable adhesive qualities and chemical resistance.

Alkyds These appear chiefly as molded electrical parts. They are also important constituents of certain paints.

Phenolic Familiar for years in the old (black) telephone handsets, it is strong, durable, and both electrical- and heat-resistant. This low-cost "workhorse" plastic is limited to dark colors. Glass-fiber insulation batts use a phenolic binder.

Polyester Appears in film form under trade names such as "Mylar," "Videne." It has been known longer as the plastic most commonly used in large glass-fiber-reinforced translucent panels that are strong, rigid, and impact-resistant. Polyesters' resistance to abrasion can be poor, as can ultraviolet-light resistance, but properties will vary widely with changes in formulation.

Urethane Even newer than epoxy, this plastic is beginning to appear in coatings and as foams that are self-adhesive, also offering the advantages of being thermosetting.

Silicones Being semi-inorganic substances, silicones might not be classified strictly as "plastics." In building, they are applied to masonry to improve its water repellance and weatherability.

What Plastics Are Not

To wind up this look at plastics, it might be worthwhile to turn things around for a moment and to consider some notions about this class of materials that may need to be dispelled. The plastics are not:

Unfamiliar Many materials have been around us somewhere between half a generation and half a century. A tabulation of their uses in food preparation, office work, transportation, medicine, etc., would probably fill this entire magazine.

Untried A "new" plastics building product is very likely to turn out to be a new application of an "old" plastic, the performance of which is well known in other, similar uses.

Substitutes Blind substitution of one kind of material for another is inviting disaster. Changing materials calls for changes in the product, too.

Incompatible with traditional materials. Far from ousting them, plastics often combine with other materials, yielding an improved product by means of coating, impregnation, bonding, gasketing, etc.

Cure-alls, as many new-fangled things are often thought to be. Strictly speaking, a material is nothing more than a bundle of properties. The designer will always have to weigh the less desirable ones against the ones he's looking for.

Identical in their attributes. The catch-all term, "plastic," is too vague to mean much to technical people.

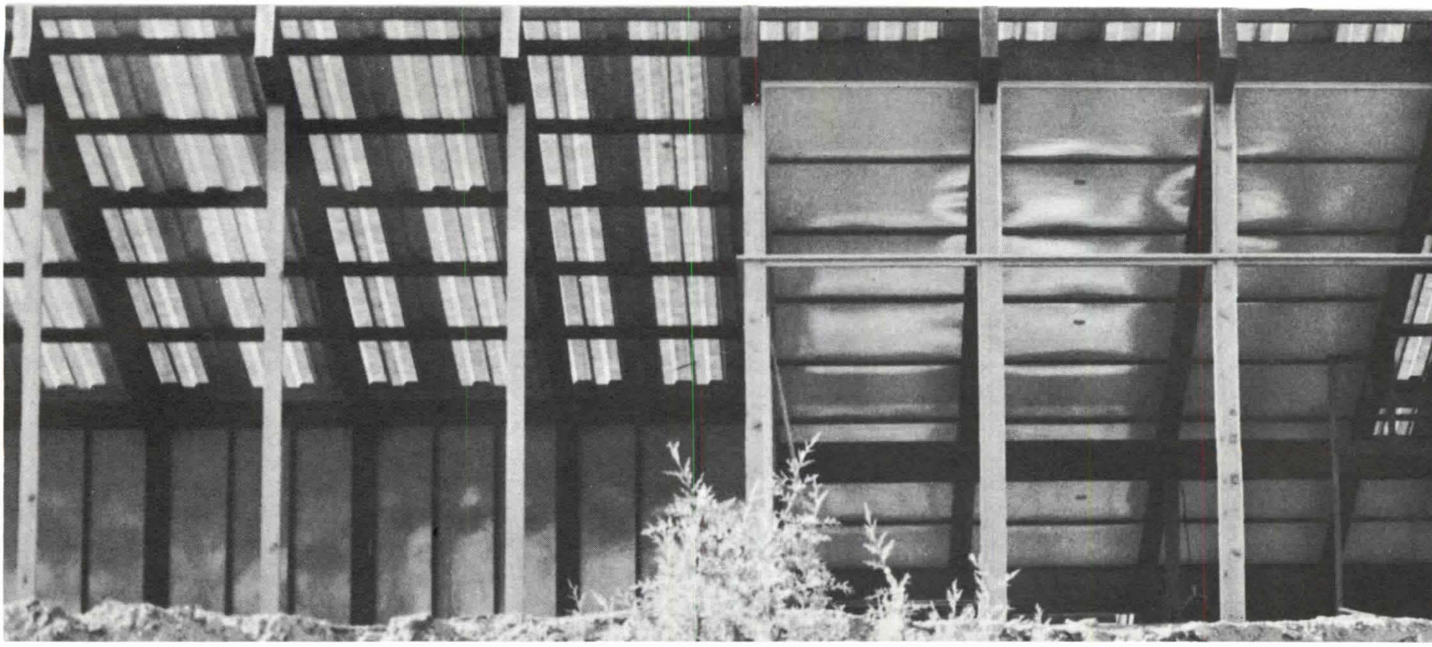
Fire hazards, per se. First, someone has to provide the fire. Then, the plastics and all other materials in the situation will perform variously, according to their own properties and the good sense with which they have been used.

Wholly "plastic" in behavior when stressed. Some are quite elastic, under low or brief stresses, or when reinforced.

Cheap This class of material does not occur in nature; plastics' molecules are manmade. This has to cost something. The justification for the use of plastics will probably always have to rest upon the excellence of their performance, and not upon cheapness.

Uses Show Best Results

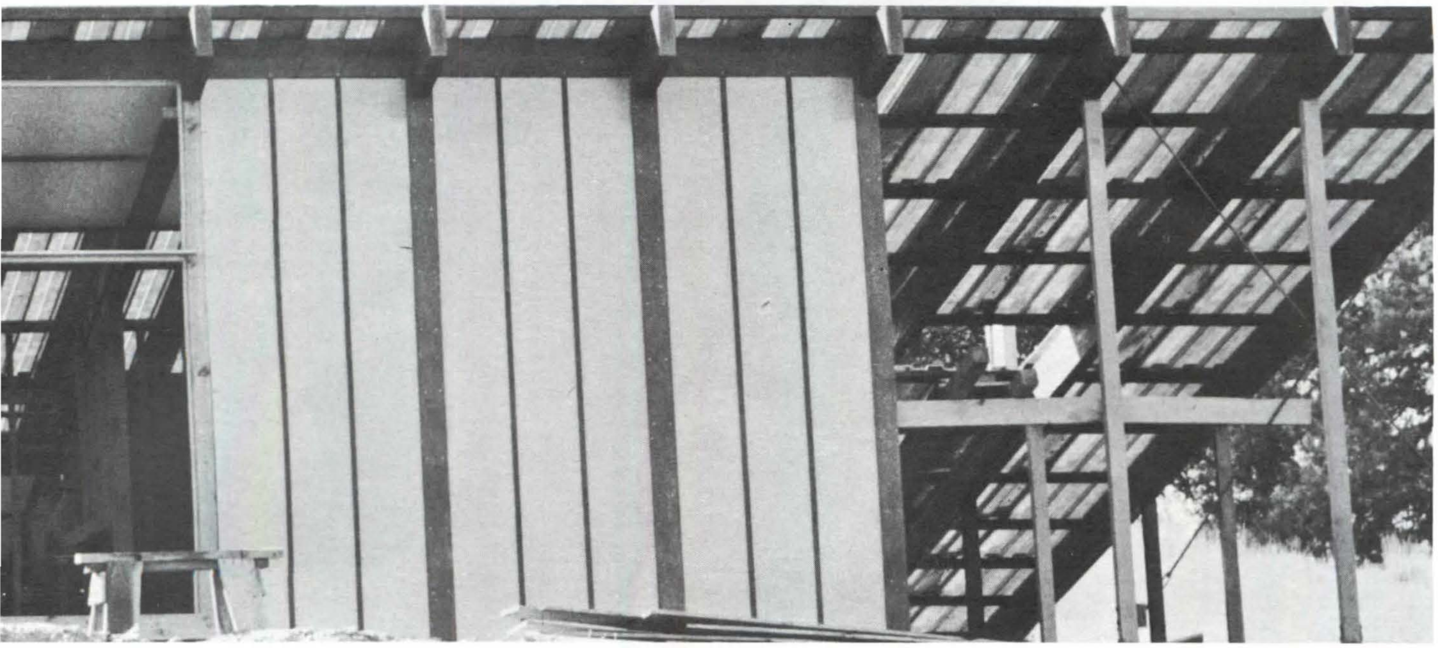
Having discussed characteristics of plastics as a class of materials, and having considered what they can be expected to perform and what they cannot, let us now consider—on the following pages—a house in California and an office in Chicago which represent significant applications of plastics being used by the architectural profession today. The article will be concluded with discussions and examples of plastics installations that demonstrate their best features.

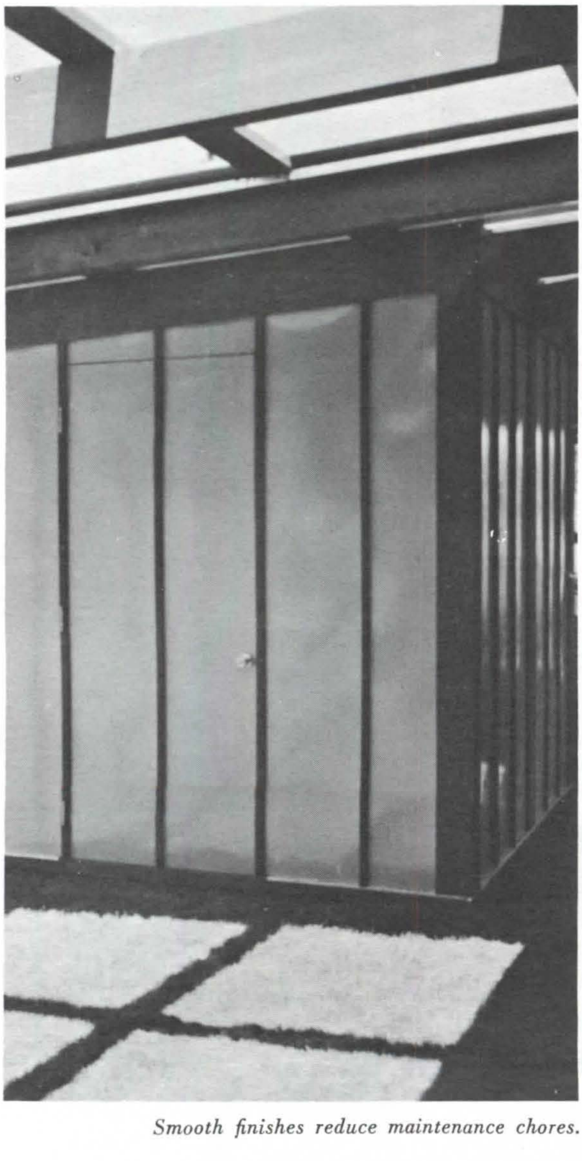


Posts and beams are 4′ o.c allowing 44″-wide plastic panels to be set between them; floors, walls, and roof are insulated.

Over the conventional post-and-beam construction of this house in Yreka, California, some 8000 sq ft of Filon's glass-fiber reinforced-plastic panels were used for walls, roof, awnings, railings, and tub enclosures. Beige-colored exterior and interior wall panels are flat, semi-opaque, .060″ thick and weigh eight oz per sq ft. All panels were prefabricated in the builder's shop. The plastic material was first spot-tacked to both sides of 1″ x 4″ lumber frames; panels were then taken to job and secured with stained battens. Roof purlins support outer layer of corrugated light-gray panels; interior surface is formed of flat, snow-colored panels held with battens. Roger Lee, Berkeley, was the architect.

Roof panels have 8″ ribs, lighting space below.

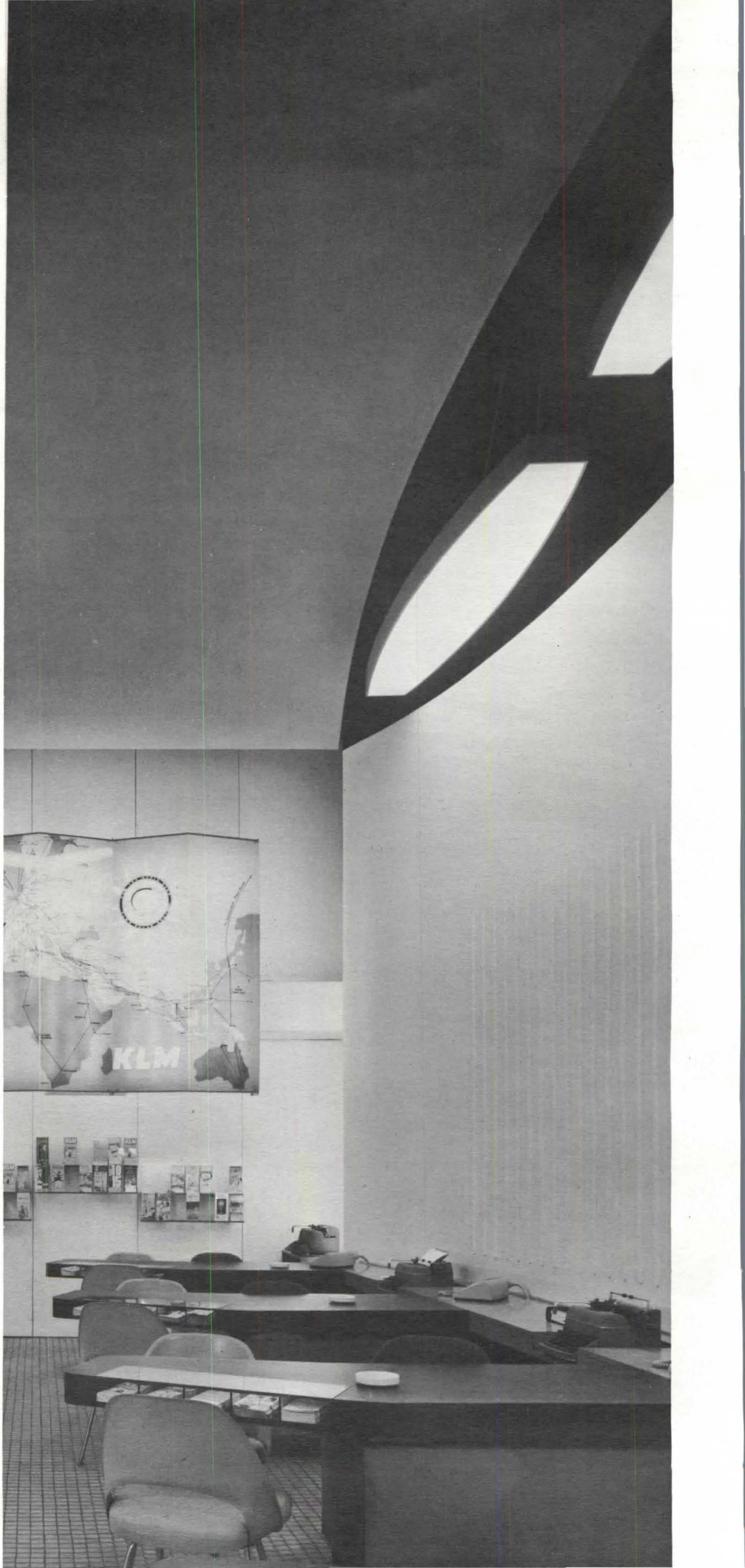




All-Plastic-Panel House

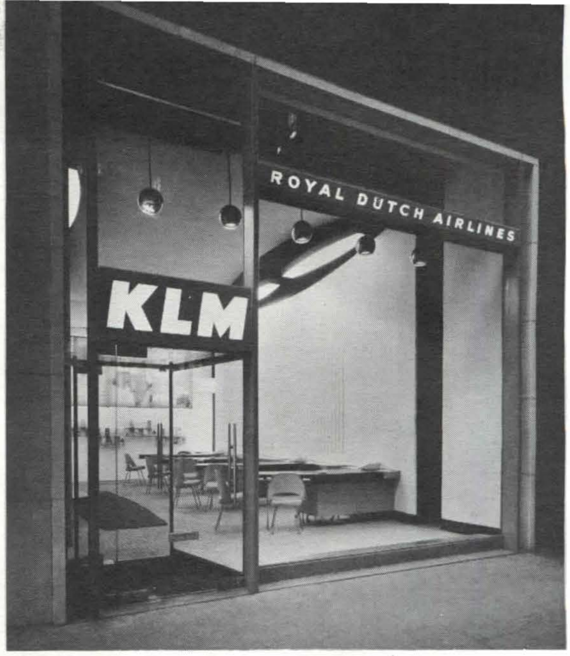
Smooth finishes reduce maintenance chores.

Sunshades are plastic over 2" x 2" frames.

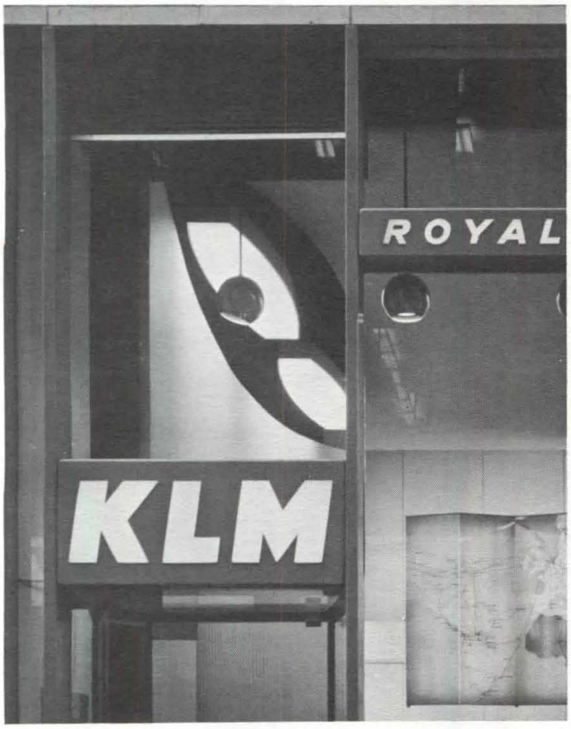


Luminaires, mounted on 30-degree angle, direct light away from wall to center.

Ticket Office

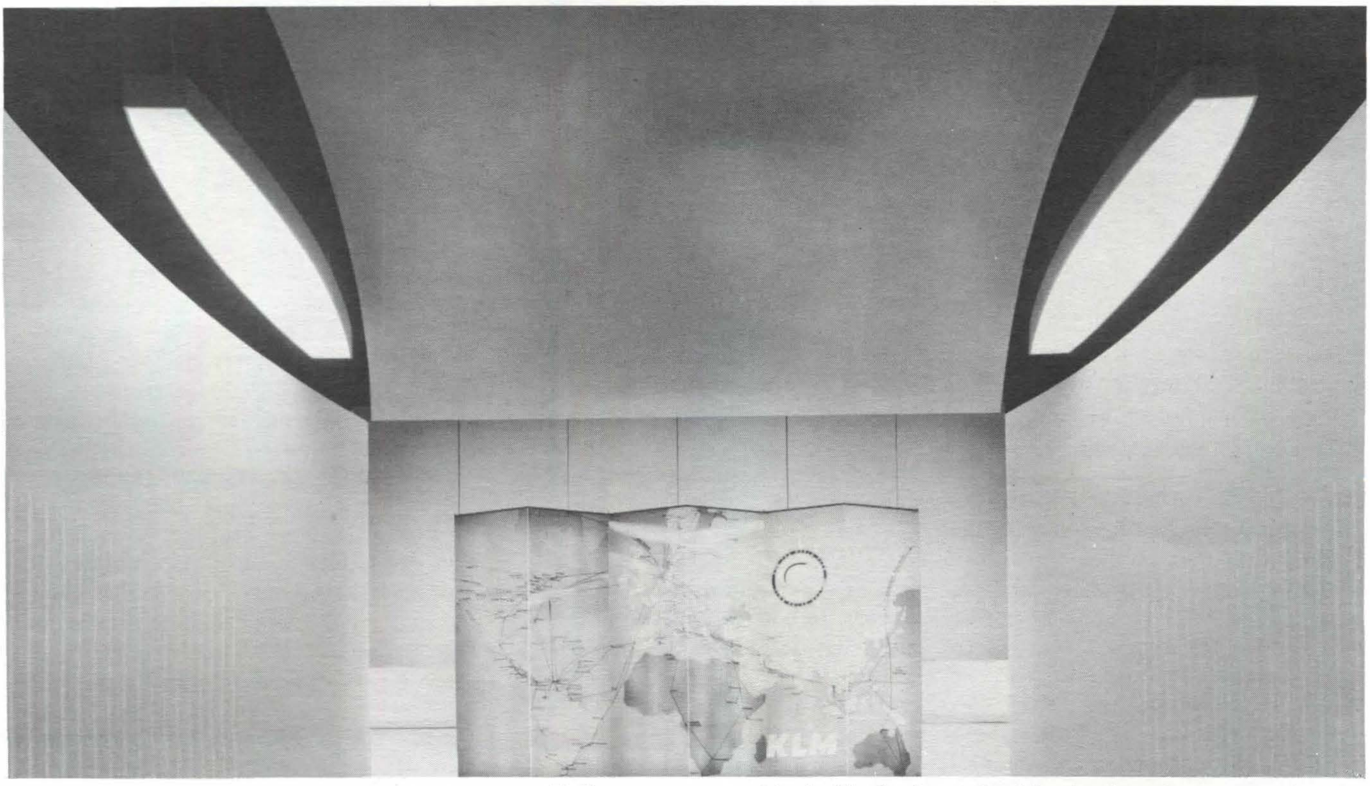


Polyester-resin/glass-fiber finish protects framing.



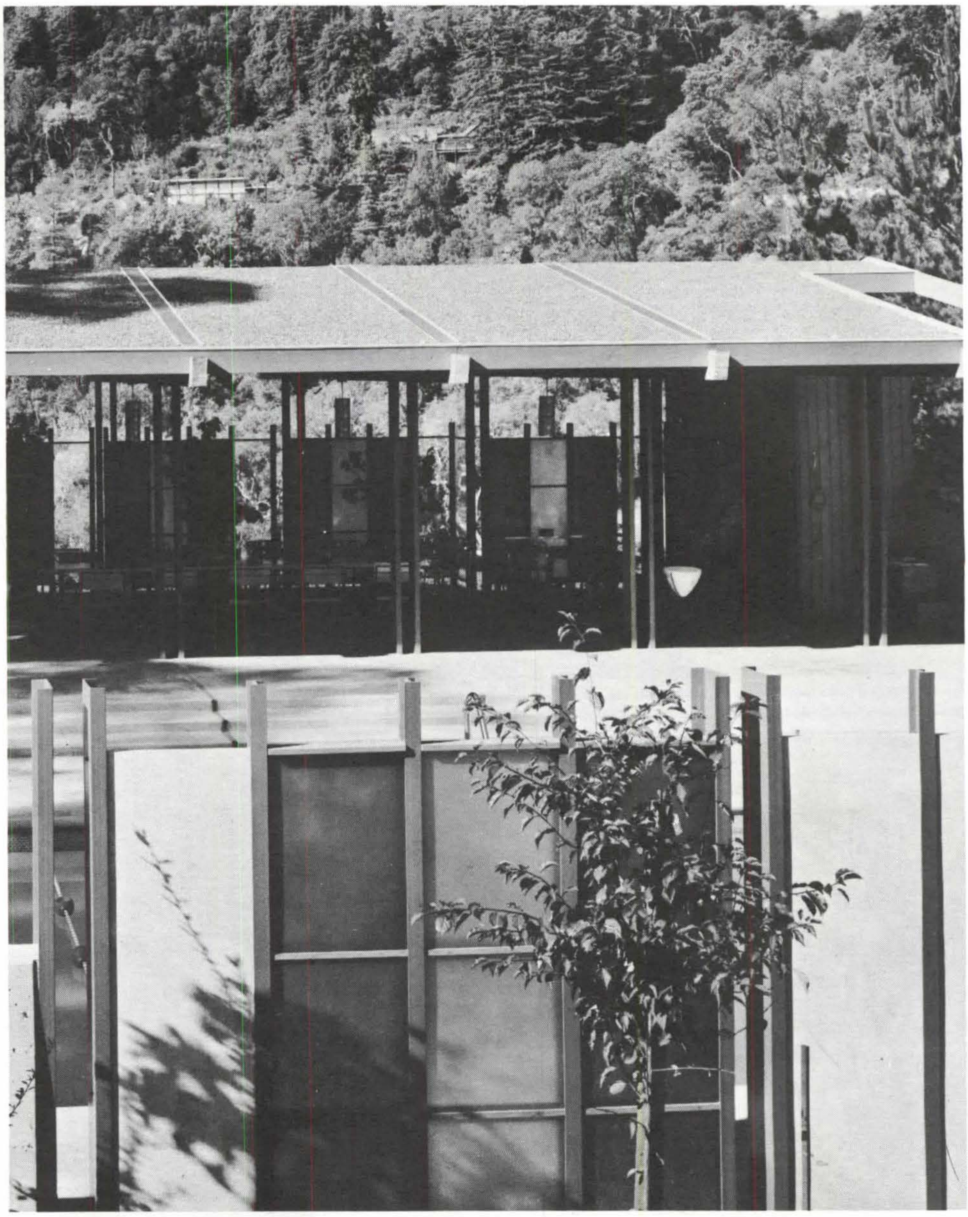
Plastic signs form integral part of front.

Framing for this ticket office front is fabricated of 12-gage tubular-steel sections. Steel was sand-blasted, undercoated, and covered with 12-oz glass-fiber-fabric saturated with blue polyester resin—in several applications—and built up to a thickness of approximately 1/16". After being sanded smooth, frame received sprayed-on coat which dries to an orange-peel finish. If damaged, protective sheath is easily repaired by application of polyester. Harry Weese & Associates, Chicago, were the architects.



Wall map was executed in double-plastic panels with colored, transparent map between.

Surface Finishes



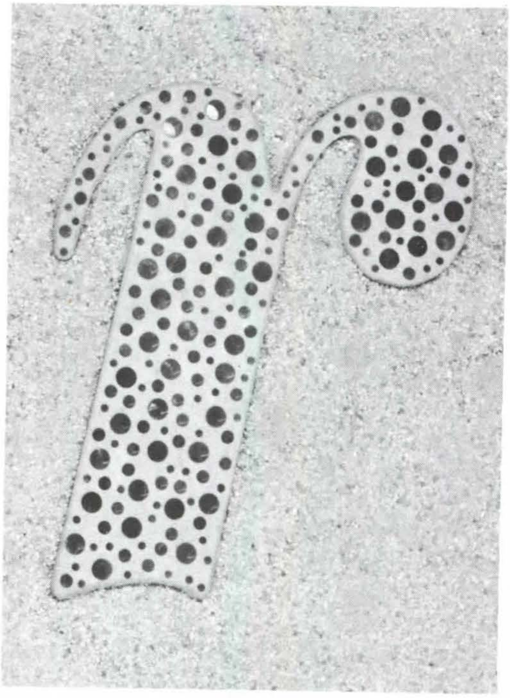
Alternating plastic and precast-terrazzo panels screen swimming pool and loggia.

Rather than taking a roll-call of the many applications that plastics have found in building, it should profit the designer more to discover the major kinds of functions they fulfill and the reasons why they excel in these uses. It is their essential attributes, as discovered and used by designers, that enable them to perform these functions in a superior manner: finish materials (surfaces applied in solid form, or surface coatings—liquid applied); water (or vapor) barriers; thermal insulation; adhesives; structural elements; mechanical equipment components. Miscellaneous uses of plastics in building are countless, but generally of minor import: insect-screening, construction aids such as tarpaulins or drain-tile spacers, etc. Other related, but nonbuilding uses, however, do concern the architect: furniture and fabrics, decorative elements such as murals and sculpture.

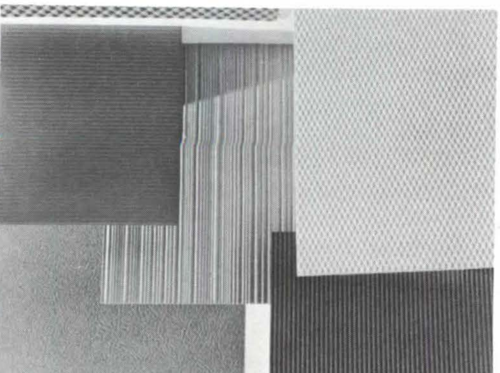
Surface Finishes

It is now well known that toughness—resistance to both impact and abrasion—is characteristic of most plastics. PVC, for instance, survives neglect better than any other resilient flooring. Combine toughness with integral color and the advantages of rigid or flexible plastics are obvious. Those used as surfacing are necessarily easy to bond to the substrate; another feature common to them is imperviousness to water. Polystyrene, for one, offers both properties at relatively low cost. PVC is self-extinguishing as well. Decorative phenolic-backed melamine laminates compete with stainless steel and ceramic tile for countertops that can withstand chemicals and abuse. Less vulnerable than these to sunlight and weather, reinforced polyester sheets can also serve a structural function, as in sandwich-panel skins.

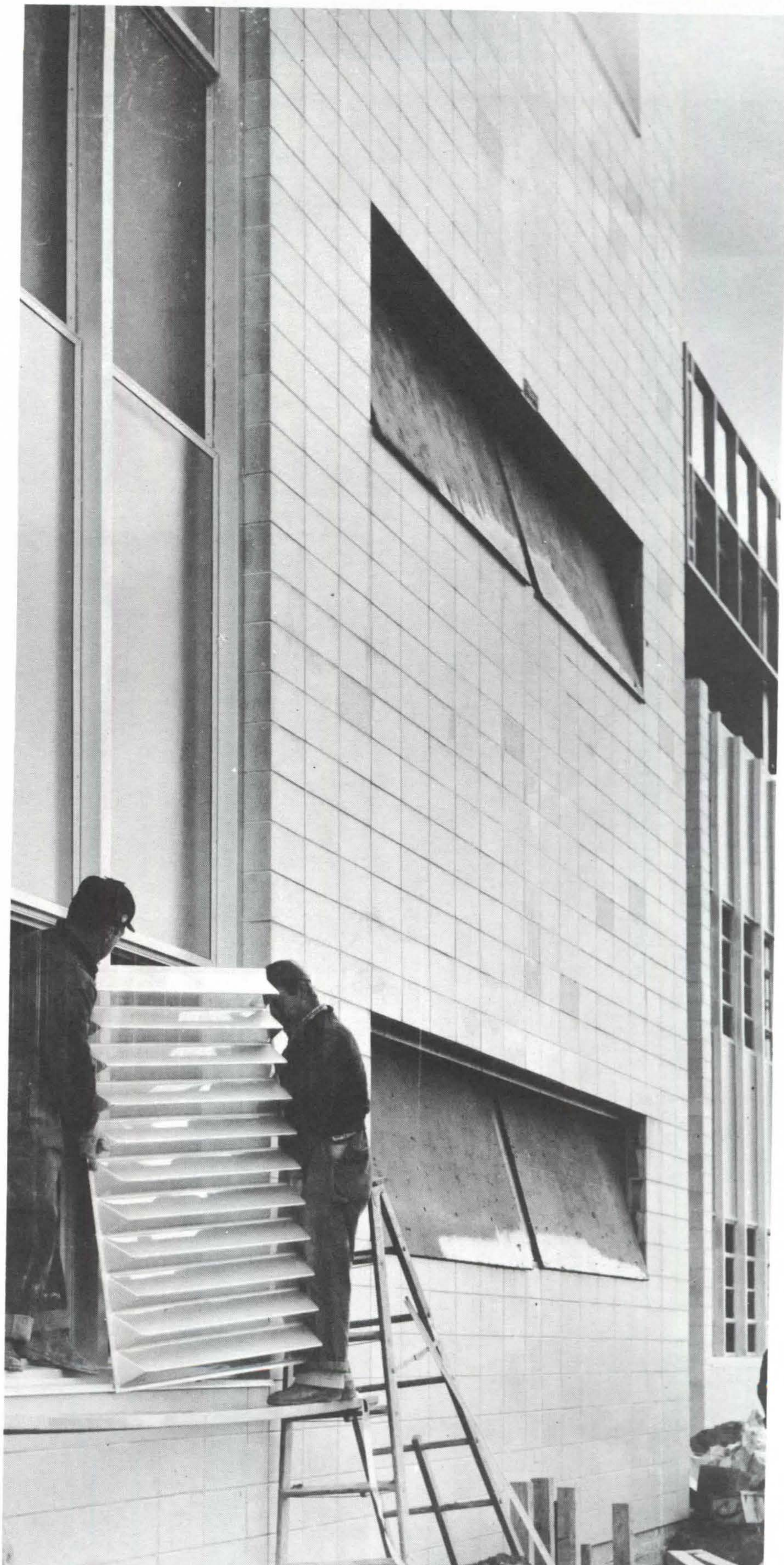
Nearly all modern paints are based upon synthetic-resin vehicles. These resins, one discovers, are the same organic high-polymers of which plastics are made. For



Concrete panels containing plastic letters are used in this department store sign.

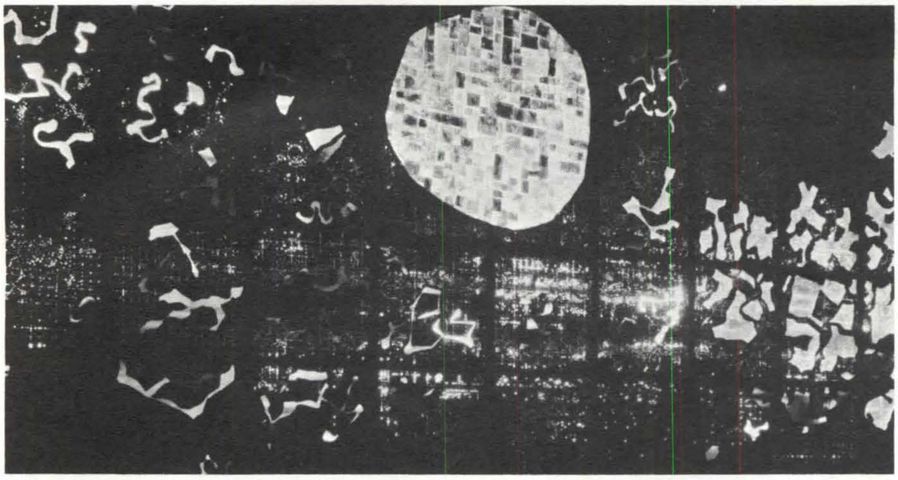


Spray applications of vinyl dispersions.



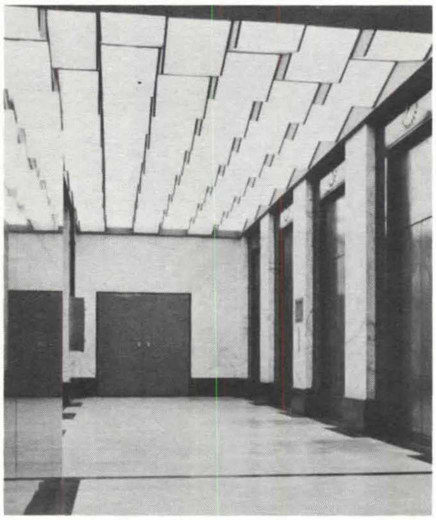
Polyester finishes for exterior block and spandrel panels.

Illumination

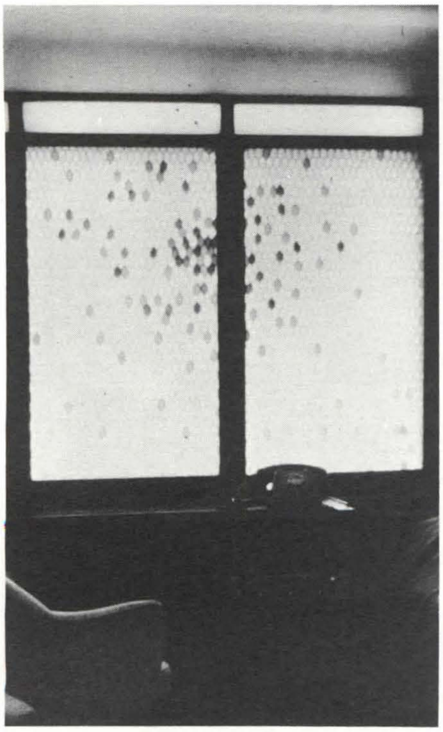


Mobile light mosaic uses plastic paints and plastic adhesive.

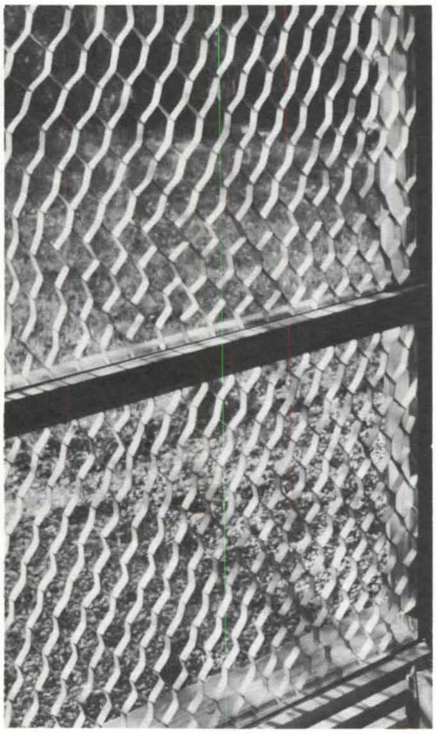
Backlighting of light mosaic.



Bent acrylic panels in luminous ceiling.



Plastic screens replace ship curtains.



Daylighting through plastic window wall.

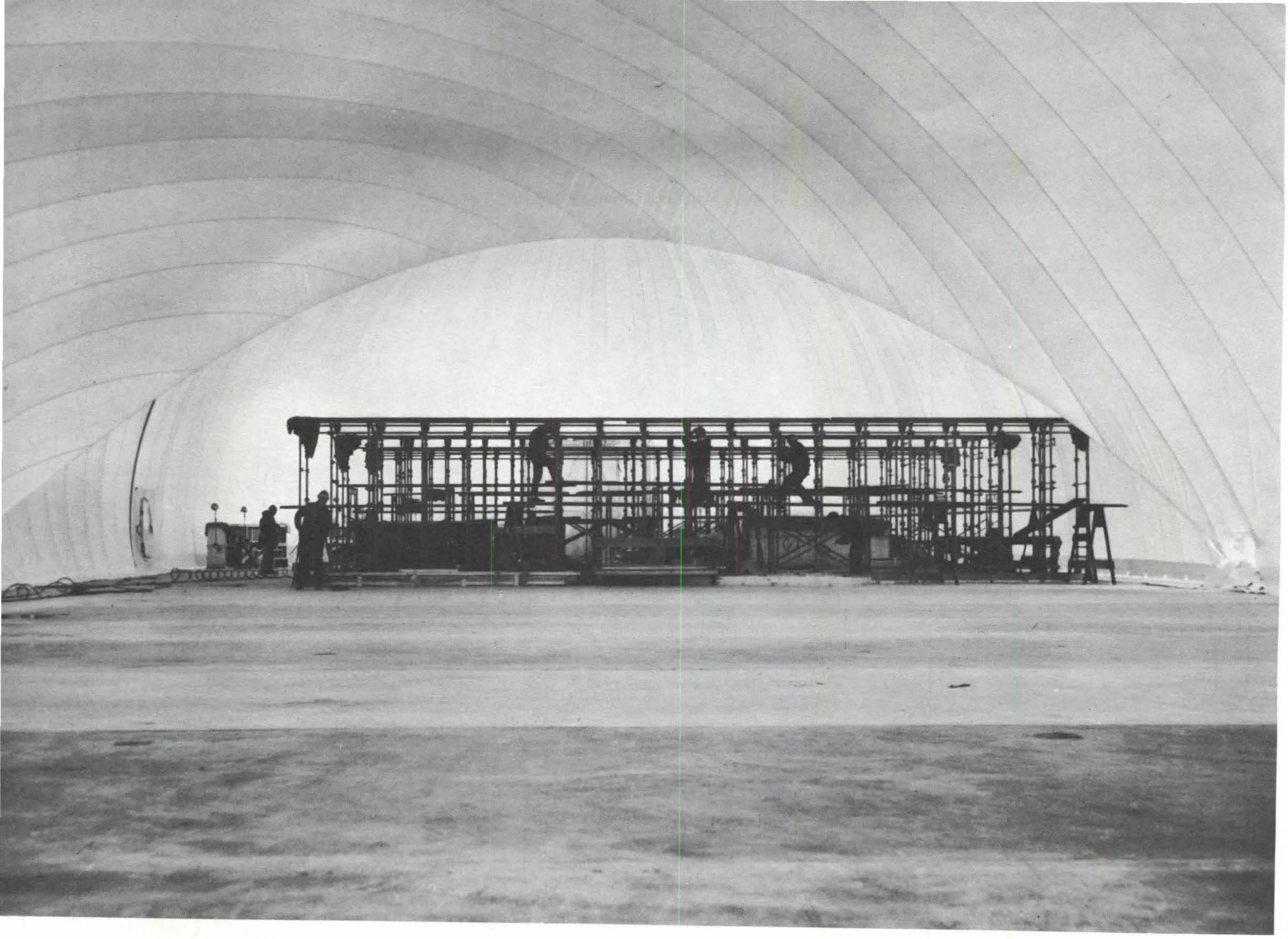
example, let us look at just one class of paints, the newest in the field. Latexes for water-based paints today use one of three types of polymer: styrene-butadiene, vinyl acetate, or acrylic. They offer important advantages: ease of working, excellent penetration control, good chemical resistance, good color uniformity. They are noncombustible and relatively odorless. They can be applied to damp surfaces and are nonburning in the presence of highly alkaline spots.

Latex paints have moved outdoors in recent years and are widely accepted for application to masonry. Now, the makers believe they have licked the problems presented by wood: adhesion difficulties under rigorous climatic changes, swelling and shrinking of wood fibers, fungus and mildew problems presented by the water in the paint itself.

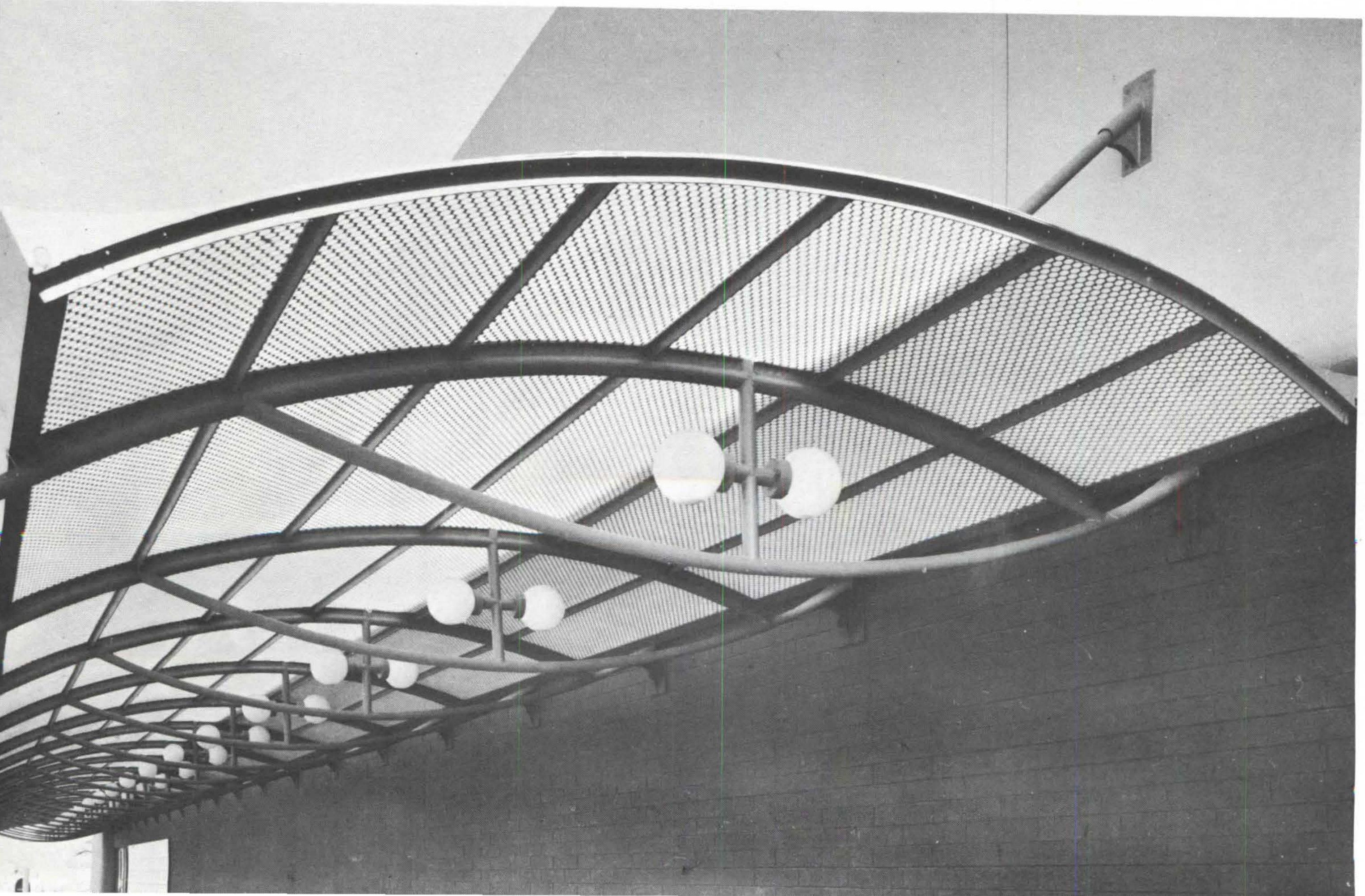
Illumination

Perhaps plastics' most singular characteristic is in fulfilling at once different functions, otherwise performed by several materials in combination. With daylighting, the well-publicized acrylic "bubble" skylight is a case in point. Although not quite self-flashing, the ease of forming the material makes possible a unit that details readily into a much more watertight installation than the old glass-lights-in-fixed-sash skylights. There is nothing more direct than the way rigid, impact-resistant glass-fiber-reinforced polyester corrugated panels are used in conjunction with similar units of other materials, to perform the same functions, plus the additional one of light-transmission. MIT's study (for Monsanto, 1958), "Building with Plastic Structural Sandwich Panels," observes: "The ability to provide interior illumination, not only through the traditional window openings, but also through the structural parts of the building, opens up a whole new approach to design."

With electric lighting, combination of ceiling surface with integrated luminescence is already commonplace, using any of a half dozen plastics. The lack of texture generally associated with luminous ceilings is not inevitable, thanks to plastics' formability and capacity for varying the amount and quality of light transmitted. Acoustical treatment can also be incorporated. In electric-lighting fixtures, where plastics diffusers are popular, still another function is sometimes introduced: electrical insulation. While noting *functions* combined in lighting, important *properties* should not be overlooked: shatterproofness, light weight, easy maintenance and —for daylighting—relatively low heat transmission.



Vinyl-covered nylon supported by air (above). *Canopy cover is reinforced, polyester laminated to rice-paper core* (below).



Barriers to Water or Heat

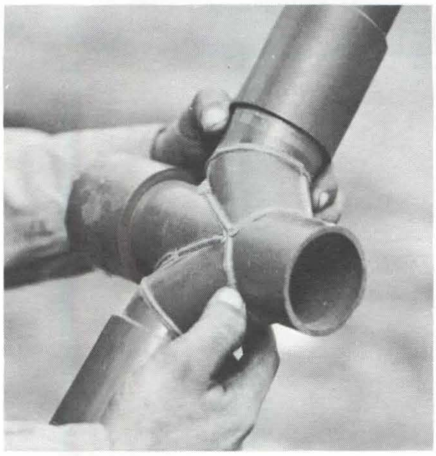
Not limited to the role of waterproof coatings applied in liquid form, plastics and related (polymeric) elastomers are now well known to be "naturals" for an array of products used to make buildings watertight: flashing and waterproof membranes, waterstops for concrete, sealants, and gaskets. Literally dozens of polymers, both thermoplastic and thermosetting, are employed thus—all being waterproof and easily shaped. Almost any degree of elasticity and adhesiveness can be selected. Some of these materials are also superb water-vapor barriers. For weatherstripping, some are used as foams. Ability to take color and to withstand exposure to weather vary from poor to excellent. Beyond just weatherstripping, plastics foams provide first-rate thermal insulation. Again, they combine important properties: remarkably low transmission, light weight, desired degree of flexibility, plus ease of handling and placement. Certain foams are vapor barriers; some are adhesive; some are self-extinguishing. Even light-transmission is possible. As cores for sandwich-panels, foams add another—structural—function to the combination.

Structural Components

Regular load-bearing building elements can also be of plastics, when reinforced. It is not economical merely to substitute them for traditional materials. Instead, the designer must capitalize on special properties available. As adhesives, the same resins upon which plastics are based find important uses in secondary structural functions: bonding, for instance, (as with plywood) or as a binder (particle board). Synthetic-resin adhesives, of course, appear everywhere in building, from glue-nailed residential roof trusses to pressure-sensitive, "contact"-type wall coverings. Whereas new concrete will not bond with old, some of these polymers will adhere to both, making possible great savings in repair work.

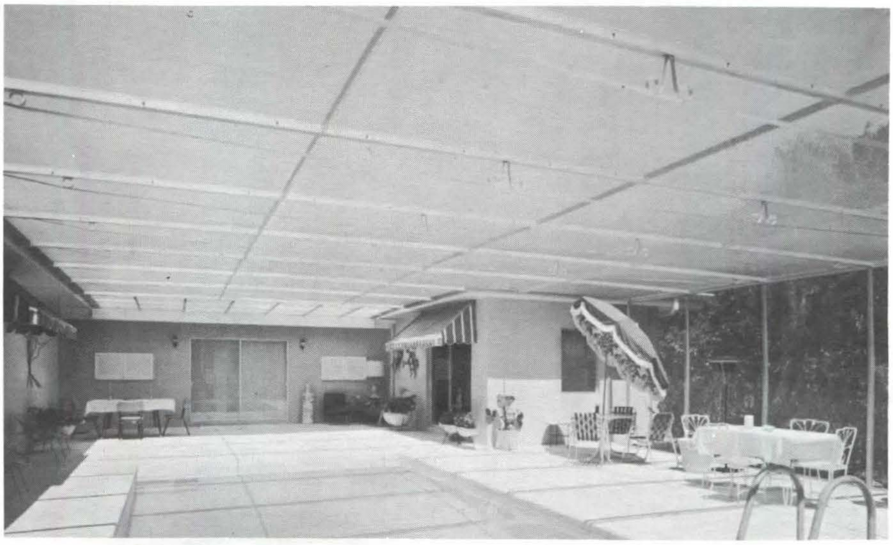
A recital of the ways plastics have become indispensable in building equipment would again simply emphasize their remarkable combinations of properties. Currently, plastics people predict that these corrosion-resistant, easy-to-work materials will shortly develop into a major factor in plumbing, with superior characteristics for hot-, cold-, and drain-lines, fittings, and fixtures.

In short, discover the combination: the combined properties by which the plastics have earned acceptance for such varied uses, and you have begun to take the measure of their potential in the architecture of today.



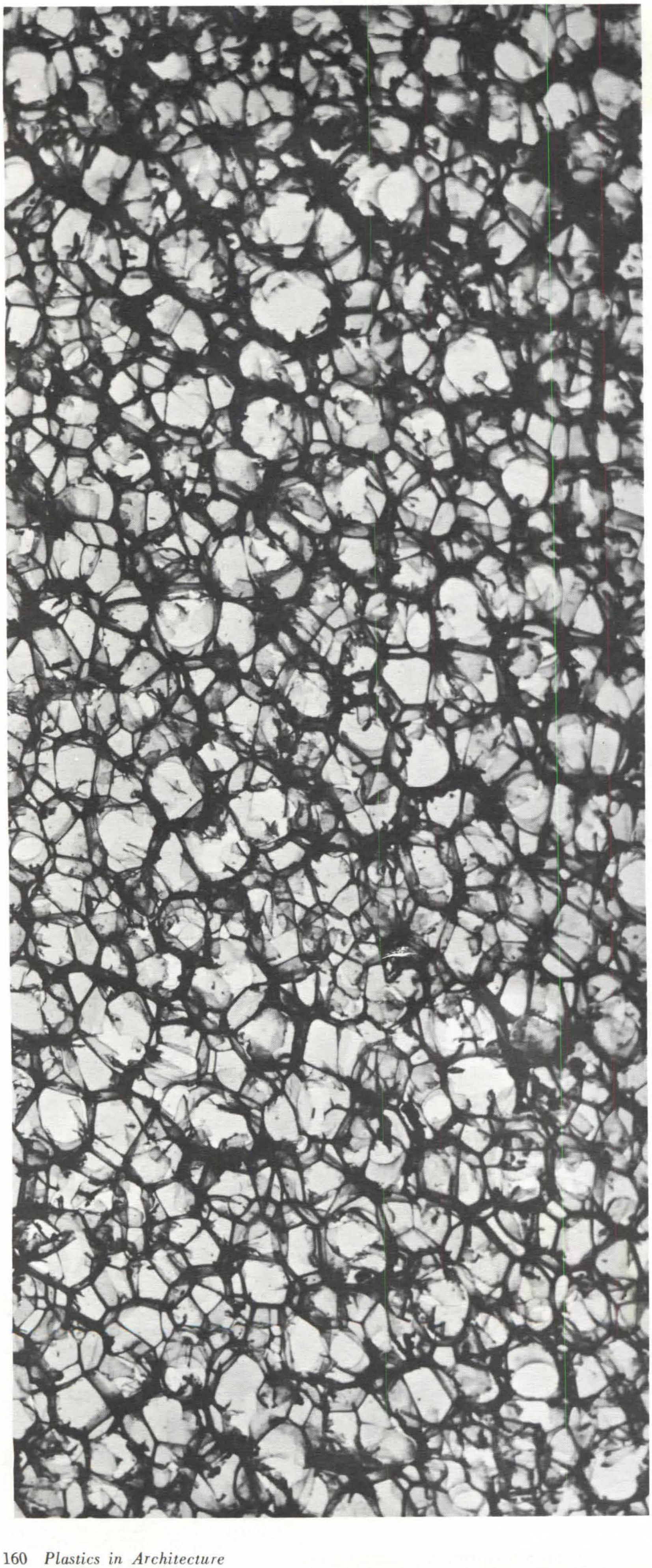
PVC piping is easily joined.

Miscellaneous Uses



Outside objects are easily distinguished through vinyl screening.

Plastic play sculpture does not rust or have sharp edges.



THE

BY R. N. KENNEDY

Although not all foamed plastics have a place in building, those that have—where their installation has proven beyond question to be satisfactory and economical—are now a part of widespread trends in mass-produced building. The following report, orienting the reader to performance expectations of these cellular plastics, is by the Head of the Expanded Plastics Section, Plastics Technical Service, The Dow Chemical Company.

Plastic foams in today's architecture are no longer speculative experimental materials, but are chosen for their utility in given applications. Cellular plastics have tended to enter the construction industry first as replacements for conventional materials. Extensive study of their potentialities has, however, resulted in new design and construction techniques based on the unique properties or novel handling possibilities of these foams.

Establishing wide acceptance for a material involves extensive research into its use and broad dissemination of the resulting information through education in the field. The job of education is made costly and complex by the fact that most architectural markets for rigid foams place them in direct competition with established "conventional" products — wood, glass, paper, and fibers. The user is asked to replace the known with the unknown and he is naturally reluctant to do so.

What Are Plastic Foams?

Foamed plastics are made from the same type of resins that give us solid plastics. Their difference is that in the manufacturing process air, or some other gas, is introduced so that gas-filled cells are distributed throughout the mass. The resulting low density, light weight, and foamed appearance of the cellular plastic readily distinguish it from other members of the plastic family.

Plastic foams can be hard or soft, rigid or flexible, depending on the polymer type and what is done to it. Some types are prefoamed and distributed to be used just as they are, or, as planks or boards, to be further fabricated. Other types are sold as liquids or solid particles which can then be "foamed-in-place," the cavity to be filled often serving as the mold. Some of the liquid types can be sprayed onto a surface.

UTILIZATION OF FOAMS

Expanded plastics may be classified in several ways: first, according to the nature of the basic plastic—that is, thermosetting or thermoplastic; second, according to their stiffness—rigid, flexible, or semi-rigid; third, according to their cellular structure—whether they have open interconnecting cells, or closed nonconnecting cells; and finally, whether they are pre-expanded or expanded in place.

For any specific plastic, the foam density, the rigidity, and the proportion of interconnected cells generally control the physical strength of the material. Thermal conductivity is a function of density and cell size. Water absorption and water-vapor transmission vary with the water susceptibility characteristics of the basic plastic and the proportion of open cells.

Foamed plastics have several properties in common. They are strong and light in weight. Types with closed cells are buoyant and water resistant. They are easy to cut and fabricate, are good thermal insulators, and have high resistance to attack by bacteria, rot, and fungus.

Obviously, the term "cellular plastics" is very broad. It can be applied to substances which appear almost like raw cotton, and to others which have a texture similar to a type of hardwood. An appreciation of the variety in the type, structure, and performance of plastic foams is a step toward understanding them, because the range is certain to become greater in the future.

Foams as Architectural Materials

The rigid foams, generally considered most suitable to architectural applications, are structural load carriers, thermal insulators, or both. In these applications, particularly in panels, a number of qualities are desirable:

Competitive cost
Structural strength
Thermal insulation
Fire resistance
Ease of fabrication
Durability
Light weight

The importance of each property depends very much on the application.

Most of the basic plastic materials have been produced in expanded form, but relatively few have created more than casual interest in the construction industry. Expanded and expandable rigid polystyrene and the rigid urethanes have gained the most extensive usage. Common expanded plastics and their limitations are listed *(Table I)*.

In some cases, the limitations listed only slow the advancement of a foamed plastic in construction; in others, these limitations may prohibit the use entirely. Cost is, of course, the most serious limitation. High cost may result from a costly base material, costly processing, or high density. It is the volume cost that is significant *(Table II)*. In many cases, experimentation has gone forward in an effort to lower density — thereby decreasing volume cost—without seriously affecting physical properties. In architecture, however, installation costs become an important cost factor, and many times plastic foams are favored over other materials for their ease and speed of installation.

Foams based on cellulose acetate, epoxy, phenol formaldehyde, silicone, and urea formaldehyde resins have all been available to the industry for a number of years, but have not found large markets because of deficiencies in properties or high cost relative to performance. The status of some of these may never change. Consid-

TABLE I
Rigid Cellular Plastics In Construction

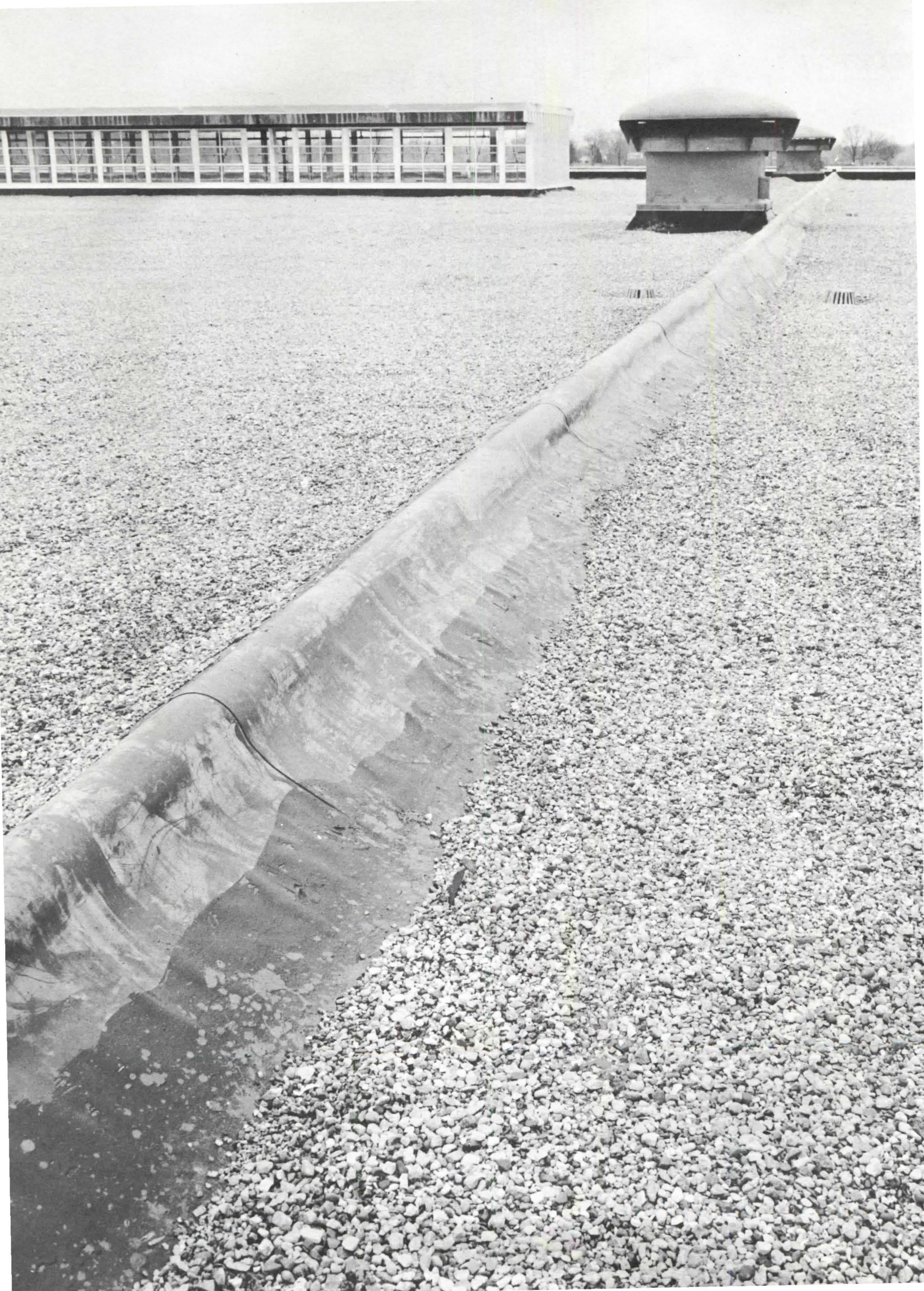
PLASTIC FOAM	FORM USED	MAJOR LIMITATIONS
Polystyrene	E, P	Heat, flammability
Urethane	E, P	Cost, flammability
Phenolic	E, P	Strength at low densities, water absorption
Polyethylene	P	Cost
Vinyl	P	Cost, high density
Epoxy	P	Cost, high density
Silicone	E, P	Cost
Cellulose acetate	E	Cost
Urea formaldehyde	E, P	Strength, effect of water

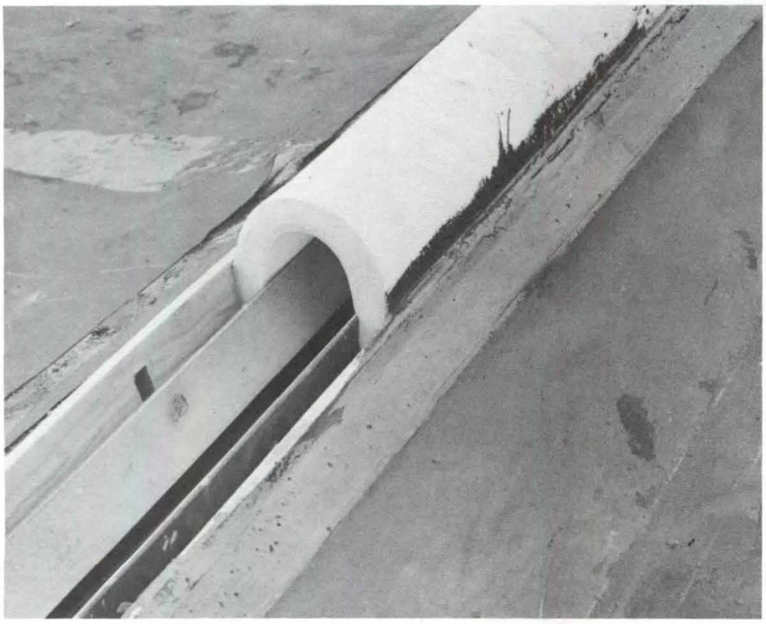
E = Expanded-in-place　　P = Pre-expanded

TABLE II
Comparative Costs

MATERIAL	COST	
	$/lb	*$/board-ft*
EXPANDED PLASTICS		
Polystyrenes	0.25 – 0.45	0.09*
Urethanes	0.55 – 1.25	0.16**
NONPLASTICS		
Insulation		
Fill type (fibers and granular)		0.02 – 0.05
Batts and blankets (fibers, organic and inorganic)		0.02 – 0.08
Boards (foamed glass, cork, fiber)		0.05 – 0.18
Structural Cores		
Paper honeycomb		0.05 – 0.15
Wood slats		0.03 – 0.08
Paper cylinders		0.02 – 0.05
Foamed glass		0.12 – 0.14

*Pre-expanded board, 1.5-2.0 lb/cu ft　　**Pre-expanded board, 2 lb/cu ft





1 *1" x 12" plank is bent into U, covered with plastic flashing* (acrosspage).
2 *Flexible polyethylene foam provides an insulating roof expansion joint.*

erable efforts are being made to overcome these limitations, however, and it is possible that with improved techniques of production, reduced costs, or improved properties, some will find a place in the major markets. Continuing research on these plastic foams and new foams may change the present picture decidedly.

The foamed phenolics were primarily investigated as wall insulating materials, both as board stock and as foam-in-place. Although low in cost, phenolic foam lacks strength at low densities. Because it has a high percentage of open cells, it does not have good water resistance. Higher-density phenolics have been used as core materials in specialized nonarchitectural sandwich-panel applications. Heated or restrained molds are not necessary for the phenolic foam-in-place operation; principal drawbacks are low strength and water absorption-transmission. Here, then, is a material that comes close to meeting the basic architectural requirements for wall insulation, but not quite close enough.

Semi-rigid foamed-polyethylene has entered into isolated architectural applications. Just beginning to gain acceptance, low-density (2 lb/cu ft) foamed polyethylene has demonstrated its suitability as a flexible insulating material to bridge the gap between moving sections of a large building — an excellent answer to the expansion-joint problem when used in conjunction with a plastic flashing 1, 2. A material that deforms under load, polyethylene foam has no structural applications, but it will be used to solve difficult gasketing, closure, and relative-movement problems.

Foamed vinyls have as yet seen little action in the construction field. Their characteristics, especially those of the closed-cell types, are similar to those of foamed polyethylenes. They are being specified to some extent for gasketing, weather stripping, and window glazing. Rigid vinyl can be used as insulation for specialized applications. Its high price, however, will prevent large volumes from moving into the insulation field.

The epoxy foams have been suggested for panel-core use, but at the present time the minimum density of epoxy foams commercially available (4.0 lb/cu ft, as compared with the 1.0 to 2.0 lb/cu ft densities now considered desirable) are a limiting factor in their utilization. Cost is, of course, high, laying on a second blow to this material.

The foamed silicones are generally designed for high temperature, with an upward limit of 600 F. Silicones that foam at room temperature have been suggested for thermal insulation, but nothing is offered for the normal construction field. Generally, foamed silicones are high in price because of their costly base materials and high densities.

Cellulose-acetate foam is high in cost, but has found restricted use where exceptional strength or thermal stability is important, and in applications where solvent resistance is required.

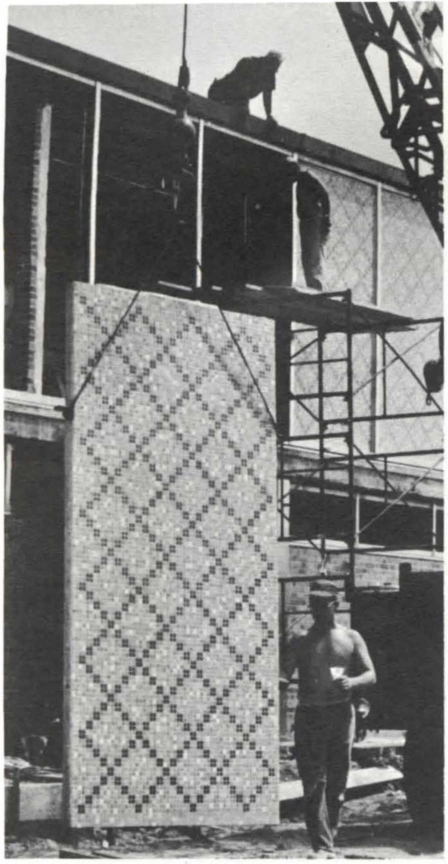
Urea-formaldehyde foam is low in cost, but has very low strength and poor water resistance. It has found some use in low-temperature insulation and as an acoustical material.

In the over-all analysis, foamed polystyrene leads all of the foamed plastics in architectural utilization. Of great promise for the future, however, are the urethanes.

Expanded and Expandable Polystyrene

Polystyrene is the leader among the rigid-plastic foams, because of its happy combination of properties. It is low in cost, readily available, easily fabricated, strong, durable, resistant, and an excellent insulator. Cellular polystyrene is produced by expanding polystyrene with a gaseous blowing agent. One type of polystyrene foam is extruded by special equipment in the form of planks and logs; the other type is molded from expandable beads.

These polystyrene foams are rigid, closed-cell foams capable of being produced in densities from 1 to 30 lb per cu ft. Low heat conductivity and resistance to water make them excellent low-temperature insulators. They have high strength-to-weight ratios and are good shock absorbers. While untreated poly-

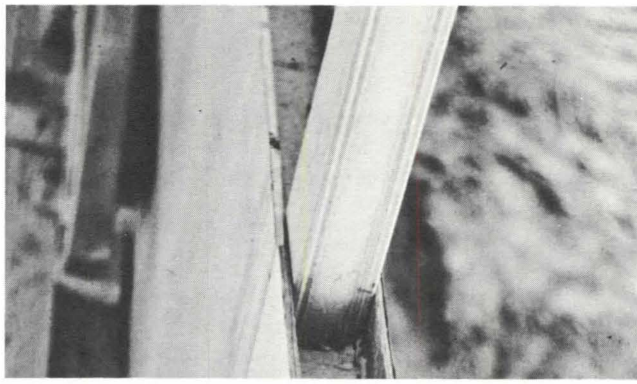


3 *Ceramic tile on polystyrene-core panels.*

styrene foam burns, it may be made self-extinguishing. It is easily cut with standard tools and easily bonded to other materials.

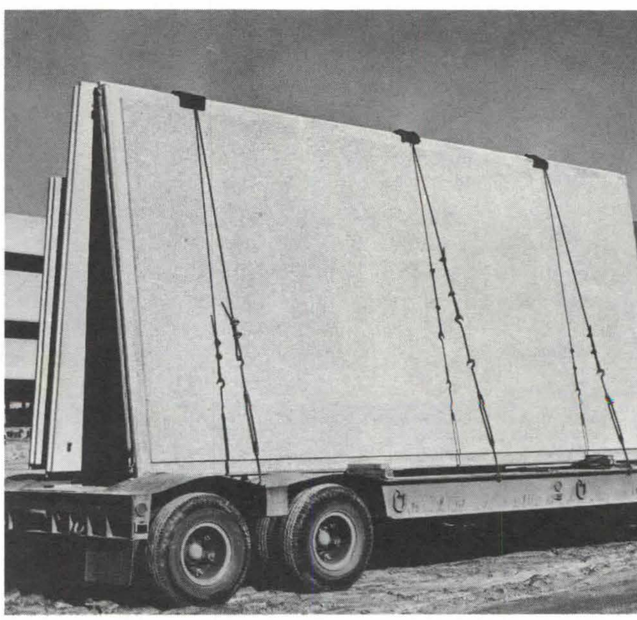
Polystyrene foam is low in cost, allowing it to compete favorably with non-plastic materials in many areas of application. The price range is from 85 cents per cu ft, for a board-type of material, to $1.50 per cu ft, for more complex molded shapes.

Extruded-expanded polystyrene opened the way for foam plastics in widespread building usage. Expanded polystyrene



4, 5 *Panels and splines of polystyrene foam and plywood.*

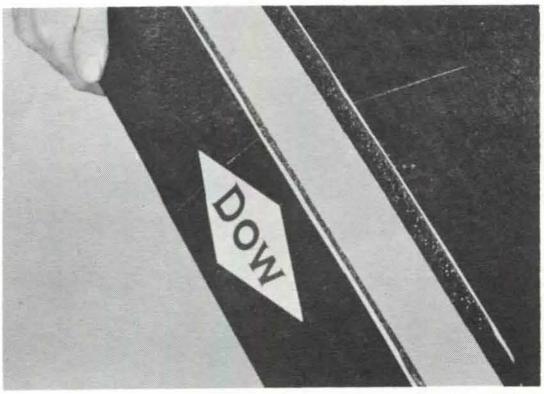
6 *Aluminum-faced panels with polystyrene-foam core.*



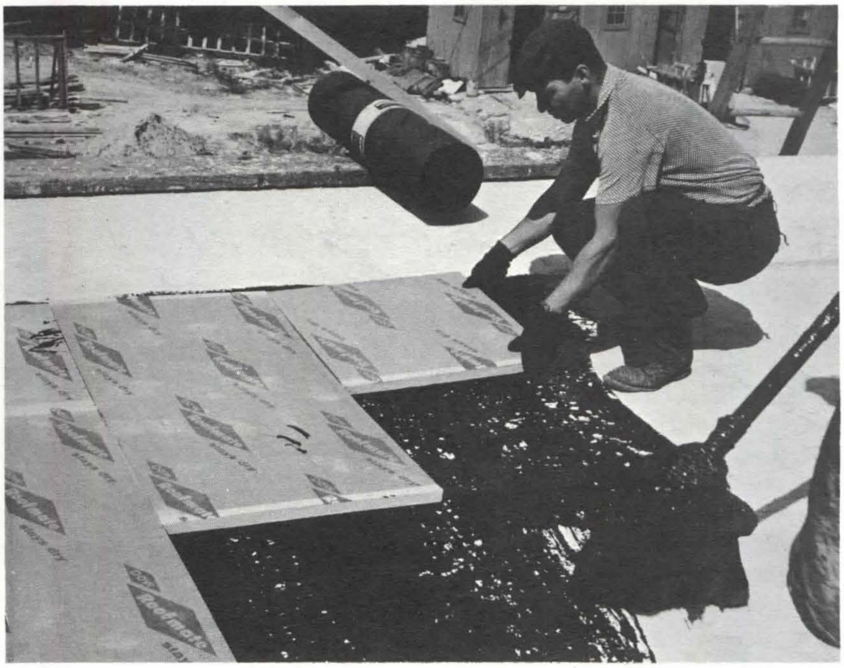
7 *Polystyrene foam and reinforced-concrete panels.*

board has received its most impressive reputation in the area of low-temperature insulation where it serves especially well. The most recent techniques in aluminum-skinned, polystyrene-foam prefab panels for quick-assembled cold rooms have proved this material excellent for cores.

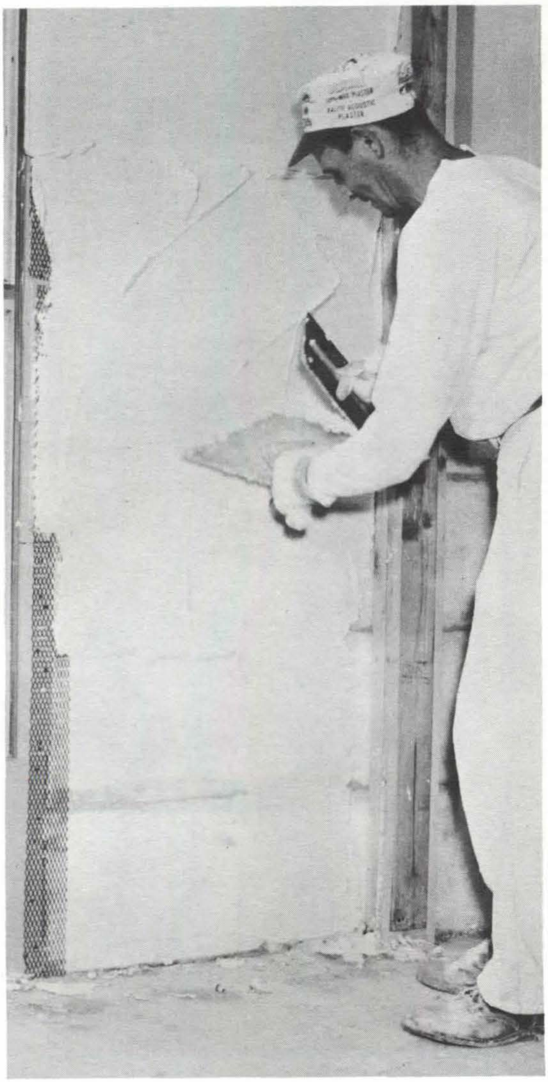
Early studies in plywood-polystyrene domestic building panels paralleled the cold-room panel development. Now there are many examples of expanded polysty-



8 *Polystyrene-foam perimeter insulation.*



9 *Polystyrene-foam roof insulation set in asphalt.*



10 *Polystyrene foam used as a plaster base.*

TABLE III

Properties of Polystyrene and Urethane Foams

	POLYSTYRENE	URETHANE
Density, lb/cu ft	1 – 4	1.8 – 4
Compressive strength*	15 – 40	35 – 50
Shear strength*	25 – 35	28
Modulus of rigidity*	600 – 1500	300 – 600
Flexural strength*	40 – 60	40 – 60
Thermal conductivity, K, Btu-in./hr/sq ft/degree F at 70 F mean temperature	.22 – .30	.14 – .24
Water vapor transmission, perm-in.	1 – 3	1 – 3
Water-absorption, lb/sq/ft of surface area	< 0.15	< 0.15
Heat distortion temperature, degrees F	160 – 185	250 – 300
Burning characteristics	*May be made self-extinguishing*	

*lb/sq in. @ 2 lb/cu ft density

rene-core panels well-suited to various architectural applications 3 to 7. Polystyrene foam board has been worked into a number of completely new construction ideas. In special forms, as perimeter insulation and roof insulation, and as board stock itself in some situations, polystyrene foam has brought building insulation to a new level of practical installation 8 to 10.

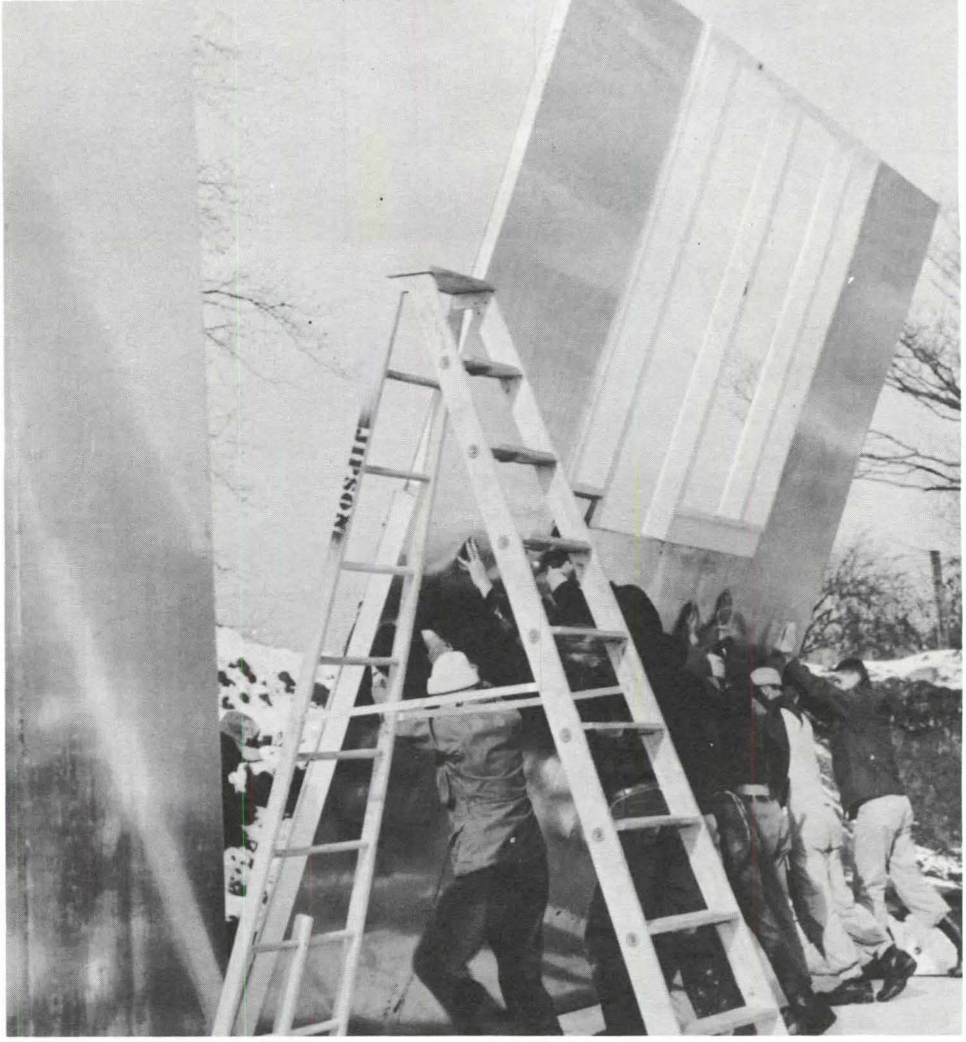
The reasons for this success lie in the particular properties of expanded polystyrene *(Table III)*. The combination of structural strength, insulation, and low vapor transmission, and the possibility of keying-in plaster or concrete have also brought expanded polystyrene board into important application in the thin-shell concept for roofs and walls.

Expandable polystyrene has also entered into the picture. With some restrictions, the beads or prefoamed pellets can be foamed in place. The expand-in-place polystyrene consists of small polystyrene beads containing a solvent-type blowing agent. Heat softens the plastic and volatilizes the solvent, inflating the beads to many times their original diameter. When placed in a mold between skins and heated, the beads knit together during expansion to form a polystyrene foam filling the space between the skins. The foam differs from the pre-expanded type in that the beads can be molded, within a range of densities, into a wide variety of shapes and sizes, without waste. Properties of the two types of foamed polystyrene are quite similar. Sandwich-type prefab panels are now being made with expandable polystyrene and suitable skins on a production basis 11.

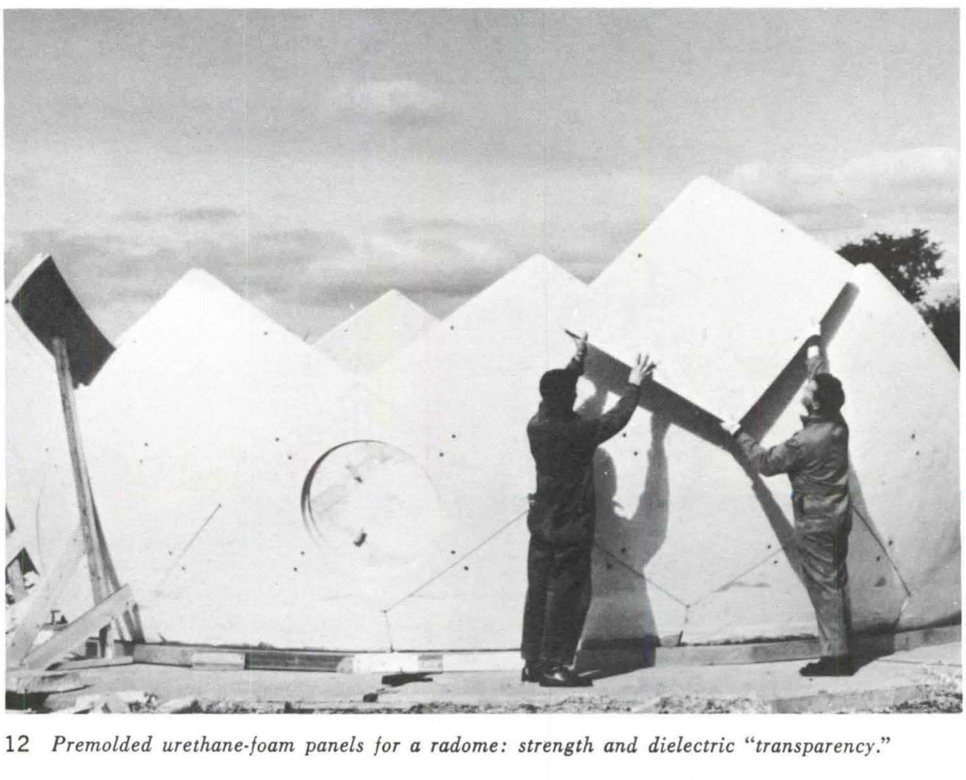
Bead-board stock is available and has taken up some of the insulation market of expanded polystyrene board.

Foamed Urethanes

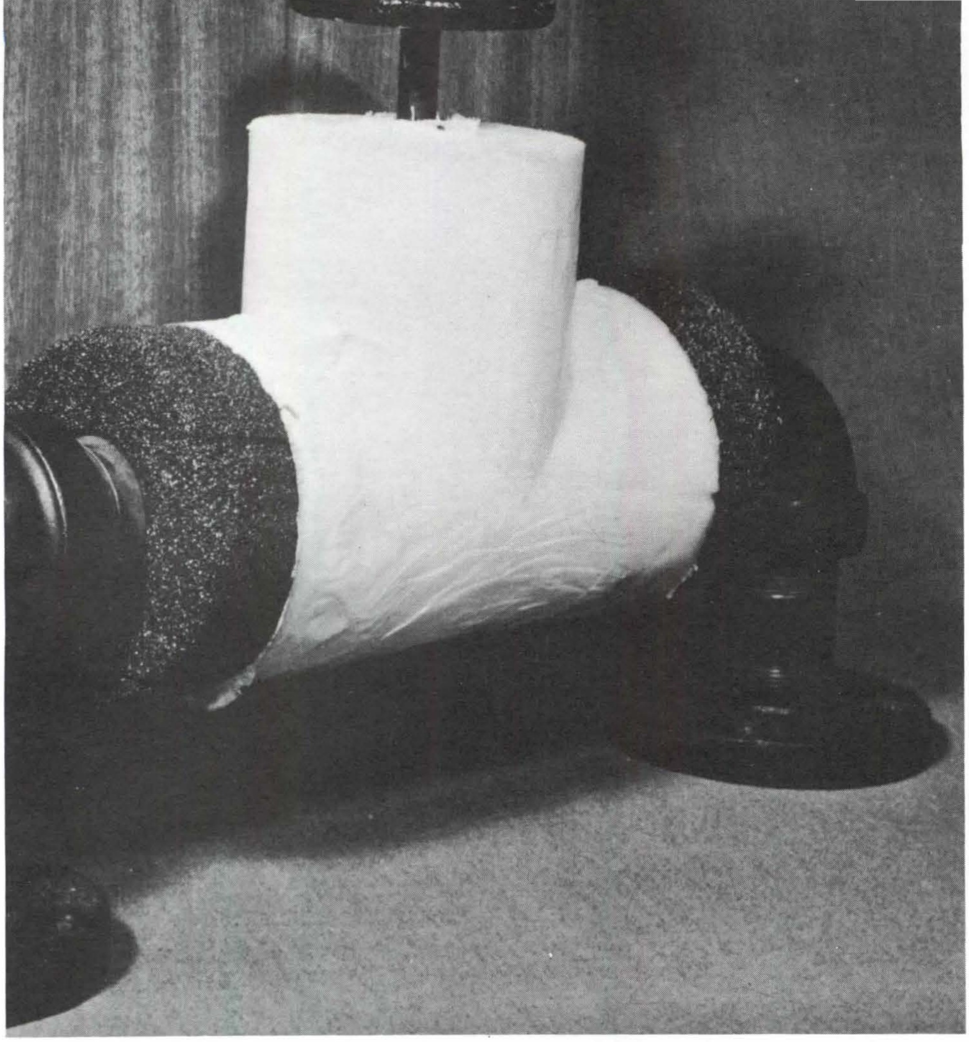
The field of foamed plastics has several important and promising newcomers such as the foamed urethanes. The extensive possibilities of the urethanes rest in the fact that they are a vast group of chemical materials linked together in name by the urethane chemical bond. By utilizing the wide variety of polyols (many not even tried) the increasing variety of multiple diisocyanate cross-linking agents, and the potentialities of known foaming tech-



11 *Panels for research house: expandable polystyrene and plywood coated with aluminum foil.*



12 *Premolded urethane-foam panels for a radome: strength and dielectric "transparency."*



13 *Expandable urethane sprayed in place as valve insulation.*

niques, tailor-made urethanes can eventually be developed to meet the needs of the building industry. It should be emphasized that the rigid foamed urethanes are not just one material, but a wide variety of separate, distinct, and promising plastics.

Urethane foams are made by the reaction of diisocyanates with polyols, such as polyesters and polyethers. When water is present during the reaction, carbon dioxide gas is released causing foaming. Expansion also may be achieved by a low-boiling-point solvent, such as a fluorinated hydrocarbon. The heat of the reaction causes the solvent to vaporize, expanding the semi-polymerized plastic. This gas remains permanently in the closed cells, producing a foam with low "K" factor *(Table III)*. Proportioning and proper selection of the reactants can control the rigidity of the foam. One of the problems in the production of urethane foams is that the isocyanates are toxic and must be handled with care in well-ventilated areas. Finished foamed products are nontoxic.

Urethane foams can be produced by either a "one-shot process," or by a process in which the reaction is carried only far enough to produce a diisocyanate adduct "semi-prepolymer." In this latter process, the final reaction is easier to handle and less toxic. It takes place by the addition of more diisocyanate and curing agents. There are advantages and disadvantages to each of these processes. The one-shot process is more satisfactory where high-volume production in a fixed location is desired. The semi-prepolymer system is more suitable to a small operation and more adaptable to field conditions. Most early development work was based on the flexible type of urethane foams. Only recently has much more attention been applied to the rigid materials. Now, large-volume sections may be molded in relatively simple molds with the foam ingredients being processed through conventional pumping and metering equipment into a low-cost mixing or homogenizing head 12. Techniques have also been developed for applying rigid foams with specialized spraying equipment.

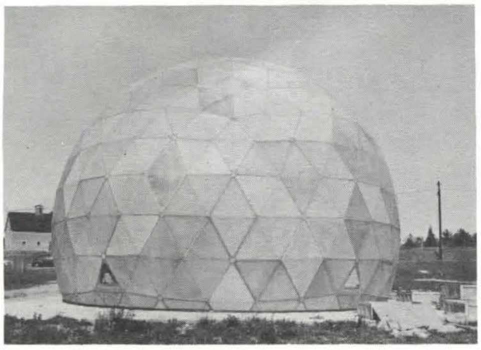
Rigid urethane foams are excellent thermal insulators because of their "K" factor, which is ½ to ⅔ that of expanded polystyrene material, and ⅓ to ¼ that of glass-fiber mat. They are made in densities from 1½ to 30 lb per cu ft. Rigid urethanes have good structural strength, are resistant to water, have high heat-resistance (250 F), and may be foamed-in-place. The foam will adhere readily to the sides of a cavity, becoming its own adhesive for many applications in the sandwich-construction field. It can be made self-extinguishing.

Flexible urethane foams in densities from 2 to 10 lb per cu ft have an interesting range of acoustical properties and are being investigated for that use.

Rigid urethanes will compete with polystyrene foam in the many fields of low-temperature insulation. In domestic refrigerators, for example, the amount of insulation may be reduced because of the low "K" factor. This increases the internal volume of the refrigerator without increasing its outside dimensions. A similar reduction in thickness of insulation can be realized in building construction. The possibility of spraying makes it attractive as insulation in some difficult architectural applications 13.

The Future In Foams

Plastic foams have definitely established themselves in architecture, but their acknowledged success has been hardly more than an initial entry. The rigid foams have a long way to go before the present latent demand for them is realized. Low-cost polystyrene foams will remain very important in the areas of perimeter insulation, low-temperature insulation, nonstructural wall and roof insulations, and as plaster bases. There is a strong possibility that the urethanes will take over the prefab-panel applications and other structural installations, mainly because of their foam-in-place and self-adhesive characteristics. The foam-in-place advantage will also lead to innumerable new applications of urethanes as insulation materials for new and old construction. Plastic foams will offer wide utility in architecture; the urethanes and polystyrenes are particularly suitable for the applications of both today and of the future.



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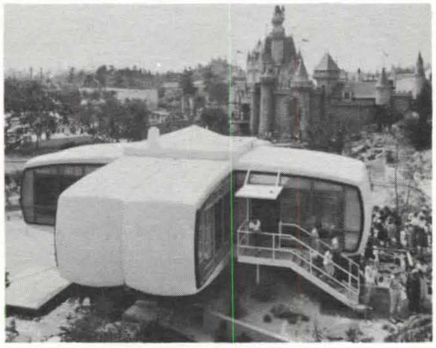

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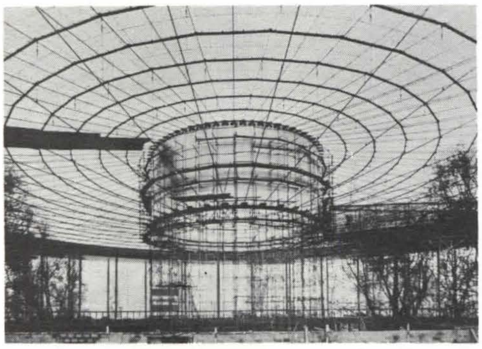

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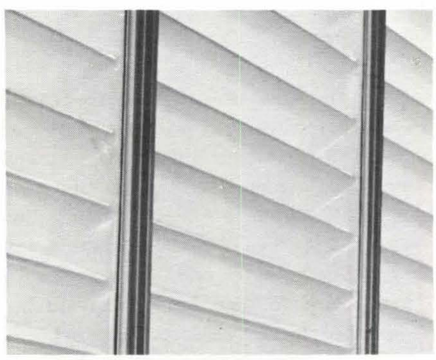
Structural uses of plastics: 1 *radome built of glass-fiber-reinforced plastic;* 2 *Monsanto House at Disneyland in California;* 3 *canopy structure at the recent United States exposition at Moscow;* 4 *United States Pavilion at the Brussels Fair;* 5 *and* 6 *plastic curtain-wall panels and window glazing in conventional buildings;* 7 *foamed plastics used in a radome;* 8 *polystyrene foam board which becomes integral part of reinforced-concrete structure.*



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STRUCTURAL CONSIDERATIONS

BY FREDERICK J. McGARRY

The use of plastics in construction merely as replacements for metal, wood, concrete, or glass is, of course, not sound. In this article the author discusses appropriate structural uses for plastics and design considerations involved in using them successfully. Examples shown (acrosspage)—*many of which are already visually familiar to the reader—illustrate topics discussed in this article. Other instances of plastics performing structural functions are found on succeeding pages.*

A team member for research on several internationally-heralded projects in plastics construction, the author is Assistant Professor of Materials, and Assistant Director of Plastics Research Laboratory, Massachusetts Institute of Technology.

As the plastics industry continues its startling growth and our need for structures of all types similarly increases, a veritable din of comment from countless sources relates the two fields. Plastics will solve the housing crisis, the school crisis, the transportation crisis, the urban blight; curiously, no one has yet pointed out the remedial capability of plastics with respect to our divorce rate, though such may soon occur. But, their critics reply, they burn and break, they creep and fall apart outdoors, their colors are garish, and you can't tell one plastic from another—until it's too late. Somewhere between the evangelical fervor of the opportunist and the total rejection of the pessimist the truth can be found, and a modest effort in that direction is attempted in this report. My reasons are admittedly selfish: my own professional interests encompass both plastics and building, and I wish to see them mutually prosper.

Are plastics really structural materials? The answer to this simple question is apparently evasive: practically all of them are, in one sense, though few are yet, in another.

Let us start with the extremes—the next time you see a new jet aircraft speed through the sky or read of the latest missile launching from Cape Canaveral, realize that neither of these devices could so perform without plastics as primary structural components in their design. Large and critical sections of the jet are held together with plastic glues quite similar to those found in waterproof plywood or in auto body repair kits; these include the control surfaces of the wings and parts of the tail assembly. Its nose, practically all of the interior bulkheads, floors, panels, and seat assemblies are even more completely plastics-based. Without the combined advantages of light weight, strength, stiffness, vibration resistance, formability, and smoothness of joint detail—which plastics alone exhibit, the aircraft simply would not function as it does.

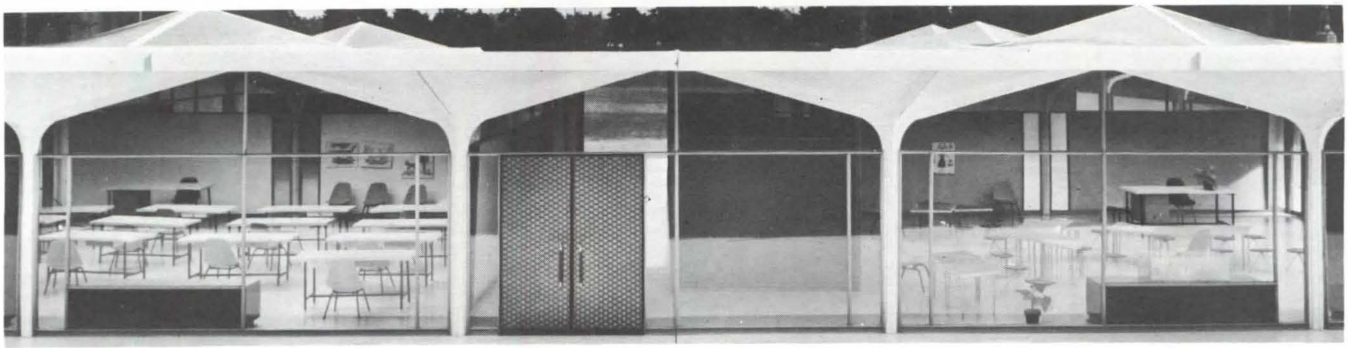
The same is true of most missiles; not only are many important areas glued together, but the most critical region, the nose cone, is composed exclusively of plastics, reinforced with glass or other ceramic fibers. The same properties, plus low thermal conductivity, absence of melting, and high thermal energy input requirement for sublimation (from the solid to gaseous states) make plastics the uniquely suitable binders to use. But, the rebuttal goes, the glass fibers do all the work and sustain all the loads. This is true, except for the fact that such fibers would be useless unless positioned, protected, and stabilized by the surrounding plastic; have you ever seen a glass-fiber curtain in a breeze?

Now think of polystyrene, the tinny-sounding plastic which was so common in toys until a few years ago, when the public finally refused to buy any more. It was certainly not a structural material, by any stretch of the imagination. At present, however, the largest single market for styrene, some 180 million lbs per year, is a really structural application—refrigerator door liners. The outer surface of the door is a thin, stamped-steel sheet with little rigidity or stability, until connected to its thicker and more precise plastic mate to complete the door assembly. The plastic straightens and stabilizes the steel and supports food contents on the shelves; the stresses so created are substantial. It is used because of its light weight, resistance to chipping, staining, and moisture, low thermal conductivity, ease of high-speed-forming into the complex shapes demanded by shelf design, and permanence of coloration. In the not-too-distant future, the entire box may be constructed of plastic-sheet material. So even styrene, when properly formulated and used, has impressive load-carrying ability; fibers or other high-strength reinforcements are not needed to make the material work effectively.

When the architect employs the term "structural," however, he usually envisions a material or member directly supporting the live and dead loads in a large immobile structure, most often a building. Can plastics do this? At present a few of them can, if one is willing to pay the price. Frequently, construction with plastics is the only way to fulfill some shelter function, the cost then being secondary. Unless the latter is true, however, the use of plastics merely as replacements for metal, wood, concrete, or glass just doesn't make sense; they are too expensive and probably always will be. This fact is really the crux of the whole question, so let us examine it more fully.

One familiar use is in the ground radome used to protect radar installations from the weather 1. A number of these, essentially identical in design, serve in remote geographical locations where transportation is limited. They need to be light and modular in design, the latter for economy of production and erection. They have to be weathertight and nonabsorbent to avoid electrical troubles; it is not critical that they be incombustible, since their contents are not hazardous in this respect and human occupancy of the shelter is limited. Either formed-plastic or stamped-metal panels would meet these requirements; but there is one additional factor: the structure must be transparent to electromagnetic radiation—the radar waves which are generated, transmitted, and received by the apparatus within. Metal reflects such waves almost completely, while glass-fiber-reinforced polyesters or epoxies pass them like a window. Thus, the radomes must be built of plastics to fulfill their function.

On a less specialized level, consider dwelling house construction. Quite aside from its esthetic and functional aspects, which many have questioned, the Monsanto House constitutes a strong statement



These doubly-curved shells utilize plastic-sandwich roof panels as minimum structural materials where it can best fill task (above). *Reinforced-polyester materials used in translucent-sandwich wall panels of this church were formulated for color stability* (acrosspage).

that glass-fiber-reinforced plastics can be used for primary structural members 2. Although it has conveyed this message explicitly to the millions who have seen it, the same structure could have been executed as effectively with metal or perhaps even wood, in combination with other materials. The light-control possibilities of the translucent plastic were destroyed by external painting; its low thermal conductivity negated by the large areas of sheet glass; none of its unique electrical properties were utilized; its low density was offset by the size of the components chosen, which necessitated a mobile crane for handling and placement; the chemical and moisture resistance of the plastic were not of primary functional value; its stiffness (about the same as that of wood), rather than its superior strength, was permitted to control the structural design; and the formability of the material was not very fully exploited. Thus the project represents essentially a tour de force, as its location suggests, but an interesting and provocative one to analyze.

By way of contrast, consider the umbrella-like design used at the recent exposition in Moscow 3. Intentionally propagandistic, it boldly asserts the architectural and engineering sophistication of our society within the context of a temporary and functional shelter whose cost, for a variety of reasons, had to be limited. A short lead time necessitated simple and rapid tooling—readily possible with reinforced plastics. The long delivery distance and the unknown qualities of Russian labor called for a simple, lightweight, modular structure to be speedily erected with a minimum of equipment. Strength, rather than stiffness, largely controlled the design. At only a few critical points was additional, more expensive, reinforcement needed, since the formability of the material made shell action possible with an astonishingly thin skin. Control over both daylight and artificial light was achieved through the inherent translucency of the material. Its combustibility was retarded and inhibited by the inclusion of chlorine compounds; this was known to promote ultraviolet degradation and color changes, but the design statement required it to last only a few weeks and no visible effects would occur in such a brief interval. Our Russian hosts have changed this factor and the structures remain standing, exposed to weathering and snow loads for which they were never intended; but as the problem was originally defined, the execution of it with reinforced plastics was nearly ideal.

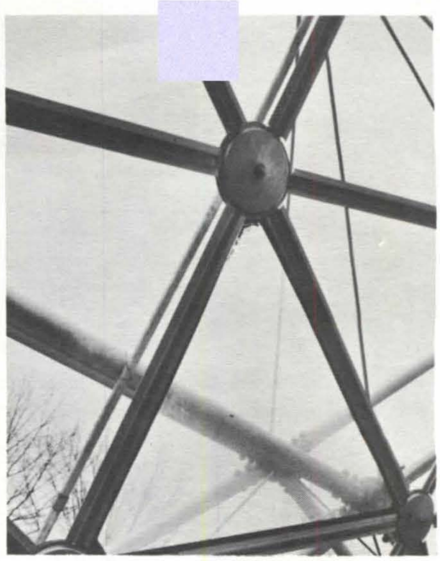
Many of the preceding comments can be applied to the Brussels pavilion 4 with equal validity, though with less rigor, since the primary structural elements there were steel—the plastics functioning only as skins to keep out wind and weather. Prefabricated, lightweight, strong and rigid where necessary, easily transported by air and installed at the site, transparent or translucent, and color-stable for the interval involved, the skins permitted the architect to achieve an economical shelter outstanding for simplicity, novelty, and delicacy despite its large size.

The same type of panel has found growing acceptance in conventional buildings 5. Here again it serves primarily as a skin, in this case in a curtain wall; its higher cost, compared to traditional materials, is offset by the thermal, visual, and weight advantages which it offers. It should be mentioned that the reinforced-polyester materials used in this sandwich panel were carefully formulated for color stability, and from the earliest installations to the present time have performed satisfactorily in this respect.

Single, thin sheets (in color and with or without formed facing) of unreinforced acrylic, which is also notably stable for outdoor exposure, are being used as spandrel panels. For windows, the same plastic, can be formed into a saw-toothed profile, to effect light control inside the building 6. Colorful, self-cleaning by rain action, lightweight, shatter-resistant, economical to stiffen by simple shaping methods, thermally effective, the material offers many attributes which are simultaneously exploited in these applications, though primary structural loads are not sustained.

Now we can become a bit more precise in our understanding of structural plastics for buildings. Within a narrow definition of the term, the glass-fiber-reinforced polyesters and expoxies are truly structural and represent a kind of high-strength wood, in their stiffness characteristics. They are so expensive compared to conventional materials, however, that it is merely submitting to a vogue to use them solely for their structural properties.

When other properties are significant, however, such as low density, formability for additional stiffness, economics of formability in large numbers by machine methods, low thermal conductivity, chemical and moisture resistance, and perhaps electrical properties, their selection for structural functions may become defensible if not mandatory. When light control is desired, it too is available, though outdoor life before resurfacing is shortened; transparent and translucent glass-fiber-reinforced plastics must be restored oftener than opaque ones, to keep their glossy surfaces intact. Don't think that sandwich panels with reinforced skins and a low-density core are the cheap answer, especially if curved rather than flat; they look beguiling on paper but are incredibly expensive to fabricate, as any aircraft builder will readily confirm. Even flat panels demand a level of engineering which only a few fabricators have yet



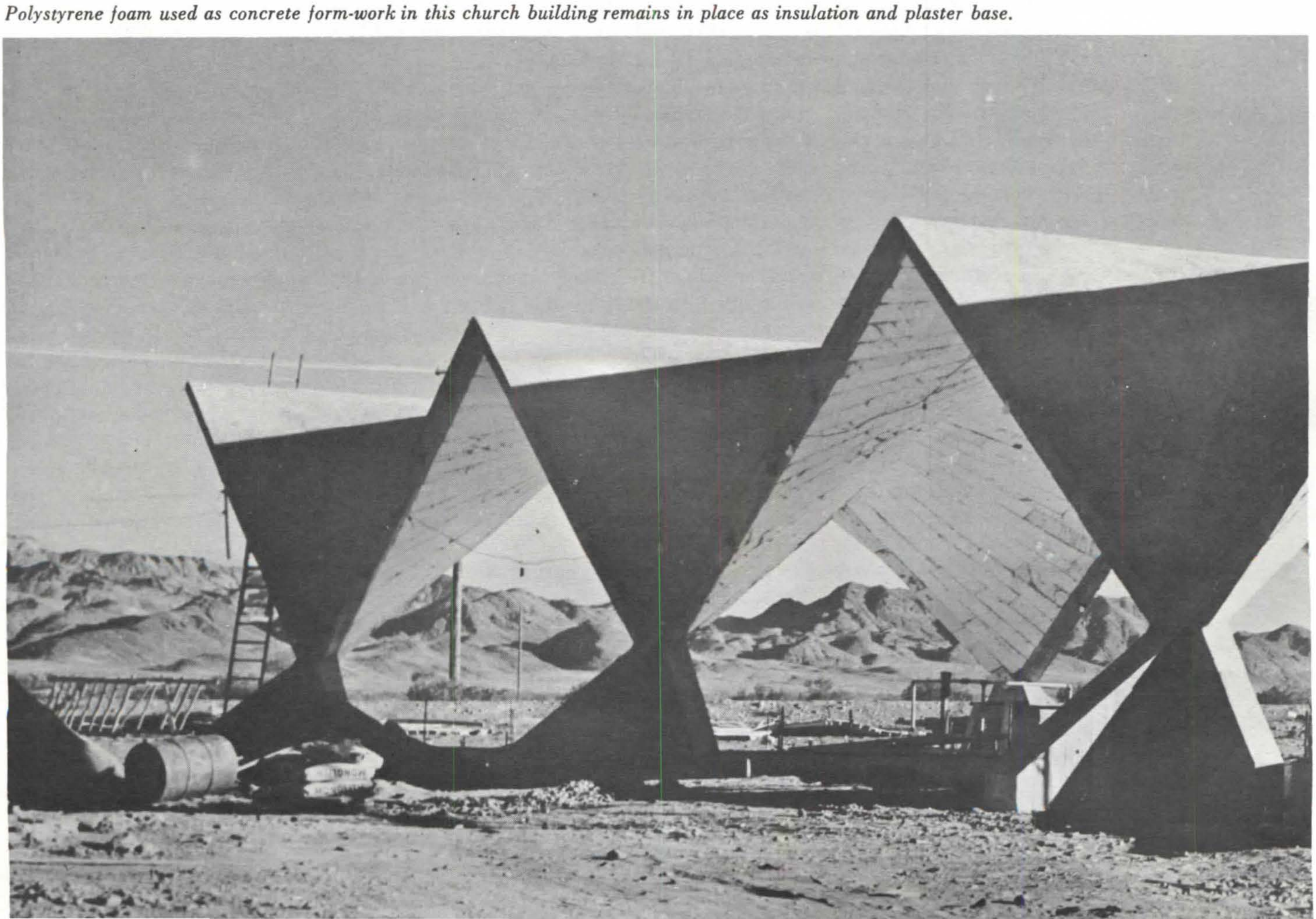
Weather surface of botanical garden dome consists of aluminum geodesic framing with triangular acrylic panels held in place by extruded neoprene gaskets.

achieved, within practical cost limitations.

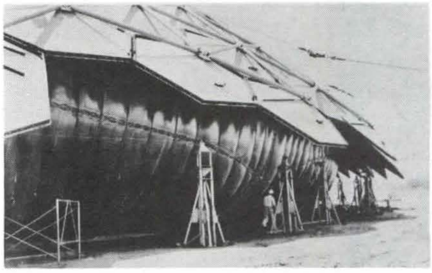
If the plastics engineer's idea of "structural" is accepted, the picture broadens greatly. To him, a plastic is structural if it will support its own weight while performing some specified function. This isn't quite as ridiculous as it sounds at first: innumerable plastic components of automobiles, home appliances, recreational articles (including boats), and building products do just that, in a fashion which no other materials can match. When he takes pride in the performance of his foamed styrene in a plywood-faced sandwich panel, such as recently used in the NAHB house in South Bend, he is not merely being naïve; this one amazing material provides stabilization against skin buckling, flexural stiffening, and thermal insulation, and acts as a moisture vapor barrier. As codes ease, materials improve, and processes and equipment develop, this is the way our houses will be built.

Before one concludes that plastics foams always need some structural crutch, such as plywood, consider a new type of foam radome being erected 7. When the technique is fully developed, this structure, 68 ft in diameter and 4½ in. thick, will be delivered to the site as a few drums of liquid plastic with a mixing and dispensing machine. But what good is a foam dome, except for housing a radar set in

Polystyrene foam used as concrete form-work in this church building remains in place as insulation and plaster base.



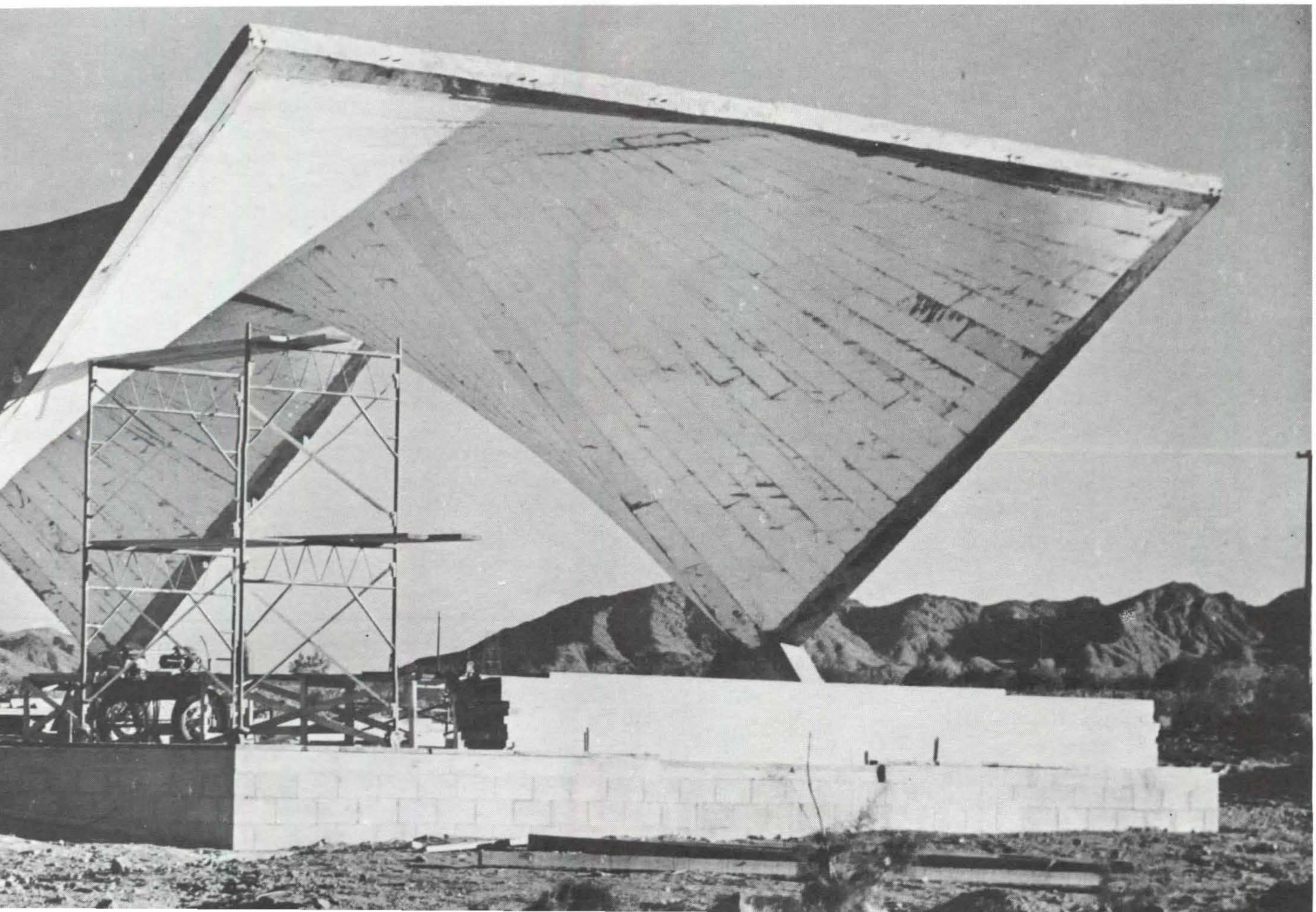
Structural use of plastics in construction of geodesic dome. Dome was supported by air pressure, using nylon pneumatic lifting diaphragm. As each succeeding row of hexagonal steel panels was welded on, pressure was increased to raise dome. At one point pressure of only 1.45 oz. per sq. in. supported nearly 560 tons.



some remote outpost?

The idea can be extended and varied 8. Here, preformed polystyrene foam plank, two in. thick, is sandwiched between wire mesh just adequate to support the planks with the live load of a workman dispensing pressurized concrete from a hose. When the outer mesh-reinforced concrete shell has been built up to the necessary thickness for the particular span, the inner surface can be covered with reinforced concrete or plaster in the same fashion. The foam plank is a light, cheap, low-labor-cost form board which serves permanently as thermal insulation and as a vapor barrier. Considering the present vogue of thin-shell construction, the ramifications of this development are arresting and significant, offering unusual design freedom to the architect wishing to work in the medium.

A greater tonnage of plastics than aluminum was produced last year. More than 20 percent of it was consumed by the building market, though very little of this amount was structural, by the architects' standard. The architects and plastics engineers should recognize that the same word—structural—has different connotations to the two groups; if they can communicate with each other responsibly, both can continue to profit from shared experience and effort.



RESIDENTIAL RESEARCH

BY LEE FRANKL

Several years ago, this author—a designer and independent researcher—established a laboratory on Cape Cod to study methods of producing house components that are particularly appropriate for the use of plastics. As a result of his research, he designed and erected his own home in Dennis, Mass., the construction phase of which is presented here. In addition, the author presents details of future projects that are based on his experience with plastics components.

Frankl's background in the housing field includes, in addition to the design and construction of several framing systems, three textbooks on modular coordination based on the work of Small Homes Council at University of Illinois; a project which comprised the writing and illustrating of NAHB Trade Secrets Reports; *a later book was the field erection manual used by National Homes.*

Before designing the house illustrated in this article (*following pages*), the author had developed a modular milled-member framing system and had built three houses based on variations of this method 1. With a puritanical approach to the use of horizontal and vertical grid lines, it was usually necessary to cut exterior materials to dimensions such as 3'-11" x 7'-10" and 3'-11⅛" x 7'-10⅜", with corresponding interior skins cut to 3'-9⅜" x 7'-9¹⁄₁₆" and 3'-10⅜" x 7'-9¼" These odd dimensions led to a serious look at plastics as a means of forming odd-sized panels to fit a modular system.

Modular assembly should mean a greater use of modular components. A structural system, however, may depend on the use of lumber having 1⅝", 2⅝", or 3⅝" widths. These members are milled to receive panels. When a 4' center-to-center grid system is used, panels of varying dimensions are required for the wall assembly. Panel components with plastic-foam cores and skins that could be relatively easily manufactured were considered an effective means of accommodating these odd dimensions.

A decision to use Dylite cores, for the first plastic-panel house, was reached. (Dylite is Koppers' trade name for polystyrene foam; Styrofoam is the trade name used by Dow, and Unicrest by United Cork.) Before this house could be designed, however, it was necessary to determine the characteristics of the foam-core panels; i.e., their thickness, allowable spans, types of skin, glue lines, etc. Accordingly, a test program was established and carried out with a university research group. Early tests of roof panels—made of polystyrene planks laminated to plywood skins with resorcinal adhesives—indicated that 2' x 8' panels with 3" cores could span a maximum of 8'. It was quickly realized that this span would be insufficient to meet a desired eave-to-roof span of 10'.

Recalling earlier panel experiments using cardboard tubes as cores, several attempts were made to study the feasibility of substituting polystyrene-foam tubes as the cores. Several panels were made using tubes in various ways: the whole tube 2, whole tubes plus half tubes above and below 3, and various systems of corrugated cores 4. Epoxy adhesives were used to weld the tubes to each other and to the skins. Each of these experimental panels, when load tested, proved to be superior to solid-foam cores in resistance to deflection.

Another experiment involved splitting a single 8' tube and wrapping one of the halves with 3"-wide gummed paper. Each of these sections was center-loaded with 10 lbs. Deflection of the paper-wrapped tube was only one-half that of its unwrapped mate. Panels made of the polystyrene tubes wrapped with aluminum foil—similar to that used in cigarette packaging—provided equal strength with the added advantage of a vapor barrier.

A discussion of these results with a research engineer, familiar with this field, led to slicing a foam plank vertically, through its depth, and placing 60-lb Kraft-paper rafters between the strips of foam 5. When laminated with resorcinal adhesives, the resultant panel proved to be excellent in resistance to bending. Since the extruded-polystyrene tubes used in the previous experiments could not be made available when we finally got into construction, the Kraft-paper/foam-type panels were selected to span the 10' distance from ridge to eave. Actual roof panels used in the house were 3'-4" x 14'-0" in size, made with plywood exterior skins and Upson board on the opposite faces of the cores.

As the photo of the workshop suggests, (*overpage*) this was really a "behind-the-barn" manufacturing process due to the lack of controls and an inadequate set-up for presses and jigs. Accordingly, interior skins were not laminated to the exterior wall panels, although interior-partition panels received finish skins on both surfaces. The partition panels were rabbeted to fit plates anchored to floor and ceiling as well as panel-locking channels at all vertical joints. The single floor is 1½" edge-grained oak Doweloc in 12" planks that span the 24' width of the house.

The milled members and panels for each exterior wall were assembled on the floor deck. Four men assembled and tipped up each wall in one hour. The 22 roof panels were placed and fastened in four hours. Asphalt shingles were then applied to the roof and ¼" cherry-plywood skins to the inside face of the exterior walls.

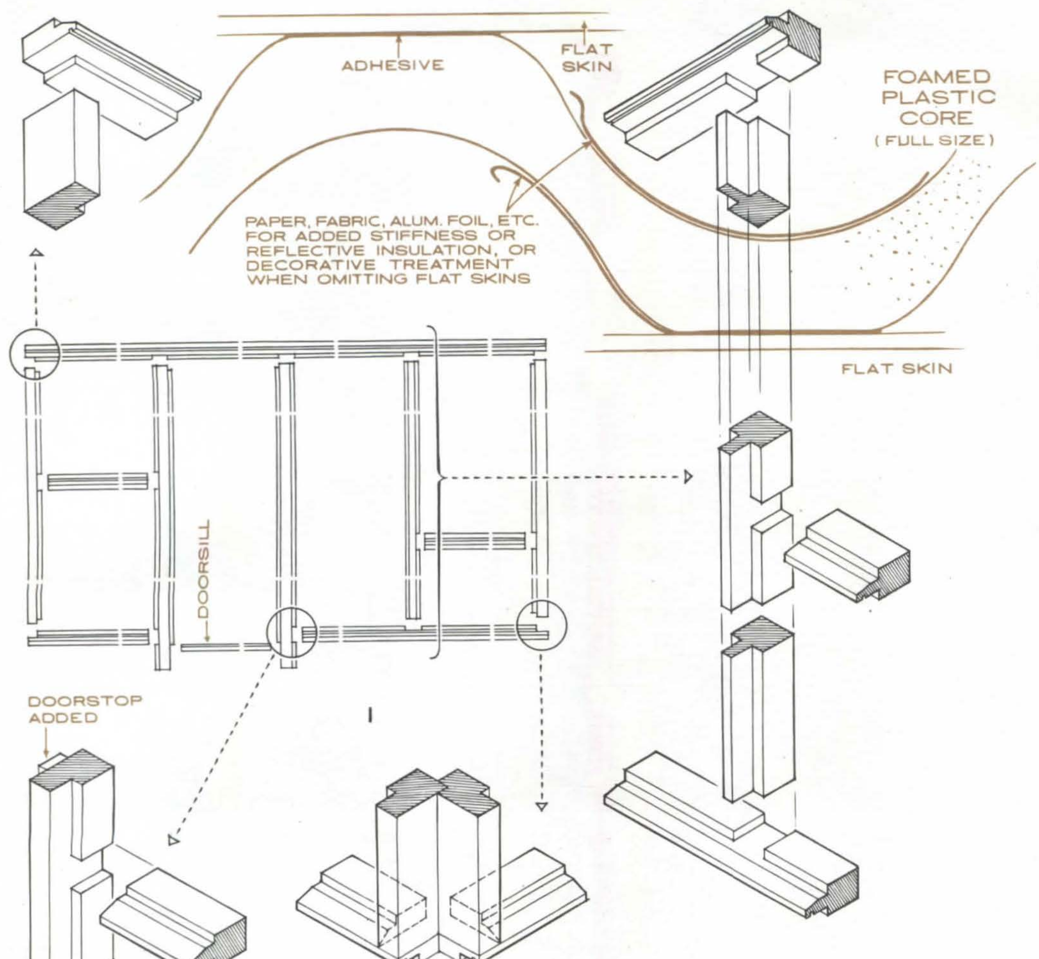
The fixed windows are insulating: two sheets of glass were placed in an extruded-neoprene surround, then set into the milled opening and secured by a back-band. Exterior and interior doors have polystyrene-foam cores which inhibit the passage of moisture and minimize warpage. (The house is generally dry and mildew-proof, because of the high quality of the foam cores.) French doors are made up of two sheets of acrylic, with embedments, set into a 2" x 4" rabbeted frame. To take care of expansion and contraction, the acrylic was set against neoprene tubing. Heating is electric baseboard, made economically feasible by the excellent insulating property of the foam.

Critical Evaluations

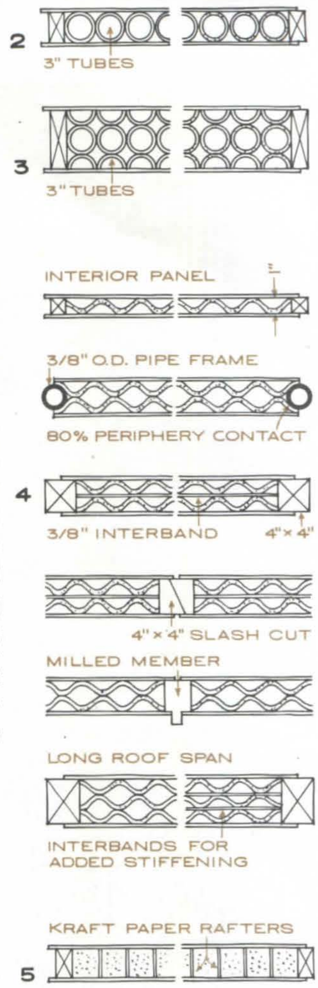
In an evaluation of this method of construction, many details are still being appraised. Essentially, the system has great merit, since foam cores make a one-quality house possible. Cost differences are related entirely to costs of skins and the basic structure remains the same—a quality product superior to conventional stud walls with conventional batt insulation.

It soon became apparent, however, that a mistake was made in using new materials in components that imitated nonfoam products. More skin finishes had been used than in conventional panels.

Unbalanced panels were used throughout—roof panels have ¼" plywood on the outside faces and Upson board on the interiors; exterior wall panels have "Tex-



FRAMING DIAGRAM



9 TYPICAL EXPERIMENTAL PANELS

ture 111" plywood on the outside and Upson board, cherry plywood, or ⅛" Masonite on the inside. However, what is a balanced sandwich panel? Is it a core with similar skins on both surfaces? Or is it a panel with 70 F temperature on its interior face and —10 to 150 F temperatures on the weather surfaces, with varying degrees of moisture content? To what degree does the moisture-inhibiting factor of the foam core allow the design of unbalanced-panel construction?

Furthermore, advantage was not taken of new structural arrangements of the parts of the panels made possible by the foam cores. Jointing methods, except at the windows, did not improve on conventional methods. Shop procedures for laminating panels was complicated.

This valuable hindsight resulted in the investigation of other plastics and techniques: phenolics and urethanes, as well as syntactic foams. The entire house began to be considered as a series of related components: the framing cage, roof, wall, and floor panels, mechanical elements, and glazing. The design of new components followed, and present hopes are that these will be incorporated into several structures currently being planned. An improved interior-partition system and 30 new sample panels are being completed at the time of this writing. The remainder of this report will discuss some of the directions that this designer has been pursuing. Although some of the occupancies discussed are not houses, the principles involved are thought to be applicable to residential construction. Applications for patents have been made for many of the designs.

Marina Roof

Bermuda panels and flat panels form the 1500-sq-ft roof of an addition to a marina on Nantucket Sound. Foamed-in-place urethane cores were used in the Bermuda panels while polystyrene planks were laminated to plywood skins for the flat panels. All panels were shop-coated with urethane and have sand embedded on the weather surface. This roof, although adequate, is not thoroughly satisfactory. For one thing, the rigid-foam formulation was not perfected to the degree that it is today, and, in shrinking, it pulled the plywood skins together slightly. There was also considerable waste of foam, since it was applied in a free blow with the excess being removed later. (Free blow means that no limiting surface was used to control the desired rise of the foaming process.)

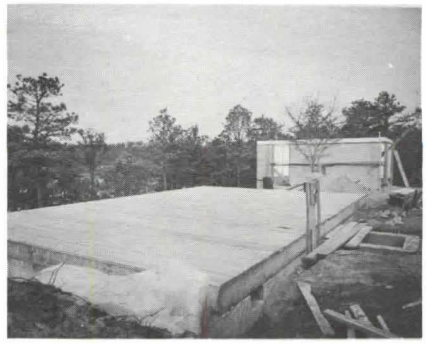
The urethane foams have an important advantage over polystyrene, since there are no added costs for adhesives and labor. Development by the chemical industry of equipment and controls for this material is progressing steadily.

Door Details

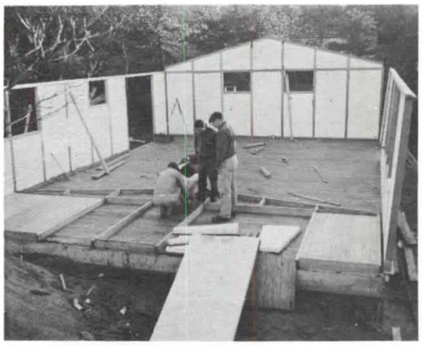
Neoprene surrounds, which hold doors and screens, are also the interior and exterior casing. A similar approach can be used for windows, with neoprene holding glass and screens 6. These designs are based on the Inlock type of stiffener.

Domes

A proposed design for a Junior Museum anticipates a structure based completely

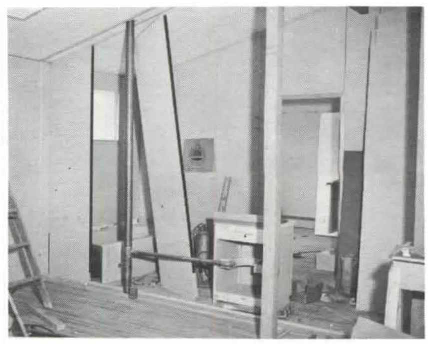


Floor of house is single deck of 1 1/2" oak "Doweloc." In background is concrete-block garage that forms far wall of the breezeway.

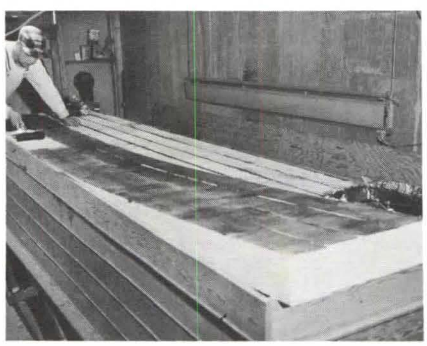


Walls of milled members and panels are tipped into place. Total time for assembly and placing of walls: 4 men, 4 hrs and 16 hrs.

Four exterior walls are plumbed. Ridge beams and posts (designed to fall in closet areas) are then positioned and fastened.

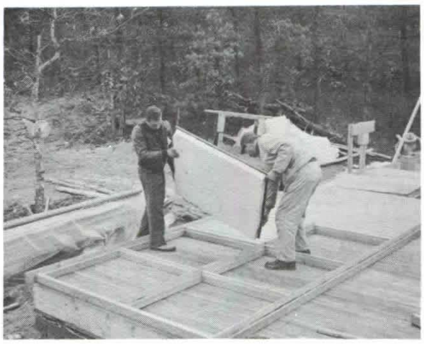


Plumbing walls are of 1 1/16" foam-cored double-faced panels. All interior walls were assembled and fastened by 4 men in 5 hrs.



Kraft-paper rafters extrude between two of the strips of foamed styrene which are laminated with resorcinal adhesives.

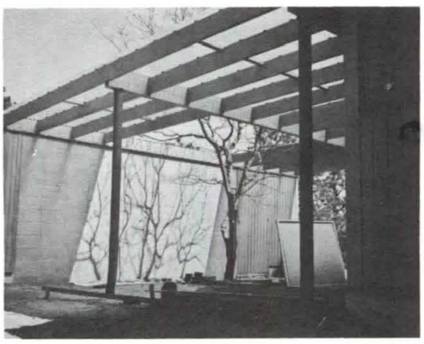
Later step in panel construction shows adhesive being rolled onto surface of foamed styrene to bond skin securely to panel.



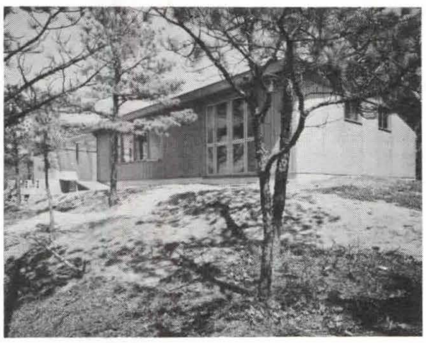
Sandwich panels, of foamed-styrene core and "Texture 111" plywood exterior skin, are inserted in rabbeted edges of milled framing.

First roof panel, of foam core and 1/4" exterior-grade plywood skins, being placed. Weight of 14" panel is approximately 140 lbs.

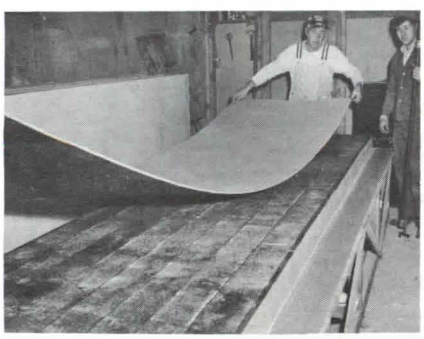
Roof panels, fully in place, are V jointed. Large openings in long walls are for double-glazed acrylic doors which have embedments.



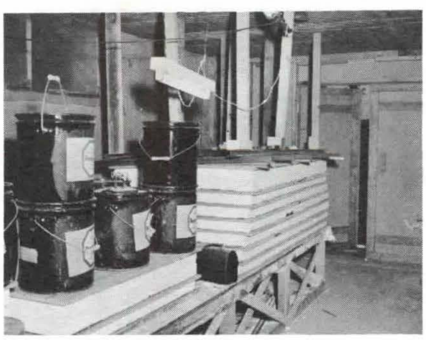
View of breezeway and stacked-block garage wall. Roof grid accommodates oak tree; roofing material is corrugated polyester.



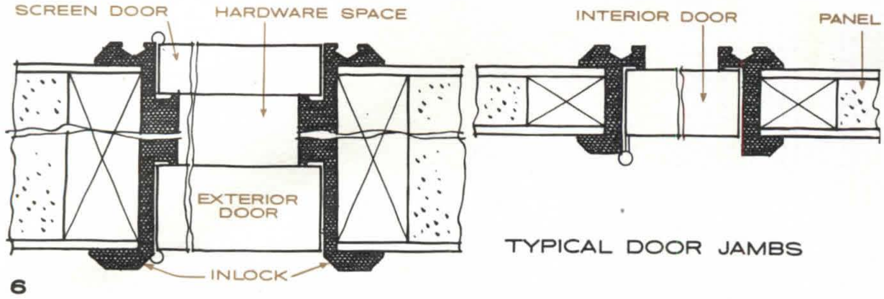
Over-all view of completed house. Exterior corners are filled with finish 4" x 4" which fits into rabbeted, milled members.



Exterior skin is draped over foamed-styrene core. Unit is then pressed to insure tight bond between the component materials.



Scene from "behind-the-barn" operation: improvised pressing methods use old containers, shims under struts to ceiling rafters.



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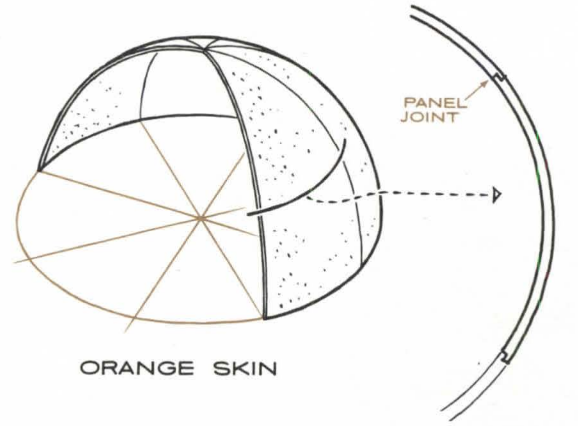

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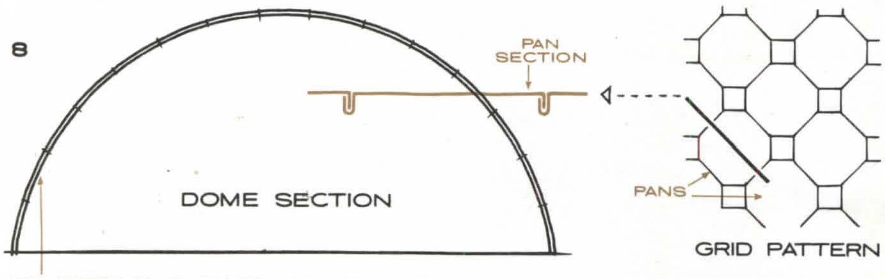

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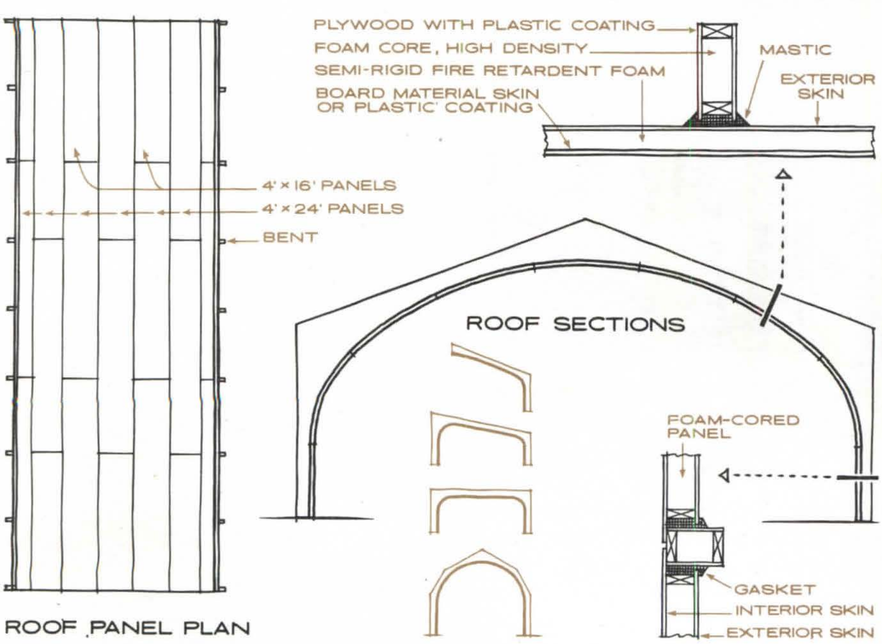
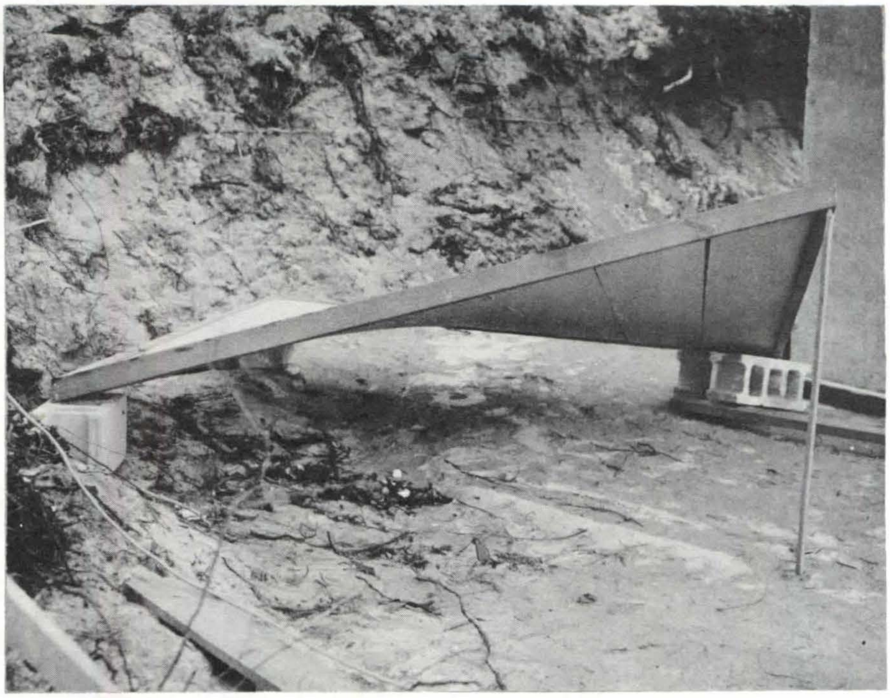


on the use of plastic components. Each of its areas has seldom been so built.

The dome (of a planetarium) could be built in several ways. Syntactic foams, pre-expanded polystyrene beads, or phenolic beads, mixed with resin, can be troweled over a pressurized balloon. This technique has been used with concrete; however, foam is much lighter in weight and gives better insulation. If additional finish is required, a plastic coating could be sprayed on. Glass rovings (nonwoven short strands) could be added to the coating or syntactic foam for additional strength, or for a thinner-walled structure. An alternate structural solution can be found in the use of "orange-peel" sections, which could be filled with foamed urethane, polystyrene, phenolic, or others 7. The joint system could be a half lap fastened with adhesives. This dome might also be built of a combination of octagonal and square foam-filled panels 8. For any of these solutions—no doubt, there are others—there is sufficient data available from work already accomplished, by the many designers working with plastic materials for building, to engineer this dome without much special study.

Bent/Curved-Panel Structure

A structure based on bents from which curved panels can be hung is an inter-



Seven-ft square hyperbolic-paraboloid roof panel. This unit was made of seven 1′ x 7′ polystyrene planks laminated with Upson-board skins. Comparison tests were made between the doubly-curved panel and a flat panel of the same material and dimensions. Under a similar loading, the deflection of the flat panel was four times greater.

esting possibility to be explored 9. Models at one-quarter scale have been built with Tekwood skins, filled with syntactic foams —both microballoons and pre-expanded polystyrene beads. It would seem that a single skin to the weather side would suffice for protection; a ceiling of flexible or semi-rigid urethane with a Hypalon finish is one of the many possibilities for the interior finish.

H-P Roof House

In a hyperbolic-paraboloid roof house, an oval is inscribed within the square of the h-p with the low points on either axis. The long spans possible with this roof remove the need for bearing walls. This then permits the design of lower-cost nonbearing walls, all of which would have straight-sloped top edges. Most of the rooms would have three exposures. The design is an economical one with pipes and fitting holding the structure together.

Conclusions

There is no doubt that plastics—in combination with lumber, metals, and paper—can play a prominent role in component design and manufacture. A number of factors, however, stand in the way of their fullest realization.

1 Policing by the industry, to make certain that formulations are correct, is essential. At present, there are some improper formulations being sold at lower prices.

2 The architect needs better information to be able to specify plastics properly. In this regard, sales personnel are often not sufficiently acquainted with construction problems to give complete and unbiased information.

With a potential billion-pound annual market for foam cores—which could not be supplied by available manufacturing facilities—it is apparent that many types of foams will be used. Methods should be developed to reduce the quantity of foam in a component without reducing strength, as in corrugated plank. There must be a freer exchange of information by all of the companies involved in this kind of research. The chemical industry might establish a central source of information where the building industry could get data on types and uses of plastics; where existing research and development information is assembled and correlated, thereby eliminating much duplication of effort; where terminology, understandable to architects, engineers, and builders, is developed; where research is channeled and new research may be initiated.

Some work of this kind is being done, but with little correlation. The Plastics Group of the Building Research Institute is attempting to find answers; without a full-time paid staff, however, its work is necessarily limited. The Manufacturing Chemists' Association now has a Director of Plastics In Building. The NAHB works with plastics manufacturers on research houses. Consumer magazines in the residential field have become involved in programs using new materials in new ways. But, will the many advantages be as quickly attained through these unrelated efforts?

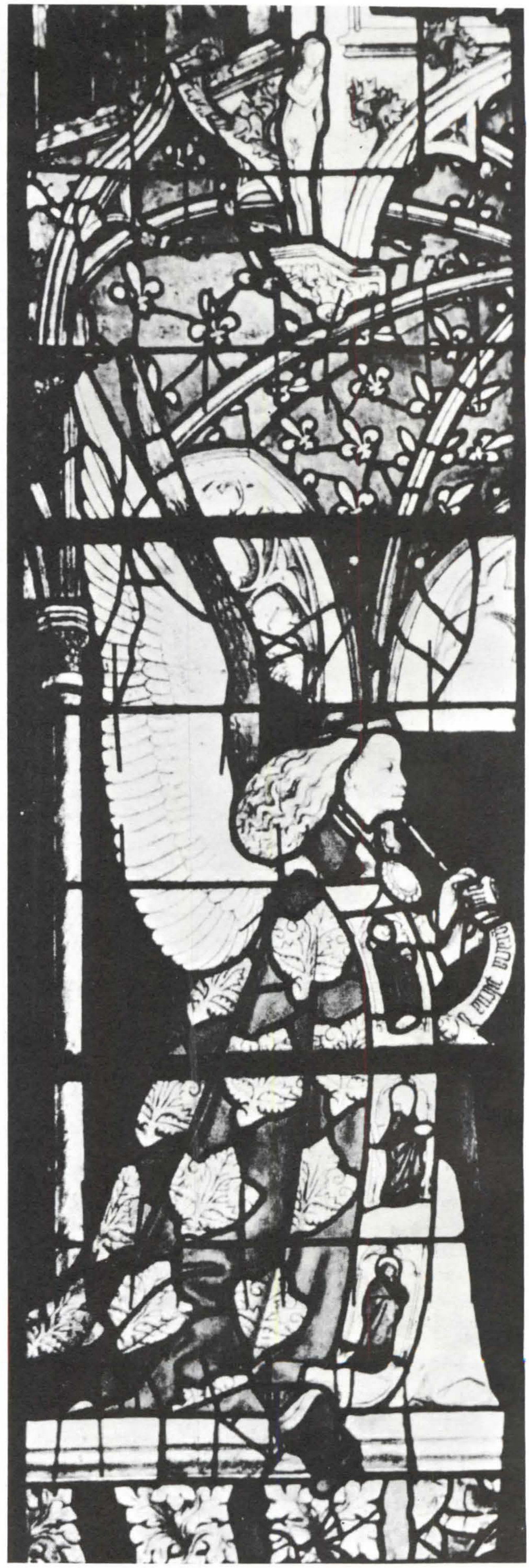
3 Teamwork among chemists, architects, engineers, and contractors is necessary for the proper design of components. Throughout the continuing process of redesign, the carpenter should continuously be kept in mind. If new components cannot be quickly and accurately assembled —without further cutting and without damage to finished skins—the product is of little value.

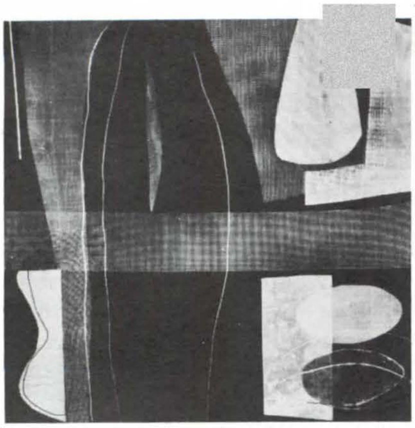
4 Regarding components, the following analogy makes their proper place clear: no one would wear a tuxedo without a tie—a missing component, nor brown shoes—an unrelated component. All components must relate in the final structure.

5 Necessity for using modular co-ordination, a common dimensioning language, cannot be overstressed. Correlated components and the ability to assemble on the site, demand such a system.

METHODS OF EMBEDMENT

. . . *in polyester* (above *and* right)





. . . *in laminated acrylic sheets*

. . . *in clear acrylic*

BY ARMAND G. WINFIELD

An embedment is the result of placing an object within a given mass of plastic material which serves as a protective sheath around the object. An expert in this field, Winfield is a staff member of DeBell & Richardson, Inc., Consulting Engineers in Plastics, of Hazardville, Conn. Several of the more important encapsulating techniques, as they apply to the decorative possibilities of plastics, are discussed. Also revealed in detail are methods used in thermoplastic acrylics and in thermosetting polyesters and epoxies.

An embedment, an encapsulation, and a potting are each basically the result of placing relatively small objects within a given mass of plastic material. The plastic serves as a total blanket or protective sheath around the object(s). Since three terms have been used to describe this phenomenon, these words need definition to clarify their specific usage.

An embedment is the total entity of an object in its plastic sheath. Embedments are usually decorative in nature, but can be medical, biological, or industrial, as well as purely esthetic. They are always cast or molded in a *transparent* plastic material.

A potting usually refers to an object placed within an *opaque* envelope or sheath. Pottings are usually electric or electronic in character—the opacity being a function of fillers required in a resin to produce explicit dielectric characteristics.

Encapsulation is a general term encompassing the two specific terms already mentioned, and is simply the enclosure of an object within a capsule or membrane. The first two terms are closely related to the plastics field (and are usually produced by casting techniques), while the last is of a broader frame of reference.

The first embedments known are those found in nature; prehistoric flies encapsulated in pitch which, through petrification, became amber—and the fly remained carefully preserved in this clear, hard shell. The advent of the plastics industry brought man's first facile and practical medium for artificial encapsulations. Insert moldings evolved as an outgrowth of the rubber-molding field which metamorphosed, prior to World War I, with the advent of the phenolics. Embedments appeared in the late '30's and pottings took their place in the following decade.

This article will deal with several of the more important encapsulating techniques as they apply to the plastics field. It will examine the methods used in thermoplastic acrylics and in thermosetting polyesters and epoxies.

Early History of Acrylics

The writer's earliest reference to embedding is work with styrene monomer and ultraviolet inhibitor in England in 1937.[1] In 1939, E. I. DuPont de Nemours & Co., Inc. had a display in New York where it exhibited a large block of crystal-clear "Lucite" in which some amethystine crystals were embedded. This intriguing specimen started him on a 20-year investigation into the possibilities of this field.

Among the first professions to become engrossed in the handling of cast acrylic was the dental field, and with the advent of World War II, the cast-acrylic dental plate made an appearance in the Army Dental Corps as well as in some of the more progressive civilian laboratories. In the early '40's several companies appeared as commercial embedders, two of the most prominent of these having been affiliated with the dental profession.

The methods used during this early era were basically derived from the dental techniques, modified for speed and accuracy of mass or semi-mass production. Converters supplying the dental laboratories had taken standard methacrylates and acrylic monomers and purified them for oral use. Molding materials were made as a fine bead polymer. Substantial amounts of hydroquinone inhibitor were removed from the monomer to ease the handling in denture applications. By combining predetermined quantities of the fine-mesh polymer with the purified monomer, a "dough" was produced, which, when subjected to the right amount of heat and pressure and a calculated cure cycle, resulted in the polymerization to the most beautiful crystal-clear acrylic end products.

These early methods of embedding were closely guarded and little information leaked out for many years. The techniques described in this article, therefore, are primarily based on the author's experience in this field—supplemented where necessary with published data.

Tedious Early Methods

The early methods of making embedments were slow, long, and tedious. A cavity or mold could be made of plaster, wood, or metal. If either of the first two were used, it had to be set in a metal flask to prevent shattering or bursting during the curing cycle that consisted of varying degrees of heat and pressure. A typical early embedding sequence was as follows: a cavity of polished brass, aluminum, or beryllium copper was coated with a mold release 1. Note the removable bottom and the draft on the sides. A layer of acrylic "dough" was placed in the bottom of the mold 2. The object to be embedded was then placed on top of the "dough" 3, and another layer of "dough" placed over the object 4.

One of several methods was then used to cure the embedment. One technique was to place this open mold in an autoclave, replace air with nitrogen or carbon dioxide, and bring the pressure up as high as 150 psi depending on the size of the embedment. Heated from 65 F to 225 F for two to six or more hours—again depending on embedment size—the embedment would cure or polymerize.

A second method was to place a top on the mold and clamp it shut. The most effective clamp had built-in springs. The reason for springs was that when the polymerization took place the acrylic shrunk, and a springless mold would not maintain the even pressure necessary to complete the polymerization. A spring mold or clamp 5 would do mechanically what the gas pressure maintained in the autoclave. Heat was applied by placing the mold or flask in a caldron of water and raising the temperature to a boil for

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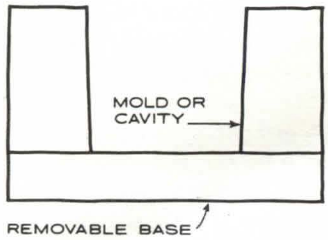

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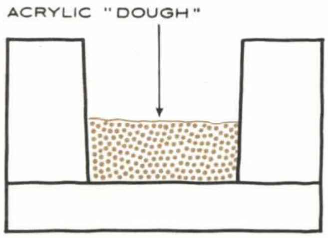

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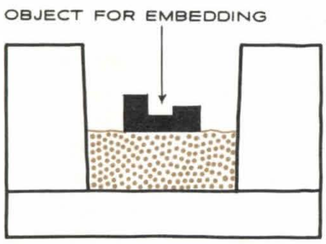

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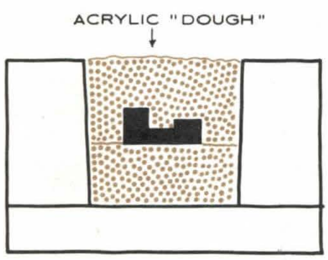

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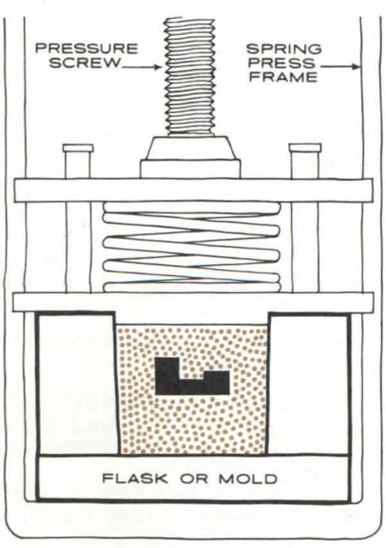


the two- to six-hour cure cycle.

The autoclave method was cleaner and more efficient; the second method was much less expensive in equipment and in operation.

Both techniques were adaptable. Cavities could be made to produce a single piece conforming to the shape or configuration of the cavity—or multiple parts could be embedded in a common cavity, to be cut apart and finished separately after curing. An important phase of this process was the finishing of the part, and great care had to be exercised to achieve a high finish free from blemishes or pits. Some embedders produced extra-hard surfaces by adding small quantities of benzyol peroxide to the monomeric mix.

Variety of Objects Embedded

Limitations in these early techniques were mainly in size. The larger the piece, the greater the heat and pressure requirements, and the longer the curing cycle. Common embedments were usually small —key-tag and small-jewelry size—earrings, brooches, and the like. Next in popularity was the cigarette-box top or the cigarette lighter (with metal parts inserted by fabrication). More difficult and expensive were book ends and large desk sets. The largest embedments by the early techniques rarely exceeded 12"x12"x 1"—and these took many days of carefully controlled cycling. Embedments of this era brought good prices: little embedded works of art upwards of $5, large desk sets as much as $200.

The remarkable range of objects embedded included everything from biological, medical, and marine specimens to those of gem and geologic nature; from tiny paintings and sculptures to coins, stamps, and locks of hair; from insects to sea shells; from photographs to drawings; from hard bits of wire to soft globs of wax; from museum objects of priceless nature to company miniature products for advertising give-a-ways.

From 1945 through 1947 a small group of New York artists used this exciting new medium to preserve miniature works of art, which under normal conditions would be easily destroyed.[2]

It was during this early period, too, that Bureau of Standards in Washington and Office of War Information, as well as a number of industrial defense plants in the field of electronics, began to look toward this technique as a possible medium for encapsulating miniature electronic assemblies. They felt that a series of delicate components could be prewired and then embedded as a single unit assembly. This unit, made up of many parts, would then be placed in the total assembly much like a single radio tube. Delicate assemblies were a problem where the instruments were subject to shock treatment—especially under battle conditions—the walkie-talkie being one such instrument.

An area of embedding of special interest to the architect and interior designer is sheet embedding, pioneered by Wasco Products, Inc. In this method, a gasket is placed peripherally around and between the outer edges of two large plates of glass. The space provided by the gasket controls the thickness of the plate and is usually not in excess of ¼". An acrylic slurry is poured between the glass plates together with fabrics, leaves, plants, insects, grass, or other desired decorations, and the whole entity becomes one large embedded sheet—up to 3' x 6'—for use as walls, shower stalls, partitions, panels, etc.[3]

The field of acrylic embedding has never become a field of high production. There is too much slow and tedious hand work involved—in placing the objects, in careful pressure and heat controls, and in the shaping and ultimate polishing of the finished pieces. As late as 1955, companies had been visited where long cycles of six to 30 hours were still being used.

Development of Improved Methods

In 1949, the first fast process was introduced.[4] This was a method of embedding by modified compression-molding techniques. Fine-mesh polymers were tamped into the base of aluminum or beryllium copper cavities **6**. The object for embedding was placed on the tamped polymer **7**, and another layer of polymer laid around and over the object to the desired depth. This, too, was tamped **8**. The mold was then closed, and heat of 300 to 350 F was applied to plasticize the polymer. Mechanical pressures of from 500 to 5000 psi were then applied in cycles as short as three minutes, although again size of the embedment was the controlling factor—the greater the mass, the longer the cycle. This process, however, shortened the standard embedment cycle from hours to minutes.

The next major change in thermoplastic embedding came in 1953 when the author developed a process for injection-molding embedments in a matter of seconds, rather than minutes. This technique, a modification of standard injection molding, could use any thermoplastic material and could embed by precision methods. Mold cost is increased by only 40 percent and cycle time, by 75 percent but the basic limitation is still mass; the method must be restricted at this time to comparatively small parts.

The last major developments in the embedding/clear-casting fields have occurred during this past year. One is the creation of clear blocks of acrylic, cast up to 2′ x 3′ x 4′, for use as submarine windows or atomic-reactor windows.[5] Although there is nothing embedded in these blocks, their size is an important advance in the technique of casting. The other development is a gargantuan embedment some 3′ x 3′ x 7′, which holds a stainless-steel capsule and serves as a corner stone in the lobby of the new Equitable Building in New York.[6]

This, then, brings the acrylic-embedding picture up to date from the late '30's to the present day. During these 20-odd years, the techniques, for the most part, have changed little. It is essentially a hand process—for custom or semi-custom production—in a quality market.

Techniques for the Epoxies

The next phase of this discussion covers the epoxies, tracing their history and development and discussing their techniques.

The first encapsulating use of epoxies was in the early '40's at Fort Monmouth, New Jersey,[7] when the Signal Corps was interested in the technique for covering wire-wound resistors. Its work closely paralleled previously-mentioned electronic developments in the acrylics. In 1949, the first complete encapsulated printed circuit was produced there. The growth of epoxies as potting compounds has been steady since that time and they can be found in common usage today in many branches of the electronics field.

Epoxies, as are the polyesters later to be described, are thermosetting in nature, which means they are chemical compounds activated by a catalyst which lines up their molecular structure as a chain reaction and crosslinks it. Once this compound is cured, it becomes permanent in this form and cannot be changed.

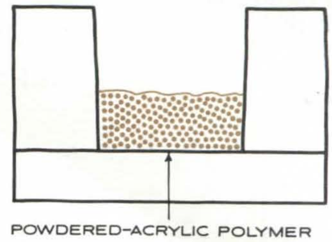
There are two types of epoxies used in the encapsulating field: first, the so-called clear or "water-white" epoxy through which the item can be seen, much the same as in an embedment; and second the opaque potting compound which is filled with an inert, usually inorganic, filler.

Until very recently, there was no real "water-white" material. Two of the lightest straw-colored materials in the lowest viscosity range are Bakelite ERL-2774 and Bakelite ERL-2795. Either of these materials could be activated by either a single amine catalyst or by a stoichiometric balance among several amines producing a multistage catalyst system. The second technique is used to counterbalance an extremely hot catalyst with a slower reacting one. Additional modification by the use of polyamides[8] to toughen the encapsulation is a common practice which does not measurably alter the clarity of the encapsulation.

Using the double-stage catalyst system with Bakelite ERL-2795, the author embedded glitter in large sheets of unsupported epoxy for the Scott Air Force Base, Illinois, in early 1956. Five and one-half lbs of resin were poured over a highly waxed glass mold, and after a gelation period of approximately two hours, glitter was sprinkled over this tacky surface. A second pour of resin was then placed over this 11½-sq-ft panel. After an additional gelation period of two hours, and a room-temperature curing cycle of an additional six, the parts were placed in an oven at 180 to 225 F for a two-hour curing cycle, after which time they were removed from the mold and were ready for delivery 9 and 10.

During the late '50's, a technique called molecular distillation[9] was used to clarify the various straw colors in epoxies to a water-white appearance. This technique cost about $25 per lb, and was impractical commercially. It was not until late 1958 and early 1959 that a real "water-white" epoxy made its appearance on the market[10] and is now gradually being used where clear castings are required. This material, however, is both expensive and somewhat difficult to handle, requiring long curing cycles of anywhere from 16 to over 70 hours at controlled temperatures (depending on the mass of the casting).

Epoxies are generally good to use where shrinkage is an important factor. Epoxies have a volumetric shrinkage factor of approximately 1 to 2 percent—or a lineal shrinkage factor of approximately 1 to



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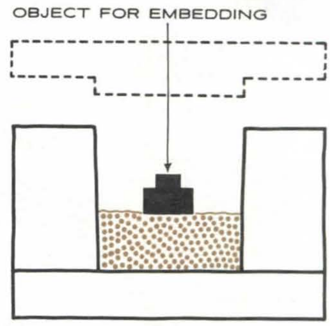

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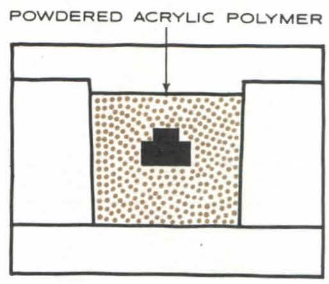

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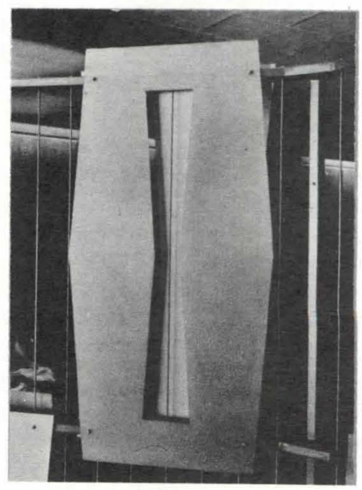
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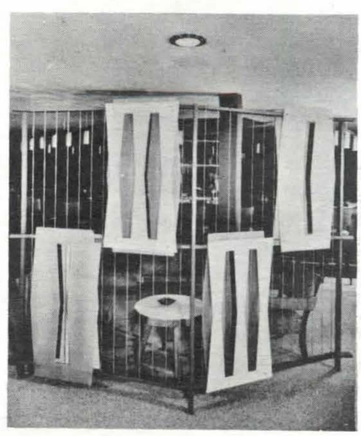
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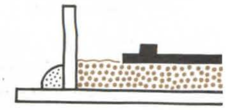

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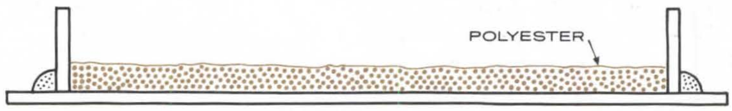

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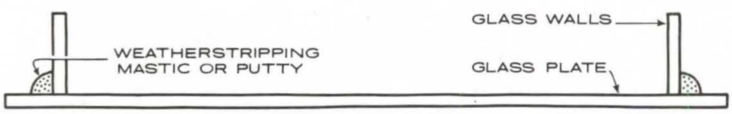


1.259 percent. This means that they can be used around metal, glass, and other delicate electronic items where high-shrinkage resins would crack. The use of filled epoxy for pottings is an area of specialization, because the exact formulation is dependent on the physical requirements necessary for the specific job. For specific problems, however, there are many compounds on the market prepared by converters for specific types of potting, and there are several companies who prepare special compounds for particular assignments. Many techniques are in use today where shells made of epoxy are used as molds and the part is left in them. The mold release problem of the epoxy is a difficult one, since the resin is very tenacious and tends to stick even to the best-prepared mold surfaces.

Embedments in the Polyesters

The last phase of this article covers the "water-white" polyesters. The author has been investigating the use of polyesters as an embedding media during the past eight years and has examined each one appearing on the market and claiming "water-white" appearance. Of all of these evaluated, two of the three that came close to the claim are difficult to use as general embedding media. These two are acrylic monomer polyesters and syrups, and are primarily designed for outdoor use with glass-fiber reinforcement in sandwich constructions. An excellent resin for clear embedding is Pittsburgh Plate Glass's Selectron #5026. This resin has a light purple-blue cast which, when cured, almost entirely disappears, leaving a clear block similar in appearance to an acrylic.

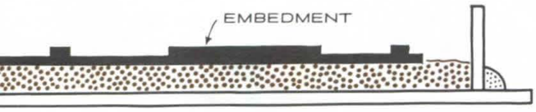
Polyester embedments present both advantages and disadvantages over the acrylic embedding. On the plus side is a less expensive basic raw material (approximately $.45 per lb compared to $1.50 to $3.00 per lb for dental-grade acrylic). There are no size limitations in polyester embedding if the material is correctly handled. Costs of equipment and manufacturing are much lower than for acrylic embedding.

On the negative side, however, the light stability of the so-called "water-white" materials is relatively short-lived. On exposure to direct sunlight, the piece will turn from clear to straw color to amber within a year or two. In normal indoor usage, this life expectancy can be extended. Polyester has a volumetric shrinkage of approximately 6 percent, or a lineal shrinkage of approximately 2 percent, and this precludes its use around many items which have large mass or are metal, glass, or materials whose coefficient of expansion differs widely from the polyester.

Polyester embedments can be made in molds of glass, latex, Teflon, plastisol without mold release, or chrome-plated steel or brass. They can also be made in throw-away molds of vacuum-formed vinyl or polyethylene. Molds of wood or plaster can be used for single parts, but mold releases of cellophane, polyvinyl-alcohol film, silicone grease, or oil must be used.

Polyesters have a strong odor originating from the styrene monomer. This theoretically disappears after the part is cured. In order to guarantee the removal of this odor, a masking agent or scent can be added as a neutralizer to the base resin.[11] This scent does not alter the clarity of the finished casting even though it has a tendency to amber the liquid during mixing.

A typical embedment is made as follows: A temporary mold is made of glass and held together with putty or mastic **11**. A layer of the polyester is then poured over the bottom **12**. In order to eliminate the use of vacuum jars, Selectron #5026 is preheated to 120 F for a period of 30 to 60 minutes. This is then catalyzed with ½ to 1 percent (depending



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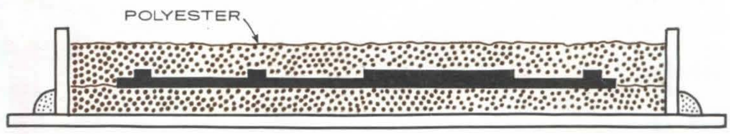

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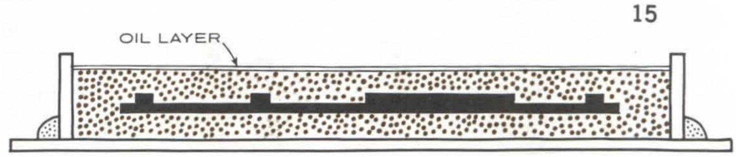

on the mass of the embedment) of t-butyl hydroperoxide which has been carefully stirred into the resin to eliminate air bubbles. The poured layer will gel in anywhere from 15 minutes to an hour, again depending on the amount of catalyst, the room temperature, the humidity in the air, and the temperature of the mold. A vibrator can also be used to remove remaining air bubbles, but for the most part this is unnecessary. After the base resin has gelled, the object to be embedded is dipped into a catalyzed solution of polyester and is carefully placed on the gelled area in the exact position desired **13**. Care must be exercised to see that air bubbles are removed from this embedment and this is often done with a needle or by additional vibration. Since the wet embedment has a tendency to slide around, care must be exercised to see that it gels in the position required. After embedment gelation, an additional layer of catalyzed polyester is poured over and around the object to fill the mold **14**. This too must gel. After gelation of the second layer, a layer of purified, lightweight, mineral oil is poured over one resin to serve as a block-off to the air **15**. Selectron #5026 is an air-inhibited resin.

The mold-and-cure cycle after gelation is, depending again on the mass of the embedment, very critical; but as a rule of thumb, the cycle is approximately two hours at 120 F, followed by 30 minutes at 160 F, and 30 minutes at 220 F. After curing, the object is carefully cooled to room temperature. Since polyester has a large shrinkage potential, it will pull away from the mold walls and is thus easily removed from the mold.

Polishing and finishing of polyester is a chore. Although all surfaces in direct contact with the mold will be as smooth as the mold itself, the area covered by the oil must be worked and finished. When the oil is removed, the area is tacky and this tackiness must be ground off and polished. The most effective method is to wet-grind with grits of 240, then 360, followed by buffing with a tripoli compound, then followed by chalk or chalk-rouge for high finish. The "water-white" polyesters are extremely versatile and can be tinted or colored as well as left clear.

The line where one layer of resin is poured onto another will never really disappear in the polyester embedment, but can be hidden by the shape of the embedment, for instance by angles meeting at this cleavage line.

Other Techniques

Insert molding is primarily a production technique used in many industries whereby an object, usually metal, is set into part of the mold before the molding compound is introduced. An example are the prongs of an electric plug. Phenolic is shot around these metal prongs by a transfer-molding technique. Insert molding is mentioned here only briefly, since it is actually distinct from the techniques already described. These have been hand techniques whereas insert molding is mechanical.

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1 Unpublished data given to author by Arthur J. Warner, concerning work at Standard Telephone Cables, Ltd., North Woolwich, London.

2 Winfield Fine Art in Jewelry, New York, N. Y.

3 "Acrylite" and "Wascolite," products of Wasco Products Inc., Cambridge, Mass.

4 Tod Harris, President, Creative Plastics Corp., Stony Brook, N. Y.: (Creative Plastics was subsequently purchased by Whitehead & Hoag Co., Newark, N. J.)

5 Cast Optics Corp., Hackensack, N. J.

6 Produced by Plastics Developments, Inc., Attleboro, Mass., for Skidmore, Owings & Merrill, New York, N. Y.

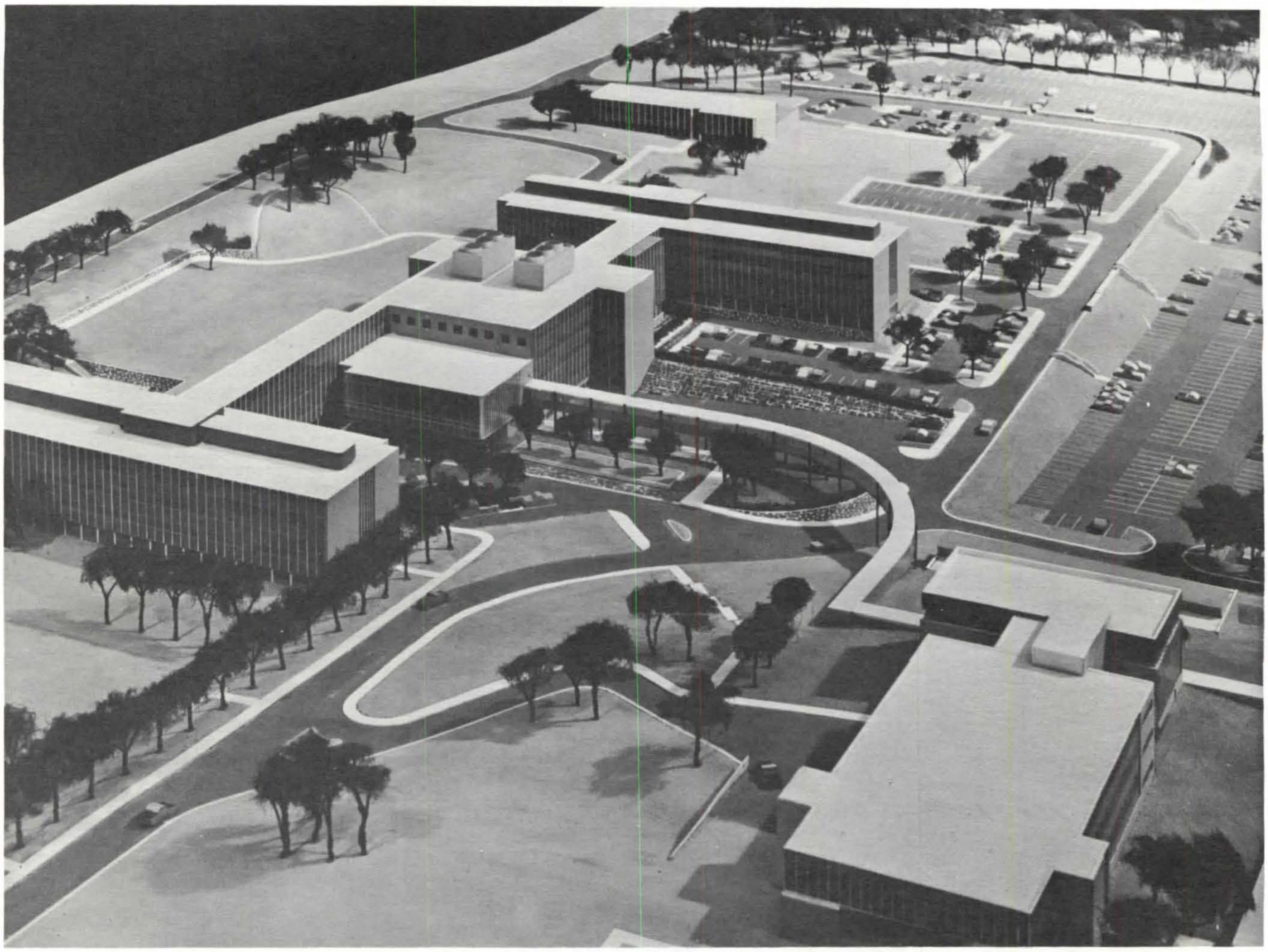
7 "Compounds for Electronics," John M. Jewell and William C. Jenner, Modern Plastics, vol. 37, December 1959, pp. 101-102.

8 "Versamid," product of General Mills, Chemical Division, Kankakee, Ill.

9 "The Use of Molecular Evaporation as a Means for Propagating Chemical Reactions," Contribution #74 from the Experimental Station of E. I. DuPont de Nemours & Co., Inc., *Collected Papers of Wallace H. Carothers on Polymerization*, edited by H. Mark, G. S. Whitby. Interscience Publishers, Inc., New York, N. Y., 1940. Chapter XI, pp. 154-156.

10 "Maraglass 655," product of The Marblette Corp., Long Island City, N. Y.

11 "Bouquet #40-R-8," Dodge & Olcott, Inc., New York, N. Y.; "Pisarro Base #416," Mane Fils, New York, N. Y.



Satisfied with over-all performance of plastics applications in three-year-old lab building (lower right), owners have begun construction of huge research complex with maximum use of similar plastics installations.

PERFORMANCE EVALUATION

BY W. A. CLENEAY

Three years ago, a new laboratory building was erected for Monsanto Chemical Company at Creve Coeur, Mo., containing nearly 60 plastics applications. Since that date, periodic checks have been made to evaluate the performance of these plastics installations. How they have withstood actual conditions are reviewed by Monsanto's Chief Architect of its Research and Engineering Division.

Three years ago, Monsanto Chemical Company undertook a research project unlike the typical laboratory investigations ordinarily associated with a chemical manufacturer. The project was a building—the Inorganic Chemicals Division Research Laboratory—which, at the time of its construction, contained more applications of plastics as a material of construction than any structure of its kind in this country.

Conceived as both a dramatic and practical research project to demonstrate the suitability of plastics as a building material, the project has proved to be a "pilot plant" for the study of plastics applications. It has done for plastics what Alcoa did for aluminum in the construction of its aluminum office building in Pittsburgh.

The laboratory is a three-story structure with approximately 72,000 sq ft of floor space. It contains 40 chemical research laboratory modules, a special section for chemical engineering, research offices, a library, and service facilities. Throughout the components of the structure are found the various applications of plastics: from the polystyrene-foam insulation of its roof to the nearly 80 percent plastic exterior.

During the years since the building was occupied, the more than 50 different plastics applications have been under constant scrutiny by an evaluation committee. From this study, Monsanto and the building industry have learned how these applications—many previously untried—stand up in practical use.

The committee's second annual report, covering the testing period from June 1958 to June 1959, disclosed that of the nearly 60 applications, 43 were considered successful, minor difficulties were encountered with 10 applications, and six applications were rated as "major difficulties."

Because many of the applications were completely new, the first year's evaluation report showed that as many problems were due to faulty installations as to the materials themselves. When these installa-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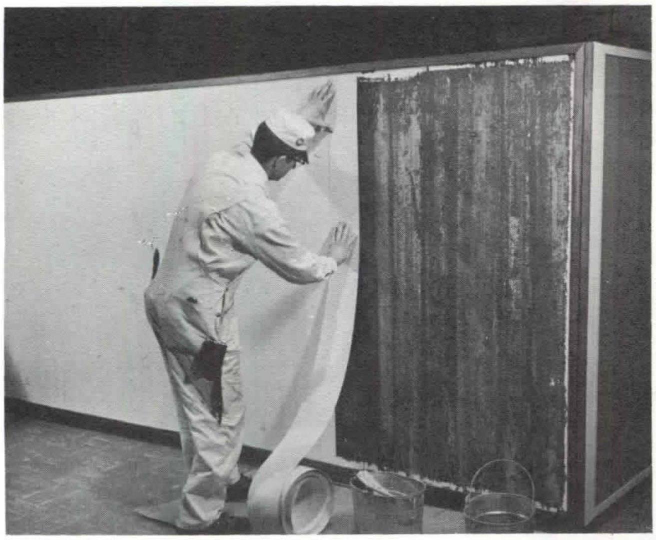
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tion "errors" were corrected, the number of plastics applications that caused either major or minor "difficulties" was decreased substantially, the report revealed.

As evidenced by the committee's findings, the plastics applications in the Inorganic Laboratory are generally satisfactory. Many of the applications, revolutionary at the time of the laboratory's construction, are now products receiving wide commercial use. Numerous others will become standard applications in the not-too-distant future.

A resumé of the committee's findings for the applications in the Inorganic Laboratory follows:

Finishes

Laminated polyester canopy support 1. Where color was applied (by brush) to this structural support, there was some fading and discoloration. The application is, however, rated as successful and there has been no noticeable distortion or deflection. (The canopy itself, constructed of translucent polyester panels sandwiched with aluminum honeycomb core, has proven unsatisfactory. The honeycombed cells filled with moisture, distorting the canopy. It has since been replaced with single-sheet polyester laminated on aluminum expanded metal.)

Polyester-faced exterior blocks 2. This application, visually appealing, was rated as having minor difficulties because of a yellowing effect. The committee has recommended that a more light-resistant lacquer be applied to a sample block, for further evaluation.

Polyester exterior sheets. Exterior translucent sheets of the sandwich panels have discolored, the white polyester turning a distinct yellow and the blue turning dark. The fault, the committee believes, lies in the resin and can be corrected. Further tests are to be carried out.

Styrene wall coverings 3. This newly-developed wall covering has held up well in the past three years. Exposed corners showed some wear and damage, but this condition has been corrected with the installation of metal molding strips.

Polyester partition panels 4. Panels between laboratory modules received a satisfactory rating. They give great flexibility to the size of the modules, since they can be removed and installed with ease.

Melamine wall coverings over masonry walls. The evaluation committee discovered that since this covering was field-applied in large 4′ x 8′ sheets, mounted flush, no room was left for expansion or contraction of the material. This, coupled

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with the fact that the material was applied during cold and damp conditions (winter of 1957), when the walls were water-saturated, caused the covering to pull away from the wall. In 1958 the wall covering was removed, the walls sealed, and the material reinstalled leaving a ⅛" joint. The 1958-59 report showed that this application is still not completely satisfactory.

Vinyl wall coverings. There has been no deterioration where the vinyl covering was applied over plaster walls, wood frames, partitions, or panel doors. Installation on wallboard on exterior masonry block was unsatisfactory due to moisture entrapment beneath the vinyl fabric.

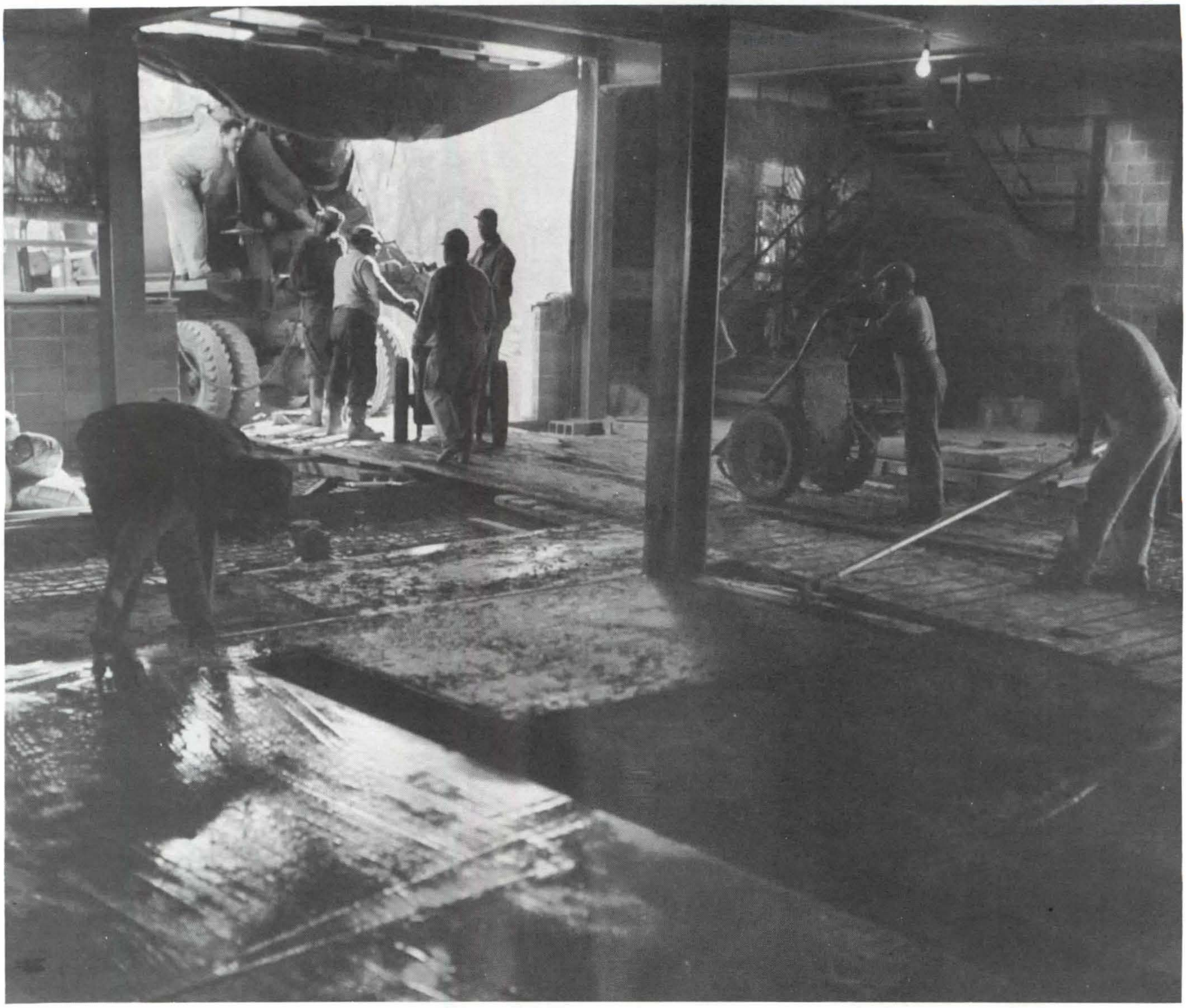
Styrene wall tile. This installation is another successful one, and one of the most attractive plastics applications in the laboratory.

Polyester-faced interior concrete blocks. Two types of blocks were used on the interior; one, a sand-polyester facing, continues to retain color and finish without fading or deterioration. The other, a glass-mat-reinforced facing, bleached rapidly after initial installation, but has changed little during the past 12 months.

Polyester-faced acoustical-ceiling tile. This is considered another appropriate application, as are the styrene lighting-fixture diffusers.

Polyester-faced paving blocks. The only adverse comment concerning this use is that the blocks are somewhat slippery when wet. A coarser corundum sand or grinding, the committee found, would remedy this problem.

Polyester-coated asbestos cement for laboratory benches. This plastic was used as a protective chemical coating on asbestos-cement bench tops, hood enclosures, and



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baffles. Proper adherence to the surfaces was a difficult problem, and, after subsequent testing, the company decided against further use of this particular application.

Resin-bonded asbestos-cement laboratory bench tops. Here, the committee found that the resin-bonded sheet had a tendency to stain. It recommended this application highly, when the working surfaces are treated with a sealant prior to actual usage.

Interior styrene-latex base paints. Usage shows full measure of durability and color fastness of these concrete paints.

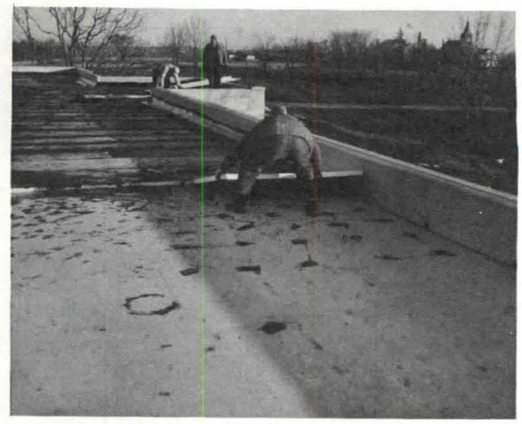
Vinyl-based paints. Early failure of air-dried, vinyl-chloride-acetate co-polymer paints has been attributed to the thin coating applied initially. The vinyl lacquer on laboratory fittings has also proven satisfactory.

Urethane floor paints. The report showed that what was first believed to be a fault of the paint—failure to adhere to the on-grade concrete slab—was actually a fault of application. When the surface was properly prepared and the paint properly applied, the material stood up to the most rigid specifications.

Urethane corrosion-resistant steel paints. Rated as another successful application, the urethane coatings have continued to show excellent corrosion resistance even under severe exposure in the engineering laboratory. After its first annual evaluation, the committee recommended heavier coatings than were initially applied to stair treads, gratings, and checker plates.

Illumination

Acrylic sun-louver windows 5. Here, the committee found that warpage from ther-



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mal expansion raised major difficulties, because of the installation, however, and not the material. Heavier glazing beads and thinner calking tape were recommended to prevent warpage, and a second installation in the company's Agricultural Research Laboratory has proven successful.

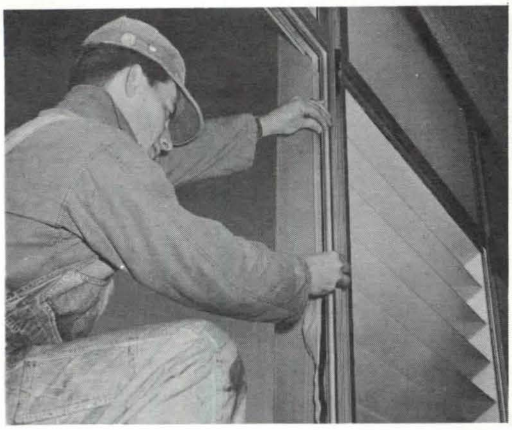
Luminous vinyl ceiling 6. The translucence and color of the rigid vinyl ceiling has remained unchanged, and the application is considered a successful one.

Polyvinyl-butyral door lights. The decoratively-imprinted plastic sheet, laminated between two sheets of plate glass, has proven highly satisfactory. This is the same process that is used in automobile windshields and is finding increased applications for decorative effects.

Water/Vapor Barriers

Sprayed-vinyl vapor barriers. The concrete foundation was sprayed to form a moisture barrier between the earth and the walls. This application is considered by the committee to be vastly superior to conventional membranes. Dampness and outside temperature during application seem to have had little effect on its sealing or adhering properties, and even those membrane areas above the ground which are exposed to the elements showed no deterioration.

Polyethylene membranes 7 *and* 8. This



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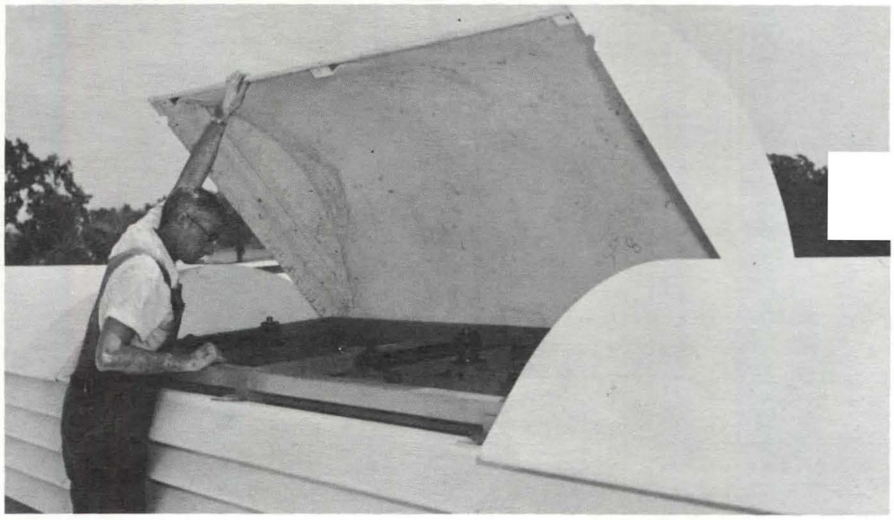

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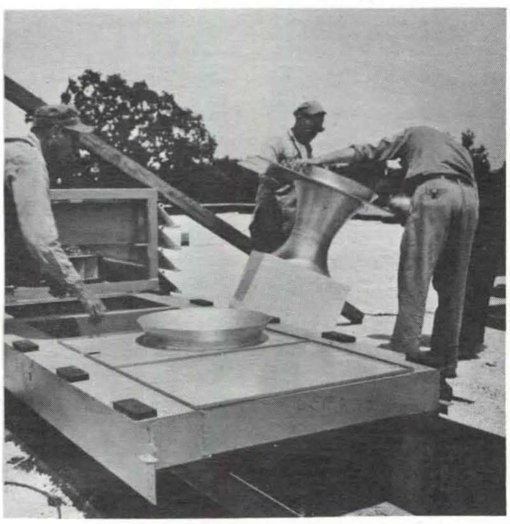

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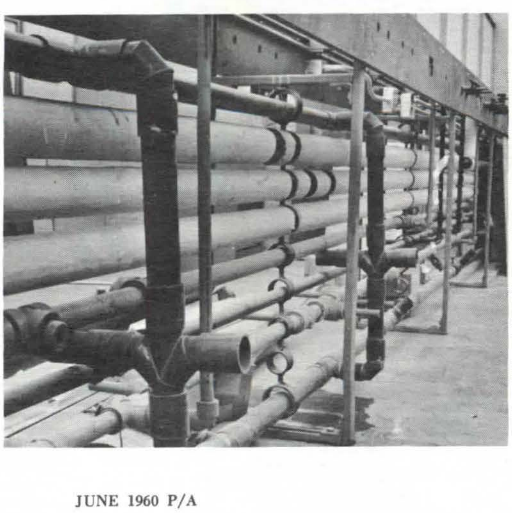
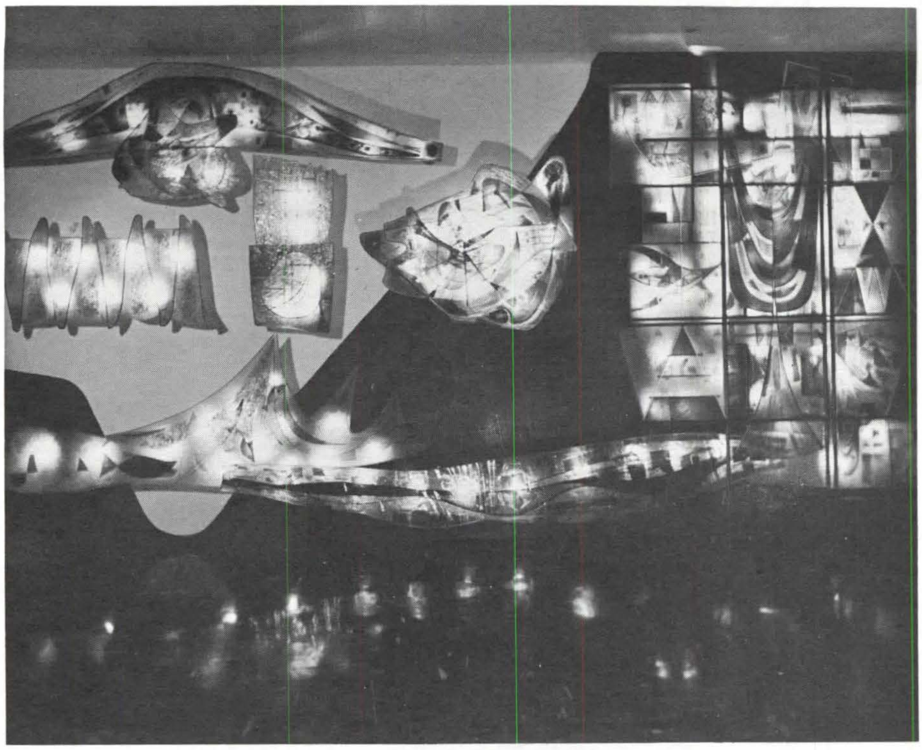


application, an excellent method of curing concrete, has one minor reservation—because the moisture is retained by the sheet to improve the curing process, it eventually escapes. There is, therefore, a longer drying time, and as the committee noted, floor coverings or coatings should not be installed until there is adequate dryness of the concrete.

Thermal Insulation

Reinforced-polyester/foamed-styrene sandwich panels **9**. To the viewer, this is the most obvious plastics application in the laboratory. Rated as having only minor difficulties, the exterior panels show no change in surface finish from weathering, although they have begun to yellow slightly. These sandwich panels weigh 70 lbs versus more than 300 lbs for a metal sandwich panel of comparable size. A 2″ core of foamed styrene provides insulation equivalent to a 16″ brick wall. *Foamed-styrene sandwich roof panels* **10**. In this application, foamed styrene was laid on the roof and covered with asbestos-cement sheets and plastic-reinforced roofing paper. To test the adequacy of this component, an opening was cut in the roof and a sample of the 2″ styrene foam analyzed for compressing or loss of foam characteristics. The insulation was unchanged from cyclic heat or aging, and there has been no evidence of deteriora-



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tion of the panels.

Vinyl-form insulation. This material was used in an insulating medium in several "constant temperature" laboratory rooms, but because of a problem with dimensional stability, it was replaced.

Sealants

Calking compounds and adhesives **11**. These have performed satisfactorily, except that the calking tape used to seal exterior plastic panels in their aluminum frames extruded somewhat.

Extruded-styrene glazing beads. These have also functioned well, holding the polyester sheet rigidly in its strut framework. They have disassembled readily when partitions were relocated or modified.

Polyester closing strips on curtain-wall mullions. The strips were initially cemented to the aluminum, but became detached when expansion and contraction of mullions caused the adhesive bond to break. Attaching the strips with metal screws in an elongated hole permitted the necessary expansion and contraction.

Mechanical Components

Polyester molded monitor over plastic fans **12**. Despite constant exposure over the past three years, this unit has weathered well and has not discolored.

Polyester exhaust fans **13**. These specially-designed all-plastic fans—27 in all —were installed in the roof of the laboratory. They were designed to provide air delivery from 1000 to 2100 cfm, with a static pressure from ⅝" to more than 1" of water gage, and speeds between 1200 and 1700 rpm with the use of fractional horsepower motors. High bearing and belt maintenance have caused them to be rated as a "minor difficulty" although their functional performance has been good.

Polyvinyl-chloride pipe and fittings **14**. The ease of making alterations makes this application particularly satisfactory. Only where certain solvents were trapped for any length of time in the drains has there been a problem with this application.

Styrene diffusers. Since this application was installed in the laboratory, styrene diffusers have become a regularly-marketed product. Their performance in the laboratory is considered highly satisfactory.

Polyester air-intake louvers. Structurally these units have proven satisfactory, although they have dulled in color and some surface roughening is perceptible.

Polyester hood linings. No maintenance has been necessary on the linings of the polyester sheet. Repeated repainting, however, has been required for the asbestos-board, polyester-coated linings.

Miscellaneous Applications

Decorative polyester screen in lobby **15**. Termed the first major advance in stained-glass art since the 9th Century, the screen is made of stained glass embedded in glass-fiber reinforced polyester resins. The plastic takes the place of soldered H-shaped strips of lead, traditionally used by stained-glass window creators since the earliest days of the art. The screen depicts the millions-of-years story of phosphorus, the foundation of inorganic chemistry. There has been minor delamination in spots that range in area from 1½ to 4 sq in. The committee reported that the defect would seem to result from inadequate wetting of the glass during fabrication.

Plastic-coated plywood forms **16**. These special forms were used in the construction of the laboratory to provide a smooth ceiling surface. The cement finishing usually required after removal of forms was substantially reduced, and the resultant savings more than offset the cost of the special formwork.

Polyethylene covering while curing concrete. This application has generally become a standard construction procedure and has proven extremely satisfactory in the Inorganic Laboratory. Polyethylene is placed over the concrete slab after it has been poured. Moisture is thus retained in the concrete while it is curing, and the slab is prevented from drying out too rapidly.

Styrene venetian blinds. There has been some sagging between the supported areas of the blinds, but the addition of a series of thickened ribs in the manner of corrugation has helped solve the problem. Light-stabilizing additives have been suggested to remedy a slight tendency of the blinds to darken in color.

Vinyl-covered steel furniture. This is another satisfactory installation; the material has not deteriorated either as an upholstery or as a decorative covering.

Polyester chairs. Chairs and their urethane padding have given good performance in the past three years, while the polyvinyl-chloride coverings have worn substantially.

Polyester-inlay cabinet and door fronts. A number of these reinforced-polyester fronts remain unchanged, but a few faded perceptibly. The company is conducting further tests to determine whether this condition was caused by undue wear and exposure, or by a deficiency of the material.

Polyester molded drawers. These lab bench drawers were installed in only one laboratory. There has been no deterioration or change.

Polyester chalkboards on laboratory hoods. The initial difficulty in cleaning these boards was overcome by washing with a mild solution of hydrochloric acid. An improved surface, installed in the chalkboards of the company's Agricultural Laboratory, has proven quite acceptable.

Familiar Uses

Other successful applications, so familiar that they need not be discussed, are *vinyl floor tile, vinyl asbestos floor tile, vinyl folding partitions, vinyl and melamine kick* and *push plates, acrilan carpeting with urethane pads, synthetic-fiber drapes, phenolic door knobs, phenolic-resin sewer drains, reinforced-polyester pressure tank.*

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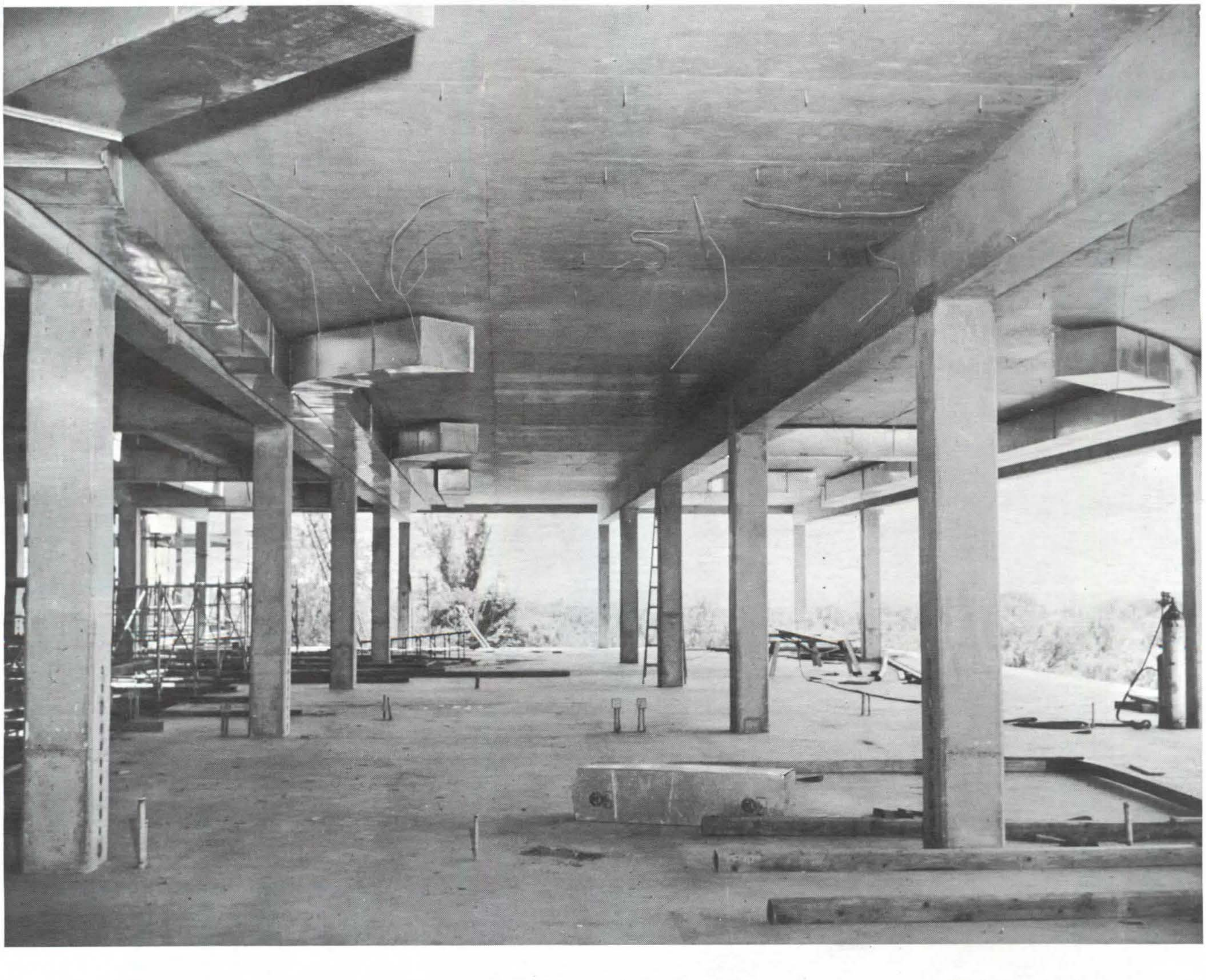
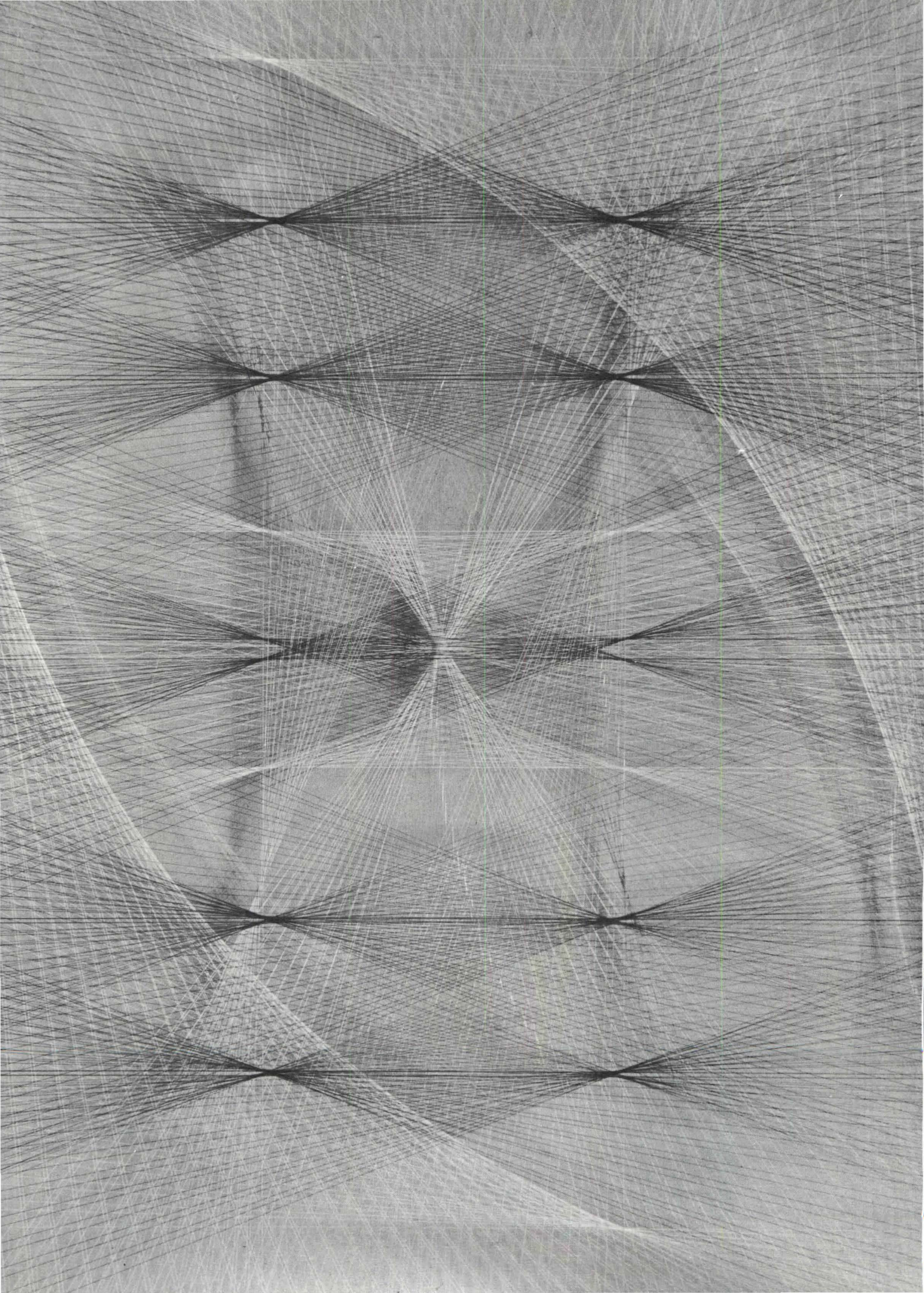
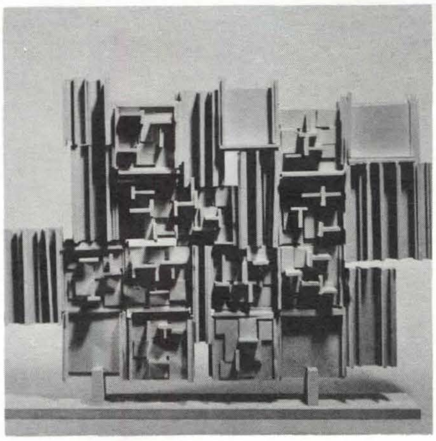
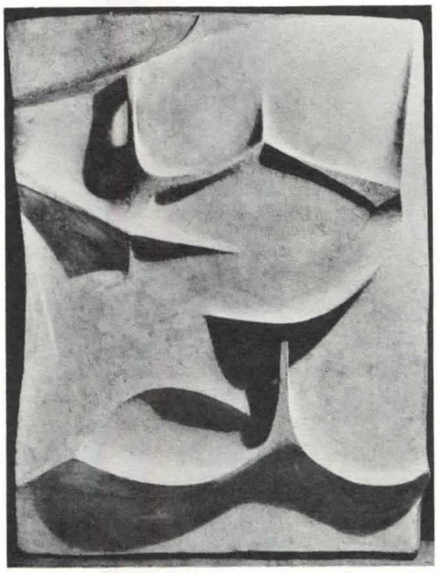




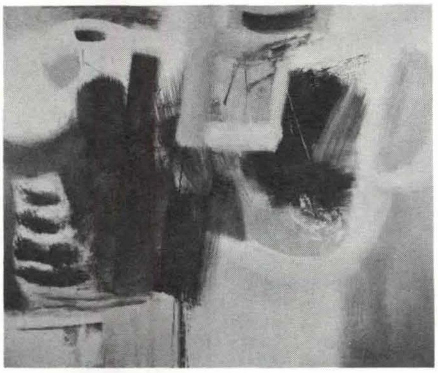
ART OF PLASTICS



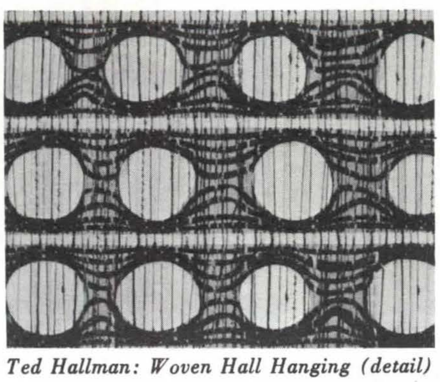
Harold Krisel: Laminate



Wolfgang Behl: Polyester Plastic Panel #1



Cameron Booth: Early Hour



Ted Hallman: Woven Hall Hanging (detail)

The versatility of plastics and their adaptability to very different esthetic purposes is apparent in these works by contemporary artists and designers.

Sue Fuller's *String Composition #50 (acrosspage)* is an intricate arrangement of plastic filament in an aluminum frame 34″ high, 45″ wide. The saran threads in low-key colors are more stable, the artist states, than natural fibers which sag and absorb moisture. Though the image formed by the threads suggests vast spaces, planes sweeping across and overlapping deep in space, the shallow frame, to which the threads are attached, is actually little more than 1″ deep and is backed with painted hardboard. Neither paintings nor sculptures, as they are classified for exhibition purposes, Miss Fuller considers her works constructions more akin to bas-reliefs.

Another kind of construction, Harold Krisel's *Laminate*, 13″ x 15″, is sculpture, three-dimensional, free-standing, space-manipulating. Krisel, an architect working in an important New York architectural office, uses acrylic for its strength, light weight, clean surface, and for the precision with which parts can be joined. Individual shapes are cut from transparent acrylic sheets and welded together with a chemical solvent which evaporates to leave a clean strong joint; units are interlocked for final massing and then sprayed with white lacquer for an opaque finish.

A contrast to constructed sculpture, built-up and finished in a permanent state without transforming the material, Wolfgang Behl's *Polyester Plastic Panel #1*, 66″ x 49″, is carved and modeled. Behl's interest in plastics was prompted by the search for a strong, lightweight, inexpensive material for large-scale commissions. Plastic foam in slab form is carved directly to form a core covered with a layer of reinforced plastic; this glass-fiber skin is modeled with a layer of plastic mixed with aggregates of varying textures and colors for a finished surface which may be filed, troweled, or sanded.

Cameron Booth's *Early Hour*, 60″ x 72″, is boldly painted with acrylic paint on canvas. The artist prefers plastic paint because it is easy to work with, flexible, durable, and quick drying.

Ted Hallman's decorative, woven, wall hanging is designed with acrylic shapes suspended with fibers of cotton, linen, rayon, and jute.

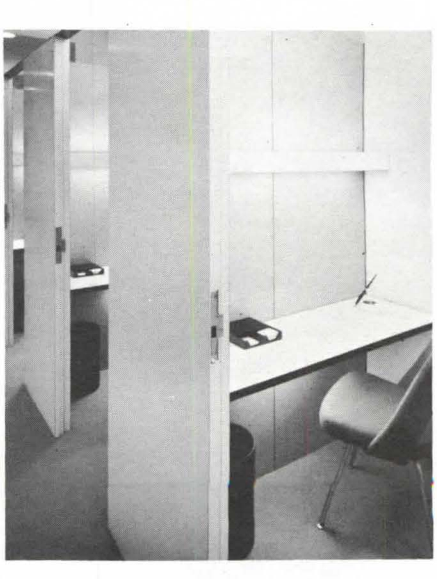
From the offices of three leading interior designers, we show recently completed interiors which demonstrate the current applications of plastic materials, skilfully handled. Each interior is heavily used, subject to constant wear by the public—one of the prime reasons for plastic surfacing materials and finishes. Plastics' advantages and possible future for the interior designer and architect are commented upon by Florence S. Knoll, George Nelson, and Gerald Luss.

TOP DESIGNERS CHOOSE PLASTICS

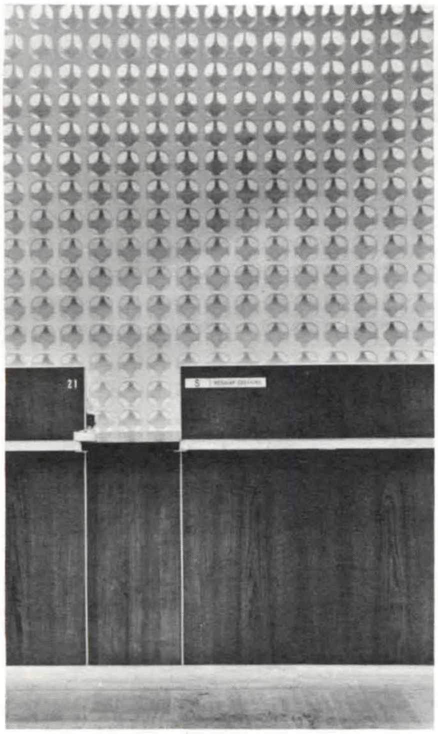
Bank

FIRST NATIONAL BANK OF MIAMI • MIAMI, FLORIDA • WEED, JOHNSON ASSOCIATES, ARCHITECTS • KNOLL PLANNING UNIT, INTERIOR DESIGNERS • FLORENCE S. KNOLL, DIRECTOR • LEWIS BUTLER, PROJECT DESIGNER

Florence S. Knoll The rapid strides taken by the plastics industry during the past decade have placed in the hands of the interior designer or architect many useful tools to help create more practical and attractive contemporary interiors. We have found their use in general functional areas of the utmost importance for maintenance. Permanent surfaces that are easily cleaned and not susceptible to color changing or surface chipping have strong credentials for use in those areas where public abuse or high frequency traffic is likely or ex-



Plastic-laminate partitions in the installment booths (right) *and the safety-deposit coupon booths* (above) *are shop-built, shipped flat—permiting dry-wall construction on the job and shop wiring for the electrical network in the coupon booths.*



Hidden plastics used here are the thermosetting type which sandwiches blocks of the screen, designed by Erwin Hauer; and plastic-laminate on the other side of the tellers' counter.

pected. There are many textured-vinyl wall coverings available now that help immeasurable in adding interest to long corridors and relieve the institutional look. While the strongest recommendations for plastics, at the moment, come from the general area of maintenance considerations, we do not feel that their employment is limited to strictly functional areas but that they can be used with discretion throughout a building. We have found the simplest textures to be the most successful visually and stay away from artificial patterns or surfaces which try to disguise the nature of the material. As far as the future is concerned, we see no reason to believe other than that further developments in

The gypsum-cement screen wraps around the vault; two Bertoia screens separate entrances from banking area.

the plastics industry will expend greatly the number of products and their uses for both the product designer and the interior designer.

DATA: descriptions and sources of the major materials and furnishings shown.

CABINETWORK, SCREENS, PARTITIONS
Tellers' Counter: teak veneer facing/plastic-laminate top/Consoweld Corp., Wisconsin Rapids, Wis.; travertine ledge/custom-made. **Screen:** gypsum-cement blocks/designed by Erwin Hauer/Murals, Inc., 16 E. 53 St., New York, N. Y. **Coupon Booth Partitions:** white, blue, and yellow plastic-laminate/white plastic-laminate writing shelf/black plastic-laminate edge/Consoweld Corp.

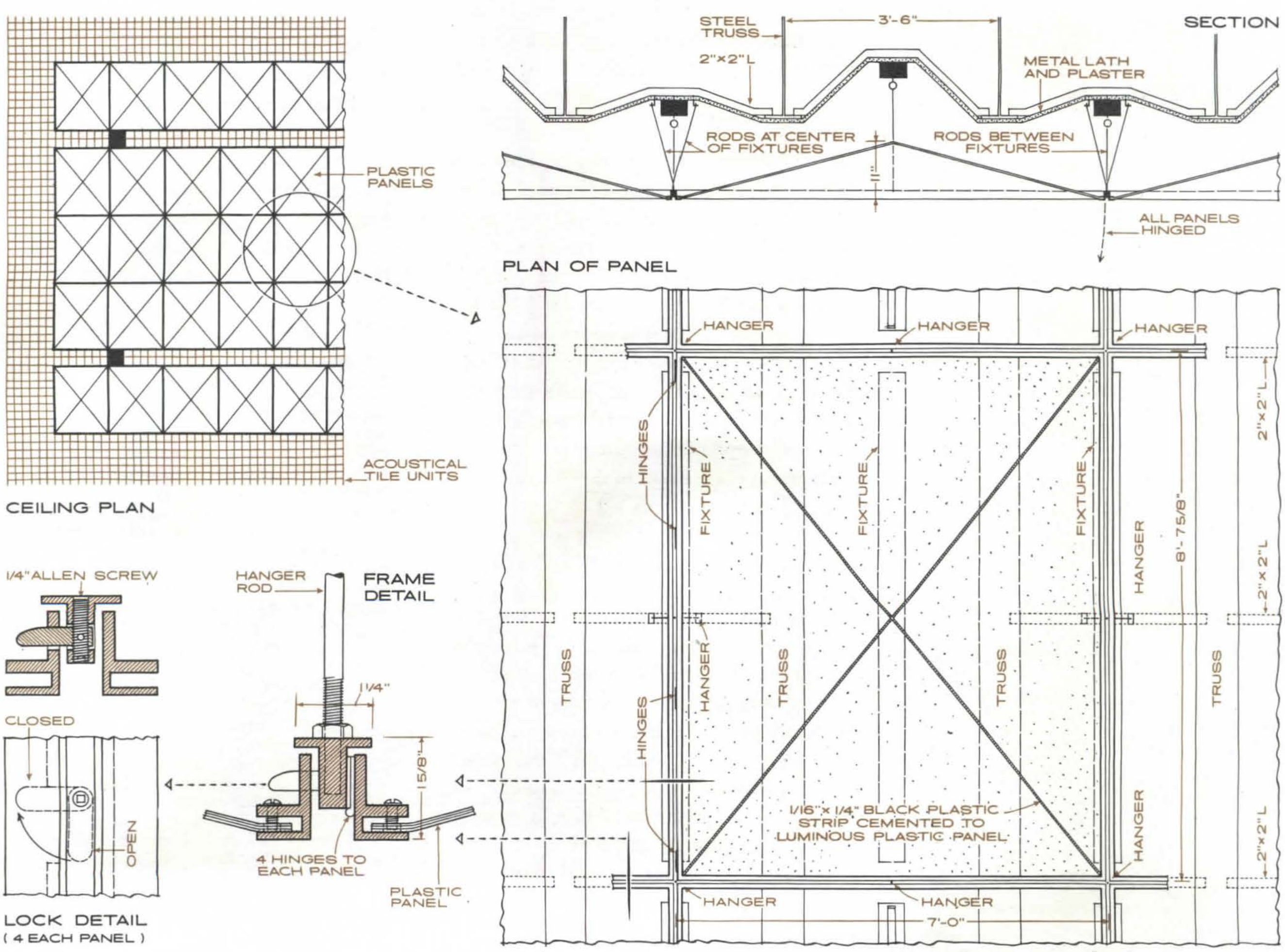
DOORS, WINDOWS
Coupon Booth Doors: white plastic-laminate/Consoweld Corp. **Windows:** white-wool casement draperies/Knoll Associates, Inc., 575 Madison Ave., New York, N. Y.

FURNITURE, FABRICS
Check-Writing Tables: teak pedestals/Italian Cremo tops/brushed-chrome base/custom made. **All Others:** desks with teak-veneer tops, walnut pedestals/tables, chairs with brushed-chrome bases/upholstery in beige leather; beige, red, and blue wool; nylon and vinyl in booths/Knoll Associates, Inc.

LIGHTING
Luminous Ceiling: translucent-plastic panels/Colonial Plastics Corp., 22 Nesbitt, Newark, N. J.; fluorescent fixtures/Kurt Versen Co., 4 Slocum Ave., Englewood, N. J.; custom-made. **General:** recessed incandescent fixtures/Kurt Versen Co. **Coupon Booths:** built-in cornice with supplementary fluorescent fixtures/Gotham Lighting Corp., 37-01 31 St., Long Island City 1, N. Y.

WALLS, CEILING, FLOORING
Walls: brown marble/Candoro Marble Co., P. O. Box 631, Knoxville 1, Tenn.; white, yellow, or blue vinyl on plaster/Vicrtex/L. E. Carpenter & Co., Inc., 350 Fifth Ave., New York, N. Y. **Ceiling:** white acoustic tile/Travertone/Armstrong Cork Co., Lancaster, Pa.

ACCESSORIES
Wastebaskets: black, tan vinyl and leather/Knoll Associates, Inc. **Planters:** white plastic-laminate box/brushed-chrome base/custom-made.



Constant use of furniture—by some 6000 persons each day—demanded vinyl upholstery and other plastics.

Student Center

LOEB STUDENT CENTER, NYU • NEW YORK, NEW YORK • HARRISON & ABRAMOVITZ, ARCHITECTS • GEORGE NELSON & COMPANY, INC., INTERIOR DESIGNERS

George Nelson Perhaps the best way to evaluate plastics as currently used in interiors, and to form an estimate of future possibilities might be to evaluate these materials in terms of the broad general trends in building. These trends include: the replacement of handwork with prefabricated assemblies wherever possible; reduction of maintenance costs and the time needed for erection and installations; increased emphasis on adequate lighting and increased attention to noise reduction. These are by no means all of the significant trends, but taken as a group they serve to make clear the success with which plastics are finding new applications in the contemporary interior. Typical examples, by now fairly common, include lightweight translucent-plastic ceilings, synthetic floor and carpeting materials, the use of plastic sheets on walls to replace painted surfaces, the introduction of foam and honeycomb materials to reduce the weight of demountable partitions, the gradual elimination of wood in furniture in favor of metal, and the increasing use of reinforced plastics to replace metal. Given the extreme versatility of various families of plastics at the present time and assuming as certain the development of new formulations with superior characteristics, one can take it for granted that the current expanding use of plastics in these areas will continue indefinitely into the future.

Since specific information on plastics as used at the Loeb Student Center follows in your data listing, my comments are of a fairly general nature.

DATA: descriptions and sources of the major materials and furnishings shown.

CABINETWORK

Built-in Radiator Cover/Bench: white plastic-laminate/wood top covered with yellow vinyl-upholstered cushions/architect-designed/custom-made/Roof Structures, Inc., 45 W. 45 St., New York, N. Y.

WINDOWS

Frame: gray, etched, alumilited aluminum/Aluminum Company of America, 1501 Alcoa Building, Pittsburgh 19, Pa. **Draperies:** orange, yellow, green stripe/Saran/custom-made/Marie Nichols Fabrics, 151 E. 53 St., New York, N. Y.

FURNITURE, FABRICS

All: black or ochre vinyl upholstery/Herman Miller Furniture Co., Zeeland, Mich.

LIGHTING

Recessed Fixtures: incandescent/Eastern Lighting Products Corp., 15 Somers St., Brooklyn, N. Y.

WALLS, CEILING, FLOORING

Walls: white vinyl/Stipl-tex/Vicrtex/L. E. Carpenter & Co., Inc., 350 Fifth Ave., New York, N. Y.; natural-color English oak panels/Flexwood/United States Plywood Corp., 55 W. 44 St., New York 36, N. Y. **Ceiling:** acoustic tile/Travacoustic/National Gypsum Co., 325 Delaware Ave., Buffalo 2, N. Y. **Flooring:** asphalt tile/black and white straited/Kentile, Inc., 58 Second Ave., Brooklyn, N. Y.; wool carpet/black, black-and-white striped runners/gold, olive-green circles/specially-designed/custom-made/Frischer Carpet, 400 Madison Ave., New York, N. Y.

Employes' lounge also used for community activities, displays Eero Saarinen's plastic pedestal furniture.

Lounge

BERKSHIRE LIFE INSURANCE COMPANY • PITTSFIELD, MASSACHUSETTS • HOYLE, DORAN & BERRY, ARCHITECTS • DESIGNS FOR BUSINESS, INC., INTERIOR DESIGNERS • G. LUSS, VICE-PRESIDENT AND DIRECTOR OF DESIGN • HENRY MUHR, PROJECT DESIGNER • EMIL DOVAN, PROJECT DECORATOR

Gerald Luss The types of materials used in the contemporary office must take into account initial cost, maintenance, esthetics, function, and durability. Because plastics and plasticizing processes take care of such requirements to an impressive degree, they are widely applied in today's office. A major attraction is the fact that plastics are relatively easy to clean and maintain. In pool areas housing clerks, secretaries, or bookkeepers, or in other areas of much traffic and use such as cafeterias and rest rooms, materials that are easily maintained are a big cost plus. There is another aspect too. Materials that can be kept fresh, clean, and bright looking bring a sense of order to things and make work more productive. Plastics have long life potential too, are lightweight, and can be manipulated into unlimited creative design. These advantages explain why there is a big market for plastic products, furniture, etc., and plastic processing—in today's office. And this market has been instrumental in stimulating all kinds of continuing experimentation—for wall coverings, finishes, products, and as a light diffuser as well.

DATA: descriptions and sources of the major materials and furnishings shown.

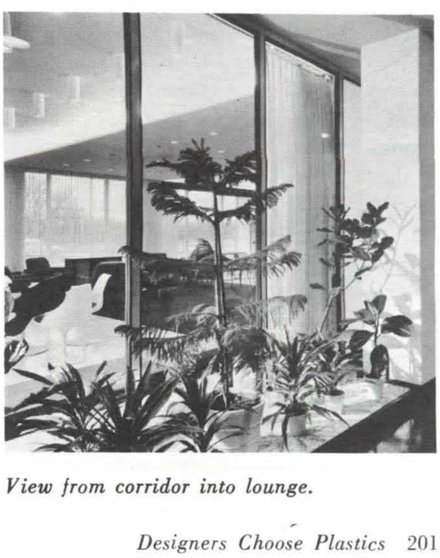
PARTITIONS
All: aluminum posts/Aetna Steel Products Corp., 730 Fifth Ave., New York, N. Y.; clear glass/Pittsburgh Plate Glass Co., 632 Duquesne Way, Pittsburgh, Pa.; hue white/Muralex/Libbey-Owens-Ford Glass Co., 608 Madison Ave., Toledo, Ohio; designed by G. Luss/custom-made.

DOORS, WINDOWS
Doors: floor-to-ceiling flush steel/black-enamel finish/designed by G. Luss/custom-made/Aetna Steel Products Corp. **Blinds:** wood woven with chenille/black/Tropicraft of San Francisco, 14 Sherwood Place, San Francisco 3, Calif. **Casements:** white, sheer, striped fishnet and wool surf/Isabel Scott Fabrics Corp., 515 Madison Ave., New York, N. Y.

FURNITURE, FABRICS
Sofas, Arm Chairs: Dux, Inc., 1633 Advian Rd., Burlingame, Calif.; high-back arm chair/George Tanier, Inc., 521 Madison Ave., New York, N. Y. **Benches:** custom-made/Ezra Blank Associates, Inc., 500 Stagg St., Brooklyn, N. Y. **Pedestal Table, Chairs:** reinforced-plastic shell chair with fused-on plastic finish/tables with plastic-laminate, marble, wood tops/pedestal with fused-on plastic finish/Knoll Associates, Inc., 575 Madison Ave., New York, N. Y.

LIGHTING
Ceiling-Installed: alternating 14-ft-wide areas/recessed downlights, fluorescent coves, surface mounted incandescents/Century Lighting, Inc., 521 W. 43 St., New York, N. Y.

WALLS, CEILING, FLOORING
Perimeter Walls, Column Facing: white vinyl Stipltex/Vicrtex/L. E. Carpenter & Co., Inc., 350 Fifth Ave., New York, N. Y. **Ceiling:** white acoustic plaster. **Flooring:** black-and-white rubber tile alternating with charcoal-and-black wool carpet/Weil Bros. Textiles, Inc., 1 Park Ave., New York, N. Y.



View from corridor into lounge.

FUTURE: ROLE OF THE CHEMIST

BY JAMES H. KRIEGER

It is indisputable that plastics in construction are here to stay. The extent of their future growth in building and acceptance by architects and other designers will be affected by many factors—their ability to provide proper performance, further education in orderly application techniques, improved properties and characteristics, and new plastics as yet unborn, to name a few. The role of the chemist in this growth is especially concerned with the latter of these factors. His particular brand of alchemy and the tools and limitations that he must contend with are the subject of this discussion, prepared by an Associate Editor of Chemical and Engineering News, *a publication of the American Chemical Society.*

It would be wonderful if the chemist could find that one magic material which would give the architect complete freedom in designing his structures. This will probably never happen. But in today's plastics, the chemical industry has given the architect a group of materials that, as a whole, provide him with perhaps the widest range of properties of any of the building materials.

As the chemical industry has become more acquainted with building needs, it has provided an increasing array of products. These can generally be sorted into the different families of plastics, with the vinyls, styrenes, polyethylenes, acrylics, polyesters, phenolics, ureas, melamines, and urethanes being the most important from the architectural viewpoint. Within each of these families, many variations are possible, resulting in a group of products "tailored" to meet the architect's needs.

Today the chemist can perform this "tailoring" to a great extent, manipulating properties of a plastic material to suit it especially for construction use. He can change many properties at the source, by synthesis, or he can change them later during compounding. Molding and fabrication techniques can further enhance the material. In the future, tailor-made plastics with specific built-in properties will undoubtedly become even more common, as new families of plastics are discovered and new ways of making and handling them are developed.

On the other hand, the chemist is not all-powerful. Once saddled with a particular chemical structure, he can go only so far in changing the properties of the final material. Each plastics family might be thought of as having a sphere of modification beyond which the chemist cannot go. However, new developments as they come along can be expected to expand this sphere somewhat.

New developments affecting architectural products will show up in all areas of processing—synthesis, formulation, and fabrication. These areas are intimately connected, each entering into the final product, but the extent to which they influence one another, and the way in which they are carried out, depends primarily upon the nature of the basic plastic material.

Basic Difference Between Plastics

Plastics have a common meeting ground by way of definition. They are all polymers, giant long-chain molecules made up of repeating units. These units—or monomers—are molecules of the original chemical from which the plastic is made. It is from these units, to a varying extent, that plastics get some of their basic properties, such as chemical resistance, flame resistance, heat stability, and electrical nature. Polyvinyl chloride, for example, is inherently flame resistant because of the chlorine atom in the vinyl-chloride molecule.

Polymers are formed by one one of two types of reactions—addition polymerization and condensation polymerization. For the architect, this is perhaps the most important difference between plastics, since addition gives rise to the thermoplastics (vinyls, styrenes, polyethylenes), and condensation forms the thermosetting materials (polyesters, phenolics, ureas, melamines). This influences the way the two groups of materials are processed, which in turn leads to the wide deviation in properties and use.

The major processing difference is that thermosets generally have fillers such as glass-fiber or wood-flour, while thermoplastics are generally unfilled. The resulting influence on properties is that thermoplastics derive their properties from the polymer molecules and the chemical additives, while thermosets have their properties (such as tensile strength, modulus, and toughness) mostly controlled by the filler.

The Two Polymerization Mechanisms

A look at the two polymerization mechanisms, along with their processing techniques, shows why these differences exist.

Condensation polymerization occurs when two different molecules react, usually splitting out water, to become the repeating unit in the polymer chain. These units tie up by means of the same reaction: chains add on to chains. For example, phenol and formaldehyde react to form phenol formaldehyde, with this compound repeated over and over again in the polymer.

Addition polymerization, in contrast, occurs when one molecule hooks on to another like molecule, as in the case of polyethylene; one ethylene unit hooks on to another ethylene unit. A catalyst is needed in this type of polymerization to activate individual molecules that start the reaction. Once activated, an addition polymer continues to build up, one unit at a time, until all of the monomer units are used up.

Differences in Molecular Structure

The long molecules of the thermoplastics are coiled and intertwined in a monstrous tangle. At normal temperatures the molecules lie quiet. However, with heating they begin to move around, and the plastic, which was rigid, becomes flexible. With further heating, the molecules slip and slide over one another; the plastic "melts" and becomes fluid. If the plastic is cooled at this point, it goes back to its original state, but if heated still further it decomposes.

Processing takes advantage of this characteristic. The plastic is polymerized to its final molecular weight. A solid, the material is then fabricated (injection molding, extrusion, calendering, and the like) by heating it to make it fluid, then quickly cooling it after it is shaped. The form of the material and the manner of processing make addition of a filler quite difficult.

Thermosets have a high degree of cross-linking—chemical bonds (rather than physical tangles) between molecules at points along the polymer chains. As a result the chains are held tightly together. With heating, therefore, thermosets do not become fluid, but remain solid up to their decomposition temperature. During production, polymerization of the material is stopped before it is completed, making it easy to put a filler in the plastic (or use the plastic for impregnating), form it in a mold, and then finish the polymerization.

Control of Molecular Weight

The above is the basic framework within which the chemist operates. With the restrictions imposed on him, what can he do to build properties into a material?

At the synthesis level, the chemist has several techniques (including control of molecular weight, control of crystallinity, and copolymerization) that can be used singly or in combination to get a final product with desired properties.

Molecular weight is one of the more important variables affecting final properties—both from the ultimate structural standpoint (softening point, strength) and from the processing standpoint (melt flow, solution viscosity). Not all molecules grow to the same length, or therefore, the same molecular weight; as a result, the molecular weight for a given material is the average of all the molecules. This average, however, can be controlled by adjusting process variables (such as time, temperature, and amount and kind of catalyst).

Influence of Crystallinity

Crystallinity, like molecular weight, has a strong influence on final properties. Plastics fall into two categories: amorphous and partly crystalline—amorphous polymers are those which have a completely disorganized tangle of molecules, while in crystalline polymers, short sections of adjacent-molecule chains line up parallel to one another and form regular crystal lattices. The same chains may then go on to intertwine and tangle in the amorphous area that exists between crystals and serves to hold the crystals together.

Crystallinity control is an example of how the chemist must often strike a balance between enhancing certain desirable properties while at the same time degrading others. With polyethylene, for instance, an increase in crystallinity increases stiffness, resistance to heat distortion, and vapor permeability; simultaneously, it also decreases toughness and resistance to stress cracking, among other properties.

Polyethylene's crystallinity can be increased during polymerization by making the molecules linear—a condition where the molecular backbone has few or no side chains branching from it. Other plastics, though, might call for mechanical methods to control crystallinity. In the case of saran, a polymer containing 50 percent or more vinylidene chloride, the cooling rate is a determining factor; a quick quench, when the material is still hot from processing, imparts crystallinity.

Combination with Other Materials

Copolymerization is a versatile technique for designing properties into a plastic at the synthesis stage. The process is a method of combining properties of a second material with those of the original; a copolymer therefore contains two different repeating monomeric units in the molecular chain. One degree of control in copolymerization is the ratio of monomers, but beyond this, the chemist can also control the way in which the two monomers combine.

The simplest copolymer form is one where the two different monomer units hook up at random, or alternate, in the polymer molecule. If, however, the copolymer is made up of molecules in which the alternating units are actually short-chain polymers of the different materials, it is known as a block copolymer. There is still another type: the graft copolymer, which has polymers (generally short chains) of one material attached to the molecular long-chain backbone of the other material.

Block and graft copolymerization are relatively new from the commercial standpoint, although they have been used to advantage in a number of applications. Some of the high-impact polystyrenes, for example, are made by grafting styrene-butadiene rubber molecules to a polystyrene backbone.

Formulation with Additives

When the chemist reaches the limits of his freedom at the synthesis level, he has another tool to use: formulation. Actually, formulation is not necessarily imposed on synthesis; the two are generally combined to give the desired result, and the amount each contributes to the final product will vary for each plastics family. Polyethylene's properties come mostly from the method of synthesis, while the many varied forms of polyvinyl chloride, on the other hand, derive most of their properties from formulation with additives.

Formulation includes polymer blending as well as the use of additives. Blending not only helps to upgrade properties, but can also be used to change processing characteristics; adding high-polymer materials that lower flow-temperature improves the processing behavior of polyvinyl chloride, for instance. An example of blending, that enhances final properties, can be found in the group of the impact resistant polystyrenes, which get their toughness from mixing styrene polymer with some type of rubber.

Additives, too, fulfill both functions. Heat stabilizers might be added, for example, to protect the material during processing. If the material has to withstand sunlight, chemicals that absorb ultraviolet radiation might be used. Other chemicals might be added to increase flame resistance. These types of additives must be chosen carefully, however, since they should not interfere with the final properties of the processing characteristics.

Plasticizers are probably the additives that give the most noticeable effect. These chemicals act as lubricants between polymer molecules, enabling the molecules to slip and slide over each other much the same as they would do upon being heated. The result is a flexible material, whereas the original polymer was rigid.

Effects by Fabrication

One final area in which the chemist—perhaps more rightly called the chemical technologist—can exert an influence on a plastic's properties is fabrication. Fabrication ordinarily serves only to put the plastic material into a usable shape or form; at the same time, however, it can add desirable properties, as in the case of foams. Plastics have low thermal conductivity to begin with, and foaming takes advantage of this quality, extending it still further to make highly efficient insulation. Styrene foam, for example, has about one fourth the thermal conductivity of solid styrene.

Conclusion

These, then, are the tools that the chemist uses and the limitations he fights. Some of these limitations are chemical: undiscovered polymers, too little knowledge of chemical mechanisms, and the like. Some are technological: pure polyvinyl chloride, for example, cannot be processed in today's equipment because of its high melting point. Still other limitations are economic: costs in certain areas of technology are too high, leaving some materials and some property ranges unexploited. But as these limitations are overcome, the architect can look forward to new materials and to even better performance from those already in existence.

Plastics: Ceiling Efficiency Three Ways

BY WILLIAM J. McGUINNESS

A mechanical engineer reports on his inspection of a new office-building ceiling installation that differs from others of its kind in almost every respect.

Plastic material makes three major contributions to the 800,000 sq ft of ceiling in the new Union Carbide Building on Park Avenue, New York. Formed into three-layer diffuser panels, it provides a specular sky over all spaces: offices, large and small, and corridors. As a gasket around the edge of each tightly-closed luminaire casing it excludes dust and thus improves the permanent maintenance factor of the fixture. The third contribution, a second function of the gasket, is to afford an acoustic air seal between the plastic diffuser panels and the ceiling divided strips. The principle of this seal, especially valuable for contiguous, small offices, is to aid in reducing the sound transmission between offices through what, in the past, has often been a noise-leaking acoustic plenum (the space above the hung ceiling).

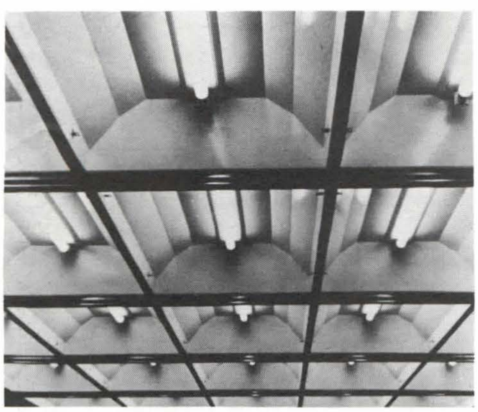
In developing this ceiling, the architectural firm Skidmore, Owings & Merrill has drawn strongly from its fund of experience with similar installations, yet this latest effort is different in almost every respect from other ceilings of its kind. Using virtually no standard parts, it represents the collaborative efforts of the architect, of a number of esthetic and technical design consultants, and of manufacturers and contractors. It is highly efficient in illumination, maintenance, and privacy.

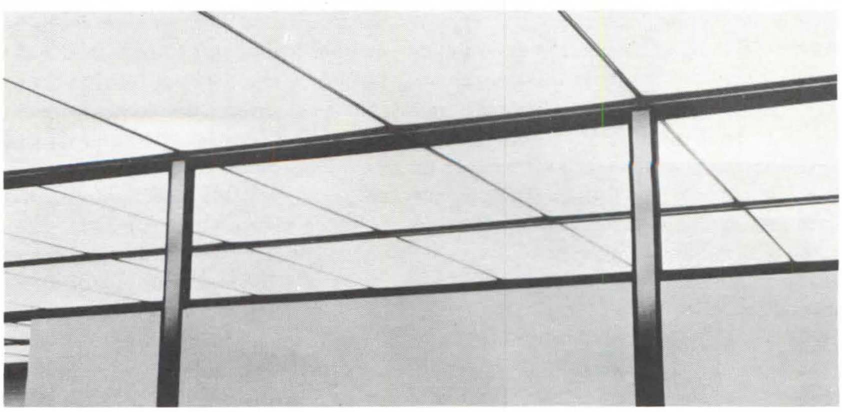
The plastic diffuser panels afford a maximum of low-brightness light source area between truly minimal divider-strip widths. Three layers of plastic were fused together for the material used. It was then formed into pans and edged with lightweight integral aluminum frames. These assemblies are suspended lightly from the four brackets on the enameled-metal reflector-type luminaire casing. The aluminum edges of the panel frame turn up against the plastic gasket. From below, only the flush plastic-panel surface is visible against the stainless steel of the major and minor runners. An efficiency statement of 4 per sq ft of floor area, for almost 80 ft-c at working level, is an index of the effective translucence of this material as a vehicle for the light received from the efficient luminaire above.

The laminations of the luminous panels consist of two layers of 0.015″ Bakelite rigid vinyl sheet, plus a layer of 0.001″ Krene cast-vinyl film on the inside—facing the light. This upper layer is hard and very smooth; dust can be wiped from it easily. Also, it absorbs ultraviolet light from the source that would be harmful to the layers below.

The polyurethane gasket prevents dust and sound from effectively passing from the room to the luminaire, or from the room to the space between the luminaires. The light fixtures, edge-to-edge inverted "bathtubs," exclude from above, the dust that would normally settle on and around the tube and its luminaire. The concept of these dust-proof chambers, also sealed from below by a gasketted plastic soffit, makes it easy to comprehend their high maintenance factor.

Bolt, Beranek & Newman have achieved maximum reduction of sound transmission —both from floor above to occupied space below, and from any office to another adjoining it on the other side of a partition. In the first instance, the sound must pass through three surfaces and two air spaces: namely the structural floor, the space above the luminaires, the metal reflector, the volume enclosed by the "bathtub," and the plastic panel. In office-to-office isolation, the sound is retarded by 3 air spaces and four surfaces as it attempts to escape *over* the partition. It must pass a plastic diffuser, luminaire air space, the metal reflector, the hung-ceiling space, and then penetrate the adjacent fixture surfaces and space in reverse order. In this process of sound retardation, the plastic gasket evidently prevents a direct escape which would circumvent the beneficial damping of these numerous sound-blocks in cumulative effect.





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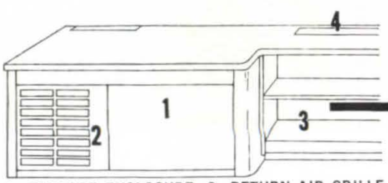

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Plastics Permeate Specifications Sections

BY HAROLD J. ROSEN

Plastics as a material of building construction are a reality, as their increasing appearance in specifications indicates. Enumerated here, in a typical listing, are sections that reveal the scope of plastics in architecture.

Building materials for use in construction, formed from plastics, have had a tremendous growth in recent years. The introduction into building construction of materials made from plastics has taken a concerted effort by manufacturers, fabricators, architects, and engineers. It has required research, exploration, tests, and use by imaginative architects and owners to overcome the problems first associated with plastics in its various forms.

Many plastics have already proved their worth in certain areas of building construction and are today accepted as standard building materials.

To appreciate the extent to which plastics have become identified as building materials, a typical listing of specifications sections outlined herein illustrates dramatically the scope of plastics as materials of building construction.

Under the heading of "Concrete Work," plastics are used as follows:

1 As a vapor barrier for slabs on grade: polyethylene.
2 As a form board for smooth concrete surfaces: plastic-faced plywood.
3 As a perimeter insulation: expanded polystyrene.
4 As waterstops: polyvinyl.
5 As an expansion joint material: polysulfides.
6 As a bonding agent: epoxy coatings.

Under the heading of "Masonry Work," plastics are used as follows:

1 Facing of concrete block: reinforced polyesters.
2 Insulation of air spaces in cavity walls: expanded polystyrene.

Under the heading of "Waterproofing," plastics are used as follows:

1 As spandrel waterproofing: vinyls.
2 As shower stall pans: vinyls.

Under the heading of "Roofing and Sheet Metal," plastics are used as follows:

1 As gutters and leaders: reinforced polyesters.
2 As vapor barriers: vinyl films.
3 As flashing materials: polyvinyls.
4 As roof coatings: neoprenes and chlorosulfonated polyethylene.
5 As roof insulation: expanded polystyrene.
6 As skylights: reinforced polyesters and acrylics.
7 As roof structures, i.e. sheets, plates, domes: glass-fiber reinforced polyesters.

Under the heading of "Calking and Weatherstripping" plastics are used as follows:

1 As calking: polysulfides.
2 As weatherstripping: vinyl.

Under the heading of "Carpentry and Millwork" plastics are used as follows:

1 As laminated-plastic surfaces on wood doors: melamine resins.
2 As waterproof glues: phenol resins and resorcinol resins.
3 As interior office partitions: melamine laminates and vinyl-impregnated fabric covering over metal or wood.
4 As counter-tops: melamine laminates.

Under the heading of "Resilient Flooring" plastics are used as follows:

1 Vinyl-asbestos tile.
2 Homogeneous vinyl.
3 Felt-backed laminated-vinyl sheet and tile flooring.

Under the heading of "Builders Hardware" plastics are used as follows:

1 Kick, mop, and armor plate: phenolic resins.
2 Pushes, pulls: polyvinyl chlorides.
3 Guides and pivots: nylon.

Under the heading of "Glass and Glazing" plastics are used as follows:

1 Glazing: reinforced polyesters and acrylics.
2 Sealants: polysulfides.

Under the heading of "Tile and Terrazzo" plastics are used as follows:

1 Plastic Wall tile: reinforced-polyesters, polystyrene.
2 Terrazzo divider strips: polyvinyls.
3 Thin setting beds for ceramic tile: synthetic rubber compounds.
4 Latex terrazzo mixes.
5 Bonding agents for terrazzo: epoxy coatings.

Under the heading of "Acoustic Treatment" plastics are used as follows:

1 Plastic-faced acoustical tile: polyvinyl.
2 Plastic channels at abutting vertical surfaces.

Under the heading of "Painting and Finishing" plastics are used as follows:

1 Paints: polyvinyl acetates, acrylics, epoxies, butadiene-styrene. This list is constantly expanding as a result of research by paint chemists.
2 Wall coverings: sprayed vinyls on fabric backing, calendered vinyls.

In the mechanical and electrical field, plastics have been introduced quite extensively too. Luminous ceilings employ the use of plastics to diffuse light evenly from its point source. Polyvinylchloride pipe is used in piping systems for distilled water and chemical wastes. Laboratory equipment utilizes plastics for fume exhaust ducts and laboratory counter tops. Electrical conductors are insulated with plastic coverings.

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Flaws in Article 34

BY JUDGE BERNARD TOMSON & NORMAN COPLAN

Judge Bernard Tomson and Attorney Norman Coplan discuss a recent New York Appellate Court decision (Snyder Plumbing and Heating *vs.* Purcell, 9 A. D. 2nd 505) *and point to the ineffectiveness of certain parts of Article 34 of the AIA "General Conditions."*

In the *Snyder* case, the County of Rockland in New York entered into separate contracts with a plumbing contractor and a general contractor for the construction of a home and infirmary. These contracts incorporated the AIA "General Conditions" and described the work to be performed by each of the contractors.

Prior to the plumbing contractor's suit against the general contractor, he had commenced an action against the County of Rockland for damages attributable to the delay caused by the County in the erection of the project. This suit was settled by the payment of a certain sum of money to the plumbing contracting company, and reserved to it any rights "which it may have against any of the other contractors involved in the construction of the project."

The plumbing contractor, after the settlement with the owner, demanded arbitration of his further claim against the general contractor that the latter had caused him additional damage because of his delaying the work. This demand for arbitration was rejected by the Court on the ground that there was no contractual relationship between the plumbing contractor and the general contractor pursuant to which such arbitration was required.

Thereafter, an action was commenced by the plumbing contractor against the general contractor to recover damages allegedly sustained as a result of the general contractor's improper performance. This action was based upon certain of the "General Conditions" incorporated in the contract between the general contractor and the owner, and in particular, upon Article 34 which read as follows:

"Art. 34. Mutual Responsibiity of Contractors.—If, through acts of neglect on the part of the Contractor, any other Contractor or any Subcontractor shall suffer loss of damages on the work the Contractor agrees to settle with such other Contractor or Subcontractor by agreement or arbitration, if such other Contractor or Subcontractor will so settle. If such other Contractor or Subcontractor shall assert any claim against the Owner on account of any damage alleged to have been so sustained, the Owner shall notify the Contractor who shall defend, at his own expense any suit based upon such claim, and if any judgment or claims against the Owner shall be allowed, the Contractor shall pay or satisfy such judgment or claim and pay all costs and expenses in connection therewith."

The Court, in dismissing the action, ruled that Article 34 was for the benefit of the owner, and could not support a proceeding by one contractor against another. The Court said:

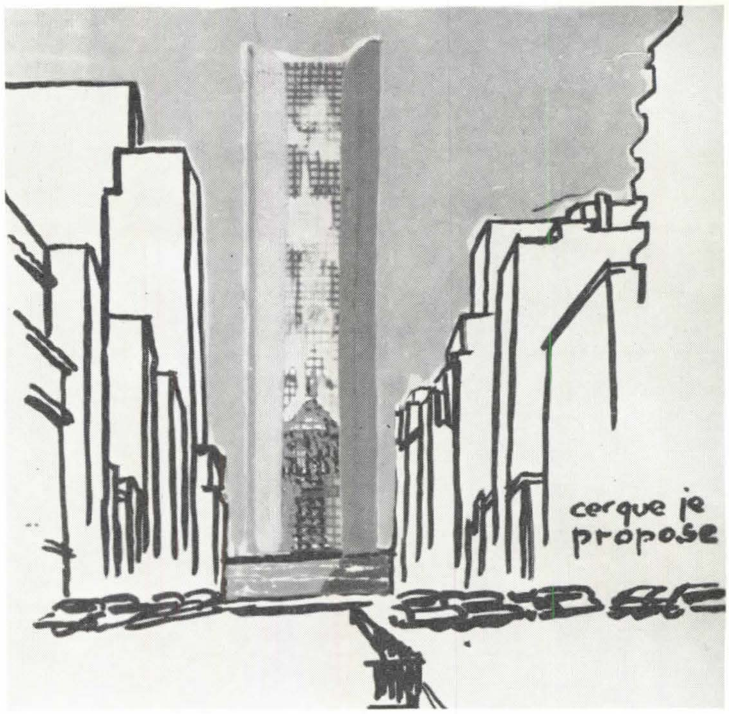
"In its brief, Snyder unequivocally states that Article 34 of the agreement between Purcell and Rockland County gives it the right to proceed *ex contractu* against Purcell as the third-party beneficiary thereunder. We do not so construe the clause. Article 34 is essentially an indemnity provision solely for the benefit of Rockland County and does not create an obligation to any other contractors performing work on the project. Moreover the county never claimed or asserted that Snyder's alleged loss was caused by Purcell. In fact, after asserting its claim for damages against the county, Snyder settled its claim and released Rockland County. The county never demanded in indemnification from Purcell at any time. Consequently, no derivative liability on the part of the defendant accrues, nor does the duty to indemnify the plaintiff under the defendant's contract with the county arise. The plaintiff's reservation of rights against the defendant in the release delivered to the county cannot enlarge or alter the scope of the indemnity clause.

"It is the generally accepted rule that the intent to confer a direct benefit on a third party must clearly appear in order to enable such a party, not named in the contract, to recover thereunder. . . . We find no such intent in the contract under consideration here. Snyder, therefore, may not maintain this action against Purcell."

The plumbing contractor could not "settle," or "arbitrate," or institute legal action against the general contractor under the provisions of Article 34. This decision points up the ineffectiveness of that part of Article 34 which provides that any contractor who causes damages to any other contractor or subcontractor shall "settle with such other contractor or subcontractor by agreement or arbitration, if such contractor or subcontractor will so settle." This provision has no legal binding effect, and can be described at best, as an expression of "hope" rather than providing for a sound method of determining disputes or damage claims between two contractors performing on the same project.

In any event, under the wording of Article 34 and the decision of the Court in the *Snyder* case, a contractor, who has not performed in compliance with his obligations under his contract with the owner, cannot be held liable for the damages sustained by another contractor based upon this breach of duty. The only remedy available to such other contractor is to establish, independently of the performance standards contained in the owner's contract, that the contractor who caused him damage was guilty of negligence.

Tower Can Open Or Block Axis



Dear Editor: I became acquainted with your magazine about 15 years ago. It was a time when, unlike other magazines, you had published a great many projects, initiated competitions, and stimulated research into design, in order to encourage the spirit of modern architecture in your country and to illustrate what should be done rather than what one was doing. All this resulted in the works by Stubbins and many others. Since then many years passed and Wright, Neutra, Gropius, and Mies have found solid support in the pages of your magazine. At the present moment, America continues to be a great laboratory of modern architecture; Stone, Rudolph, and Yamasaki try other experiments; Breuer, at The Hague, and Bunshaft, at Brussels, are realizing other plastic expressions in contemporary architecture.

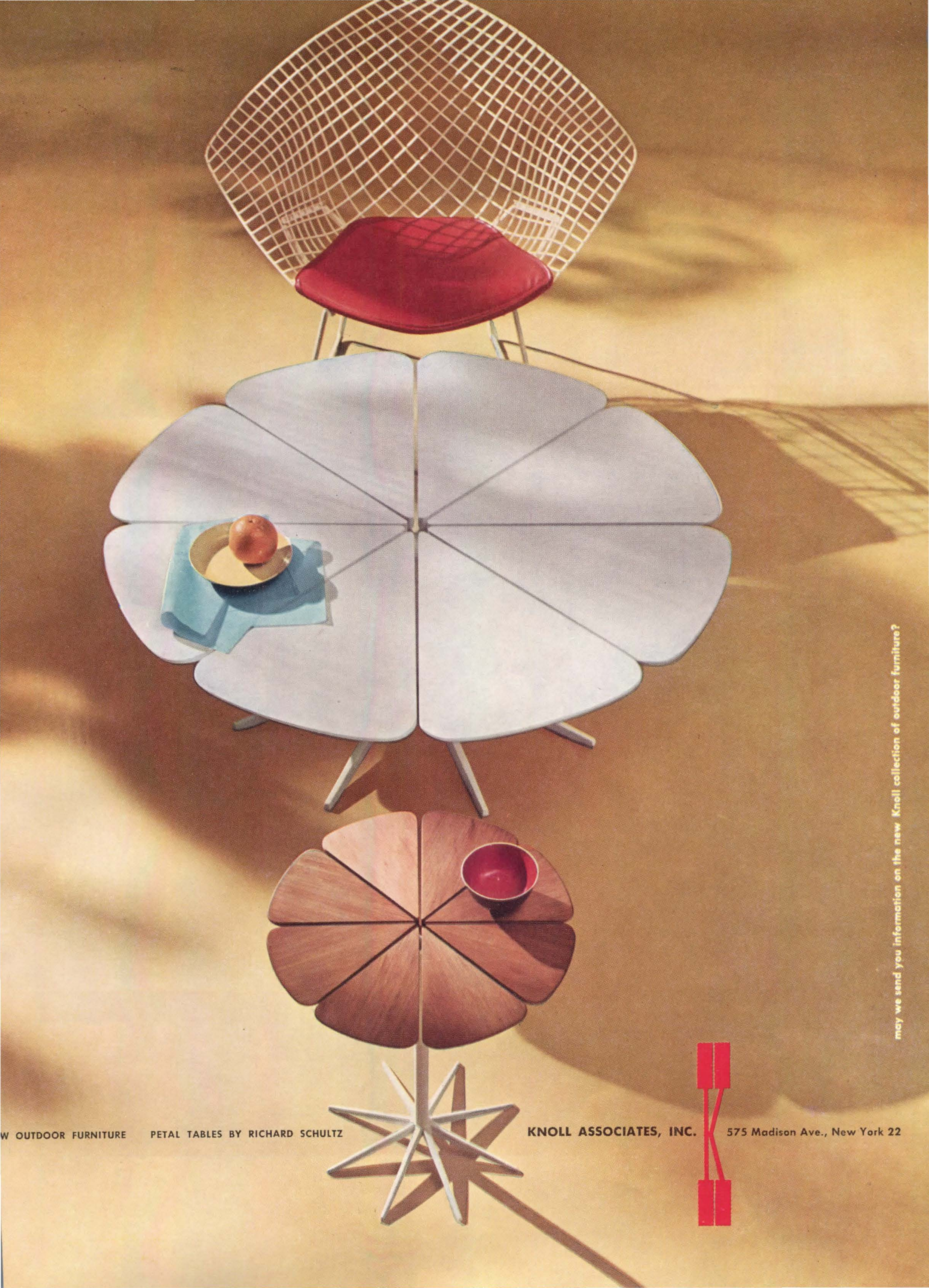
One rejoices to see all this intense emulation. But what does one think of the writer in *Architectural Design* who, in speaking of the work of Stone (published in *Architectural Record* for March, 1959) says, "the work of Edward D. Stone which is shown in this issue fills most modern architects with a sort of fascinated horror. . . ." Certainly, in the end, we are going to know whether the spirit of modern architecture will escape, or a new inspiration will seep in through the openings of these "pierced screens."

Most of the downtowns of the great American urban agglomerations will be reconstructed. Chicago, Baltimore, and San Francisco have new plans for their cities and some of the construction has already started. The number of new skyscrapers, of which all Americans are very proud, is constantly increasing. According to the importance of the building, the site, and the size of structure, proportionate care is taken to assure the best solution. In spite of this, outdated regulations of municipal authorities, exaggerated rentability requirements, excessive utilization of the land, lack of planning foresight, etc. sometimes cause results contrary to the architect's good intentions.

In making some studies of Grand Central City which is to be built in New York, I have the impression that those who were in charge of designing this important project have not found the best *parti*. To prevent what seems to me a complete mistake, I have decided through the publication of a series of letters, to seek the opinion of my colleagues in the profession.

Here are my thoughts. One of the most important skyscrapers that has ever been constructed in New York will be built behind Grand Central Station on the axis of Park Avenue. Its location, in the very heart of the city and in the most congested business section, raises innumerable problems of urbanism and architecture. The lack of a master plan for New York makes it even more difficult to solve the siting of important buildings.

From the point of view of urbanism, one must realize that a building of monumental character, located on the axis of the most important major artery and at the center of gravity of the city, imposes certain *requirements of composition*. At the same time the size of the building demanded by the program calls for a height which will make it a spire as well as the dominant element of a gigantic composition, and in this way will surpass the silhouette of all the skyscrapers existing in New York. It is necessary to bear in mind that the Avenue is on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the average only 45 meters wide while some of the existing skyscrapers bordering it rise to a height of 200 meters. Between these two cliffs of glass and steel there is only the sky and the horizon which are free. Hence, there is the necessity of preserving the characteristic endlessness of New York avenues and not to create opaque screens which would obstruct them.

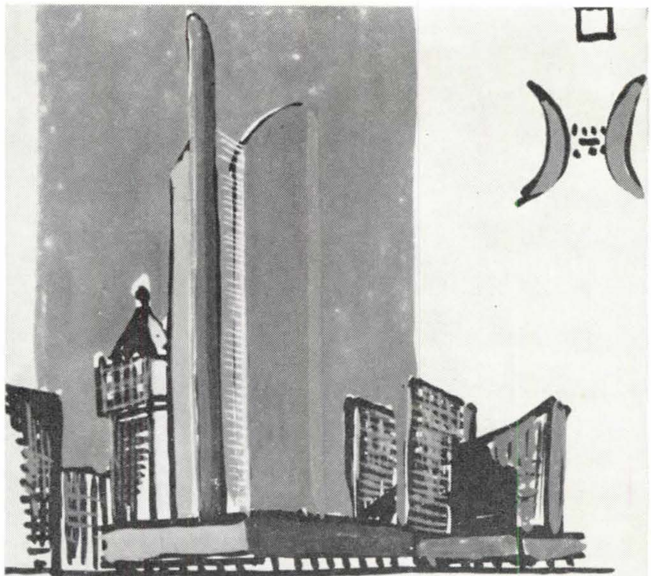
From the architectural point of view, the future building should accommodate all the elements demanded by a complex program consisting of restaurants, movie theaters, garages, and a number of offices occupying an area of 2,500,000 square feet. However, the plan should have considered equally important both the skyscraper tower and the Avenue which passes on both sides of the building.

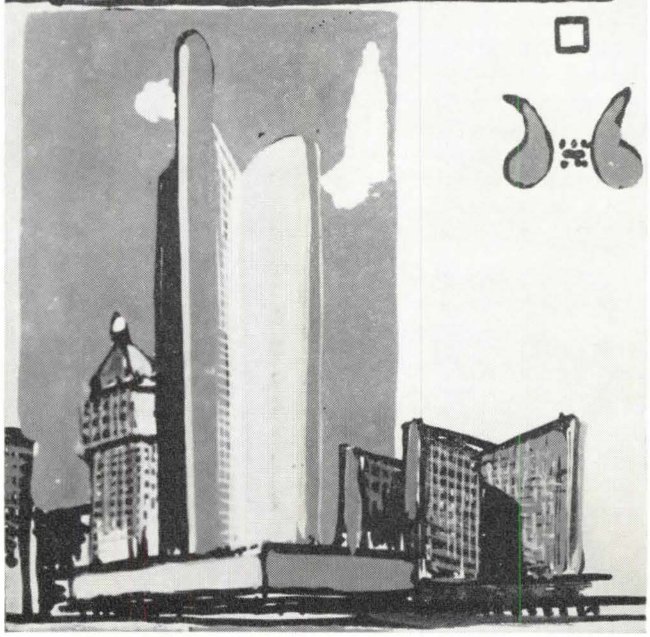
As a solution to this difficult problem Dr. Gropius has presented a project where the tower is an elongated octagon placed perpendicular to the Avenue and thus forming a barricade. It is easy to see that this concept ignores the surrounding space—it has a clear formalistic character and gives the impression that it came from an outdated bag of ideas. The long axial view of the Avenue, the old tower which is part of the composition, and the tremendous circulation around the building have a radial influence. This has not been expressed in the Gropius project either in plan or in the composition of the building.

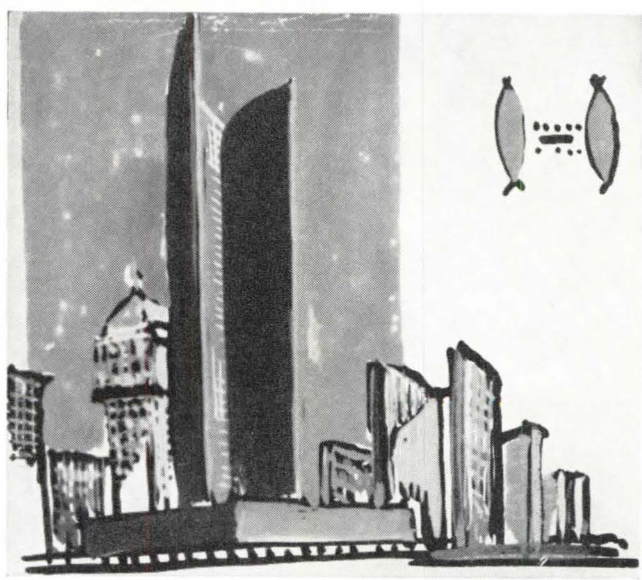
Guided by a different idea, I have sent to those who might be interested some sketches with another concept—a building with a transparent center and two lateral towers which could have different forms.

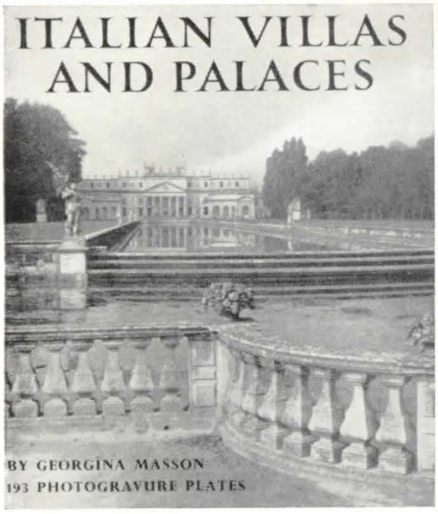
Therefore, we are faced with two ideas: One is the barricade, a wall which stops you. It is a static idea and contrary to the movement within the most dynamic business district in the United States. The second concept allows the Avenue, together with the sun and the sky, to pass through the building. This dynamic idea animates the composition, creating a movement which expresses the intense circulation around the site. The question is one of deciding whether the siting and the massing of the building, its integration into the environmental space, and the representative and symbolic aspects of the movement, are expressed by an octagonal barricade or by a transparent spire, a kind of modern obelisk allowing the Avenue to pass on both sides of Grand Central Station.

MARTIN PINCHIS
Bucharest, Roumania









Settings Reflect Rich Age

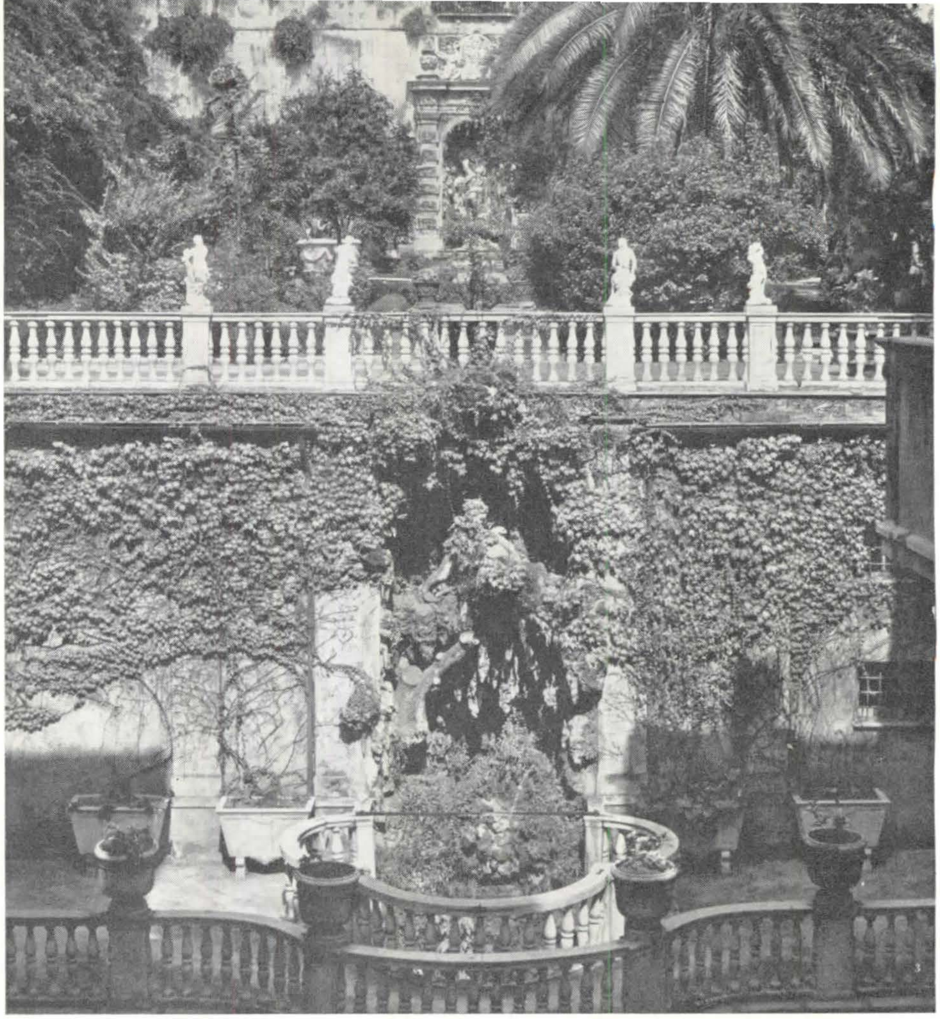
BY ILSE MEISSNER REESE

P/A Contributing Editor recommends Italian Villas and Palaces. *Georgina Masson. Harry N. Abrams, 6 W. 57 St., New York 19, N. Y., 1959. 244 pp., 193 photogravure plates, $17.50*

In this book Miss Masson focuses on the residences of the Italian aristocracy of the Renaissance and Baroque. She has included not only the buildings they commissioned, but also the gardens, furnishings, paintings, and sculptures that reflected the personalities and the periods in which they lived. No less than the great cathedrals and public buildings of the time, these residences are an impressive part of Italy's artistic heritage.

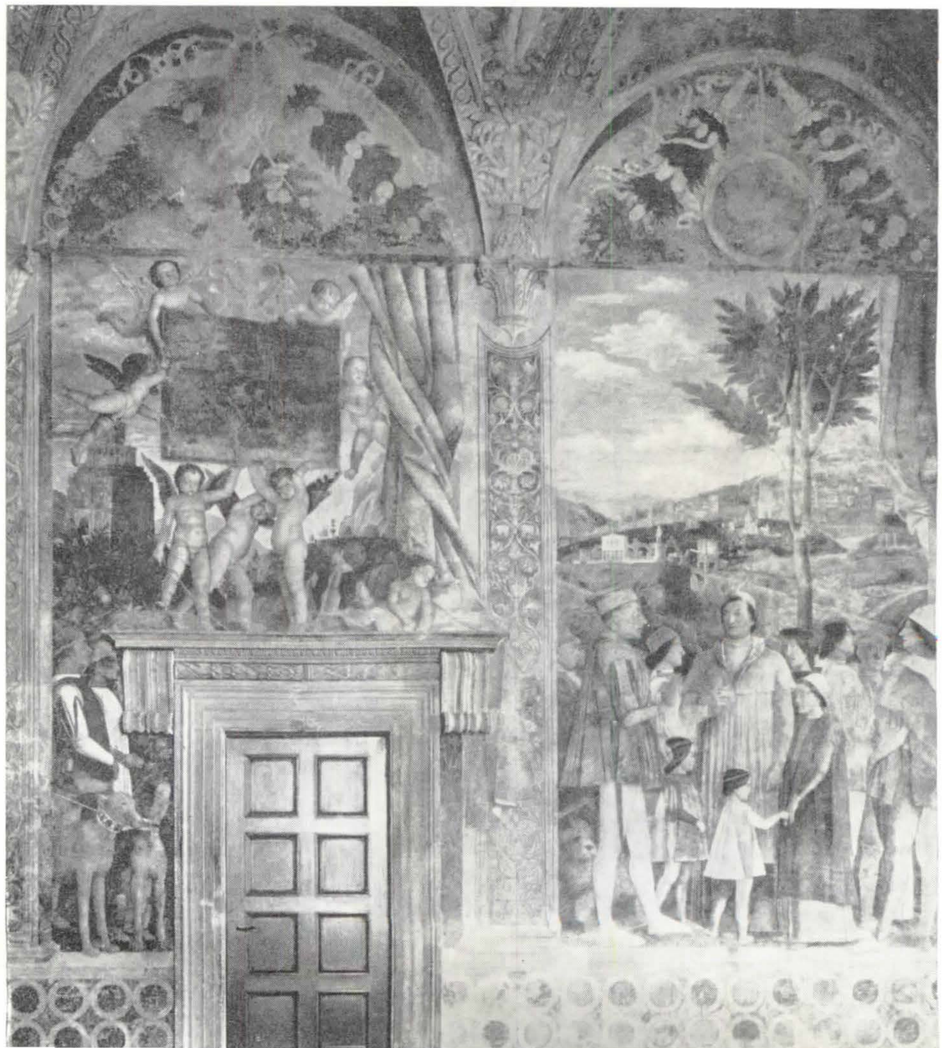
Judged purely as book design, this volume is one of the handsomest of its type I have seen. On inspection of its content, one is assured that it measures up to the book's fine appearance. Miss Masson's material is logically organized, her text is highly informative and readable, and her photographic illustrations are not only expressive but also mouthwatering. In fact, the only disappointment is that one becomes greedy for more of this excellent information—for more photographs, and, particularly in the case of the architect-reader, for the

Continued on page 216



Palazzo Podesta, Genoa. Terraces and fountains of a charming hill garden.

Palazzo Ducale, Mantua. Frescoes by Andrea Mantegna.



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inclusion of plans. Undoubtedly the volume was originally intended to convey visually the essence of these works of art to an audience of wide, general nature. However, Miss Masson (who is, incidentally, the Italian correspondent for *The Architectural Review* of London), has come up with a work of such scope that it will be of particular interest to the architect. One hopes, selfishly, that Miss Masson will go one step further some day and provide us with a complete history of art. We could depend on her to avoid the dull pretensions of the standard history of art "survey" and to make the subject come alive. (I am thinking of a volume like Nikolaus Pevsner's "Outline of European Architecture" but as handsomely illustrated as this volume of villas and palaces.) It is rare that such talents as Miss Masson commands are combined in one person—she is not only capable of gathering and organizing innumerable political, social, and artistic facts, but also of using them to paint absorbing word pictures; and, last but not least, she is admirably qualified to provide us with photographs of a high order of technical and artistic excellence.

One example, selected at random from the book, will demonstrate her many-sided skills. The caption accompanying pictures of Villa Pisani at Stra (illustrated also on the jacket of the book) follows:

"A pre-existing villa was destroyed to make way for the present monumental villa when Alvise Pisani was elected Doge of Venice in 1735. Girolamo Frigimelica was the architect of the new building, which was, however, completed in modified form by Francesco Preti. The villa is one of the most magnificent in the whole of the Venetian *terraferma* and is often called the Villa Imperiale owing to Napoleon having stayed there and its having been one of the residences of the Imperial Viceroy Eugène Beauharnais.

"Even at the height of the baroque period when the villa was built, the strength of the Palladian tradition is still evident in the design of the stables which are situated at the far end of the long canal that divides the formal garden behind the house, completing in typically Venetian style the scenic effect of the whole layout. The interior of the stables has remained untouched, a rare circumstance in Italy, but fine though they are they do not compare with those of the little-known Villa Lechi at Mortirone.

"Though coldly magnificent the house lacks the charm of one that has been the home of a family for generations; perhaps its creation as a setting for the pageantry which surrounded the life of a Doge is responsib'e for this. There is the inevitable bedroom in which Napoleon slept, and a fine ballroom whose ceiling was frescoed with the

Continued on page 220

Continued from page 216

Gloria di Casa Pisani by G. B. Tiepolo in 1767. Russian tsars, Austrian emperors and archdukes, crowned heads and princes innumerable have stayed in the villa, whose greatest charm undoubtedly lies in its large park-like garden, with its famous maze, shady avenues, exquisite wrought-iron grilles and delightful gazebo. The villa now belongs to the Italian State."

In this instance, as in almost all of the examples, one wishes that a plan were provided. However, Miss Masson has succeeded in stirring the imagination to such a degree that related reference works were sought out (by this reviewer at least) and passage to Italy booked.

As the author explains in her foreword, the "sheer embarrassment of riches" made selection of villas and palaces difficult. Therefore she has concentrated on palaces and country estates not necessarily of the most "famous" stature but on those, rather, that were the product of the peculiar political and social structures of the various individual Italian city-states and principalities.

In subdividing the book into several geographic areas, and in grouping historically related structures, she has managed to make her points very simply. One immediately senses the distinction, for example, between the buildings of Venetia and those of Tuscany.

The Renaissance is the starting point of Miss Masson's survey and it continues through the period when Italy was a "patchwork of small states," resulting, she feels, in a benevolent artistic as well as political decentralization. The unification of Italy in 1870, she concludes, put an unfortunate stop to such "creations of the spirit."

Though an architect will more likely be asked today to design a "palace" of commerce or industry rather than a "palace" expressing the wealth and importance of a family, this book will be a rich addition to his library.

For Your Bathroom Shelf

Clean and Decent. *Lawrence Wright. The Viking Press, 625 Madison Ave., New York 22, N. Y., 1960. 282 pp., illus. $4.95*

A history of the bathroom could be anything from the Rabelaisian back-country humor of a Chic Sale to a matter-of-fact handbook for plumbers. This "unruffled history of the bathroom and the w.c." is neither; it is an entertainment by facts slyly written by an English architect-artist as an outgrowth of a building exhibition he staged.

The preface announces that this book is meant to entertain "even if scholarship does keep breaking through." The scholarship is evident in the excellent collection of prints and charts of bygone apparatus and habits, and in the collection of facts. Different chapters will no doubt astonish different readers, but all chapters contain discoveries of one kind or another.

Taken at random, here are some of the facets touched upon:

The city of Rome, at its peak, supplied 300 gallons of water per person per day—in contrast to present-day London's 51 gallons per person per day.

Monasteries—there are diagrams to prove it—had elaborate water systems. At Christchurch *Monastery, Canterbury,* comments Wright, "The efficiency of this water-system may explain, as much as the holiness of the inmates, the exemption of the monastery from the Black Death in 1349."

In a history of the methods of heating bath water, titled "Plumbers' Progress," the practical foundation for the ancient custom of bathing in large groups is

Continued on page 228

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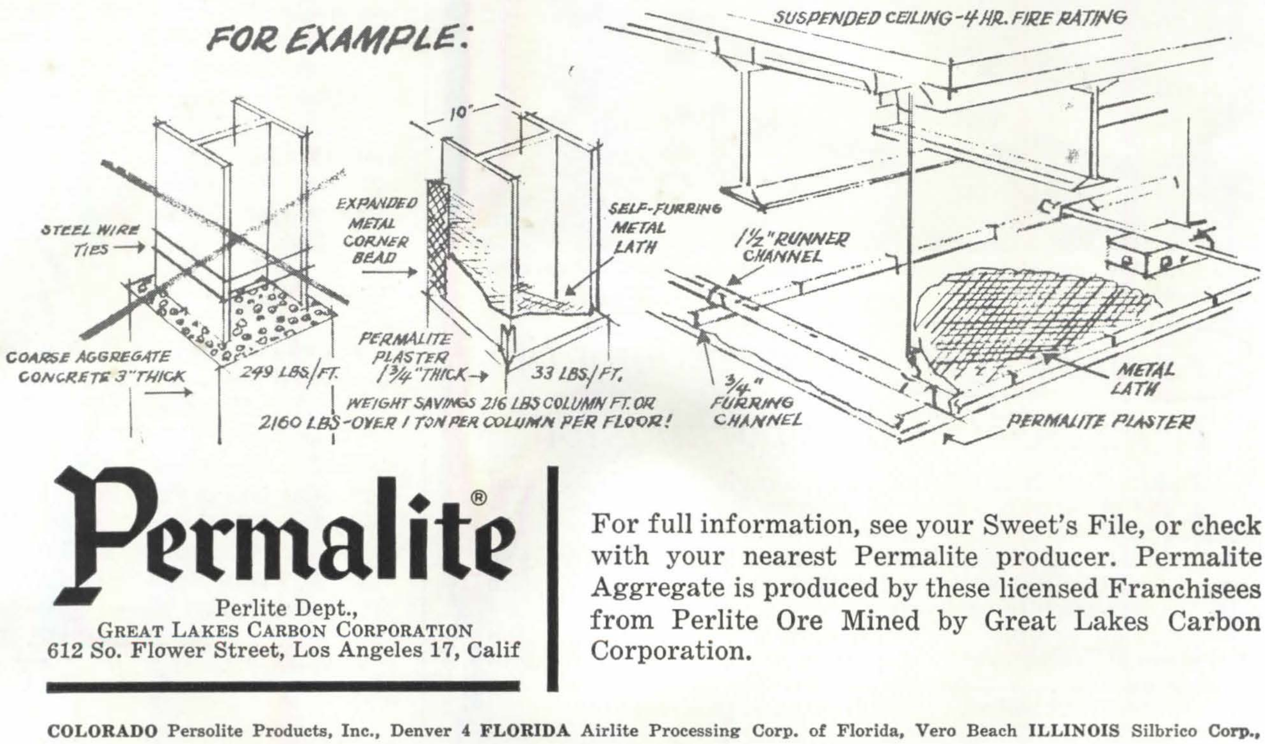

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Continued from page 220

given: "use the water while it's hot!"

It was mid-19th Century in the United States before a hotel had hot and cold running water for every bedroom. "A costly idea, and slow to spread."

The ancients did not use soap, but oil and sand. The soap bath really came into its own about 1880. The dawn of the new era brought an amazing variety of combinations of plumbing parts, with glorious rococo decorations, almost as lavish, if slightly more practical, as the Royal Close Stool at Hampton Court, circa 1600, with its black velvet seat. Around 1900, one designer "managed to combine a bidet, a footbath, a Sitz bath and a 'commode pail' on one reversible double receptacle that must have needed cautious handling."

Other chapter headings include: "Man Becomes Housetrained," "The Odour of Sanctity," "The Cholera Year," and "Basin, Bidet, and Pot."

Wright indicates that progress has not been orderly; different classes of society have had different cleanliness habits. Comparisons are difficult because of different concepts of the bath. (A rite? A social engagement? A remedy for ill health? Or just a way to keep "clean and decent"?) Nevertheless, the author covers the field, from what he terms "the beginning of sanitary planning . . . the discovery that the washing and drinking-place should be up stream from the 'convenience,' up to the present, of which he says, "the average bathroom, in relation to the technical means available and our skill in far more complex installations, is hardly worthy of the sputnik age," and points out that a million more homes in the USA have television sets than have bathrooms.

The subject of plumbing is as corroded as a tenement water pipe with verbal taboos. The "coy evasion" as Wright puts it of "cloak room" or "rest room" was in vogue from the beginning. The medieval phrase was *garderobe;* the Latin equivalent was the *necessarium.* "The language of the toilet," is summed up at one point as "indeed an etymologist's nightmare."

Napoleon was reputed to have taken a hot bath daily; Wellington, a cold one. Wright suggests that Waterloo may well have been won in the bathroom. This attitude is possibly the keynote to his entire narrative. It is more than a collection of historical bric-a-brac, more than an amusement. It is a new approach to history, pointed up by the author himself who says in the style that makes the whole book delightful, "Some of the wavering patterns of . . . social history will inevitably be mirrored . . . in the bathwater, or found locked in the water-closet."

J. W. F.

Urban Structure

New York Metropolitan Region Study. *Raymond Vernon, Director, and Max Hall, Editor. Undertaken by the Graduate School of Public Administration, Harvard University, for the Regional Plan Association, Inc. Harvard University Press, Cambridge 38, Mass., 1959.* Volume 1, Anatomy of a Metropolis. *Edgar M. Hoover and Raymond Vernon, 345 pp., illus. $6.00* Volume 2, Made in New York. *Roy B. Helfgott, W. Eric Gustafson and James M. Hund. 388 pp., illus. $6.75*

The first two publications of the New York Metropolitan Region Study, these books are the start of a series that will eventually comprise nine volumes. Together, the study will constitute the most impressive examination of the nation's largest and most complex urban agglomeration since the now-classic New York Regional Plan studies of the

Continued on page 230

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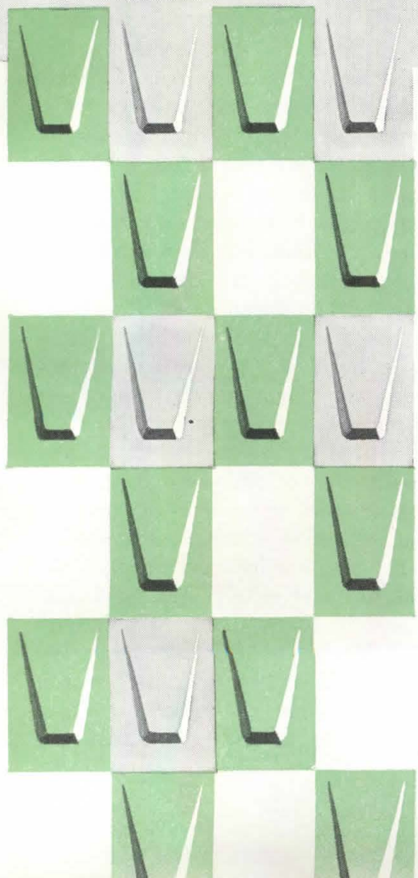

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1920's. The New York Metropolitan Region Study bids fair to be a very worthy successor to the earlier survey, which itself was a major milestone in the progress of American planning.

Neither of these volumes is easy reading, unless you happen to be an economist by training or avocation, but their content makes the necessary effort well worthwhile. Clarity and simplicity of language, coupled with an admirable use of technical appendices to satisfy the needs of the serious student, characterize both volumes. Nevertheless, these are not guidebooks to the wonders of New York, but serious analyses of the economy of the metropolis. The authors have steered a remarkable path through the dangers inherent in the complexity of the subject, the highly technical nature of much of the material, and the ever-present temptation to impress by being obscure.

Anatomy of a Metropolis provides a methodological framework for the entire study. It is the key volume in which the over-all nature of the region is examined, and is appropriately subtitled, "the changing distribution of people and jobs within the New York Metropolitan Region."

The region, as defined for the purposes of the New York Metropolitan Region Study, consists of twenty-two counties lying in the states of New York, New Jersey, and Connecticut. For much of the analysis, a three-part subdivision of the region into Core, Inner Ring, and Outer Ring counties is utilized, with reference also made to the core of the Core counties: Manhattan's Central Business District. Over-all, the region is the home of nearly one in every ten Americans. No other urban center in this hemisphere, and only a few elsewhere in the world (London and Tokyo are the nearest approximations), has the population or the international economic importance of the New York Metropolitan Region.

Despite its great size and its awesome complexity, the New York region is not uniquely different from other American metropolitan areas. The findings of this study indicate that the economic forces shaping the New York region are substantially the same as those operating, with fortunately abated pressure, on the urban areas that contain most of the nine out of ten Americans who are not New Yorkers. This is not to say that the findings of the New York Metropolitan Region Study are wholly applicable to other areas of the nation; it does suggest, however, that most of the analysis used by Raymond Vernon and his staff can be used with value in other cities and that many of the more general findings can be adapted with a good degree of accuracy to other metropolitan centers.

In dissecting the New York Metropolitan Region, Hoover and Vernon have examined both the *structure* of the region and the *trends* which are changing and influencing the future form of this structure. They do this from two viewpoints—where (and how) people live and where they work. This method has the great advantage of providing a strong, readily understandable and dynamic picture of the region's development pattern, although it does have the disadvantage, probably inherent in any simplified frame of reference, of somewhat de-emphasizing important aspects of urban life, including, among others, the urban resident in his non-economic and non-residential roles, as a participant in civic life and as a seeker of recreation.

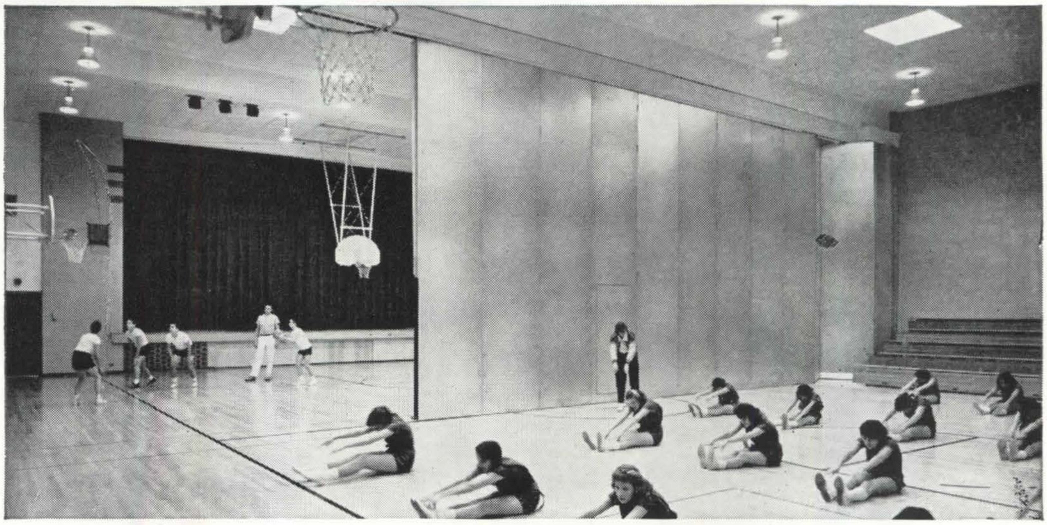
The total impression given by their analysis is of the metropolis bursting like an over-ripe fruit. People and jobs are moving in nearly every *direction*, but always away from the city's center. The density pattern of the region, whether in terms of people or jobs, is that of a mountain, highest at the center (Manhattan) and falling at various slopes toward the periphery of the region. This density pattern is changing slowly, with the slopes becoming less steep for most types of activity. In terms of residential development, for example, the density levels of the Core counties are falling, while rising densities characterize the Inner and Outer Rings (the *rate* of growth is greatest in the lightly settled Outer Ring, but the the absolute *amount* of growth is greatest in the already well developed Inner Ring).

On the whole, the centrifugal processes in the New York region are proceeding with great power, fueled by basic changes in technology and in social attitudes. The movement, as portrayed by Hoover and Vernon, appears to be composed of mechanistic and predetermined forces which far overshadow the attempts to effect a revival of the central city's economic and residential functions. In short, the study's findings conflict bleakly with what might be called the "downtown revivalist" school.

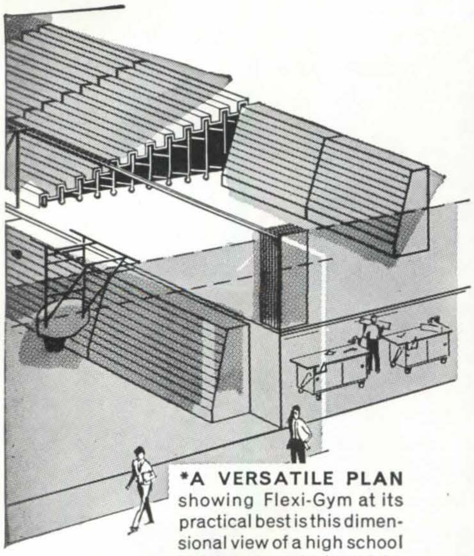
It is impossible in the short space of this review to indicate more than the

Continued on page 236

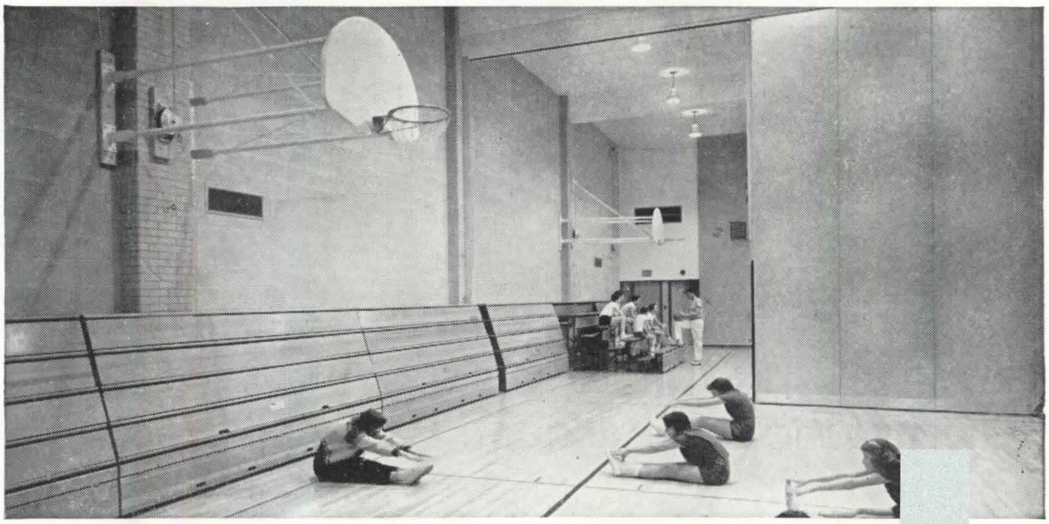
AT WORK—Advanced Planning resulted in a truly versatile 4680 square foot gymnasium area, Oakview Junior High School, Skokie, Illinois; Dr. Homer O. Harvey, Superintendent; Orput-Orput and Associates, Architects.



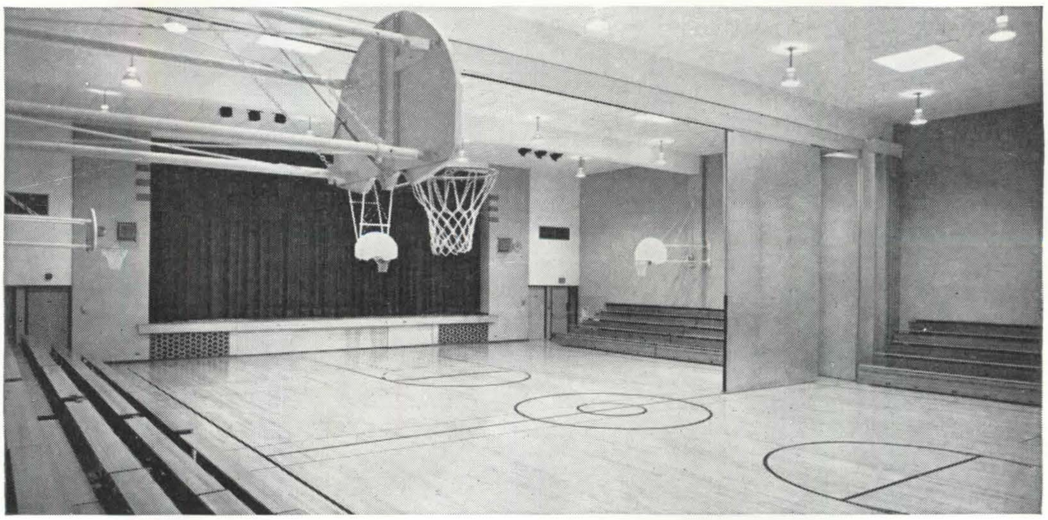
A FOLDING PARTITION, 20' high by 65' long, gives important flexibility to this gymnasium. With electrically powered partition closed there are two smaller courts each large enough for a gym class. With partition open, the Oakview Junior High School has an auditorium for glee club and band concerts, stage plays, community activities and assemblies; gym area for wrestling demonstrations, badminton, golf, touch football, AAHPER Fitness Tests, or a regulation basketball court.



***A VERSATILE PLAN** showing Flexi-Gym at its practical best is this dimensional view of a high school "idea" gym designed by the Brunswick Planning Service. It includes 14,400 square feet on main floor and balconies; seating for 5200; can be divided into 5 separate areas for physical education, sports, assemblies, dining areas, study areas, other educational and community purposes.



10 SETS OF 5-TIER FOLDING STANDS provide a seating capacity for 500 and are set up in 10 minutes by two men. An equivalent capacity in portable stands would require 4 men working 1 hour. In addition to obvious labor-cost saving, no additional storage space is required. In the first year of experience the folding stands have been effectively used a minimum of once a week for academic, sport and community purposes, according to Dr. Homer O. Harvey, Superintendent..



6 BASKETS AND BACKSTOPS are arranged to give both boys and girls 3 each for refereed games or free-throw practice. Five of the six baskets are retractable and easily handled by even the girls' gym instructor. When weather is inclement the gym is opened to students during lunch hours giving them a place to sit and talk or practice basket shooting. Approximately 142 boys out of 170 enrolled in school, participate on either the school or one of the many intramural basketball teams.

Continued from page 230

barest outline of the items covered by the *Anatomy*. In well-integrated fashion, it considers the nature of the metropolitan economy and its highly specialized character. For example, a full chapter is devoted to the "white-collar corps," the mass of workers and activities that is rapidly making New York the office headquarters of the nation and of which the astonishing boom in office building construction that has changed the face of Manhattan since 1945 is only one facet.

Made in New York, the companion volume, is composed of three sections, each of which deals with one of the major manufacturing industries of the New York Metropolitan Region: the apparel industry (more familiarly known as the garment trades), the electronics industry, and printing and publishing.

For each of the three industries, the key findings follow a remarkably similar pattern. The New York region is the leader in the nation for the most difficult aspects of manufacturing, generally those that lend themselves least readily to mass production. In part, this would appear to be the result of the wage pattern of the region; for most comparable types of employment, wages in New York (and many other manufacturing costs as well) are generally higher than in other regions in the nation. Transportation costs between New York and the rest of the nation also tend to be high, and have become higher as the national center of population has moved westward.

To combat this high-wage, high-cost pattern, the New York region has the advantages which accrue from its great size and tremendous concentration of activities and from its complex and impressive concentration of talents.

In the apparel industry, the advantages are primarily those that derive from New York's role as a mass market and as the center of national style, as well as from the presence of a magnificent complex of related arts and services and the nimble talents of the region's workers.

In electronics, New York's chief advantage is its resources of skills and brains; in the early stages of development of any electronic device these advantages far outweigh the higher wage and transportation costs of the region. However, as the stage of development of a piece of electronic equipment

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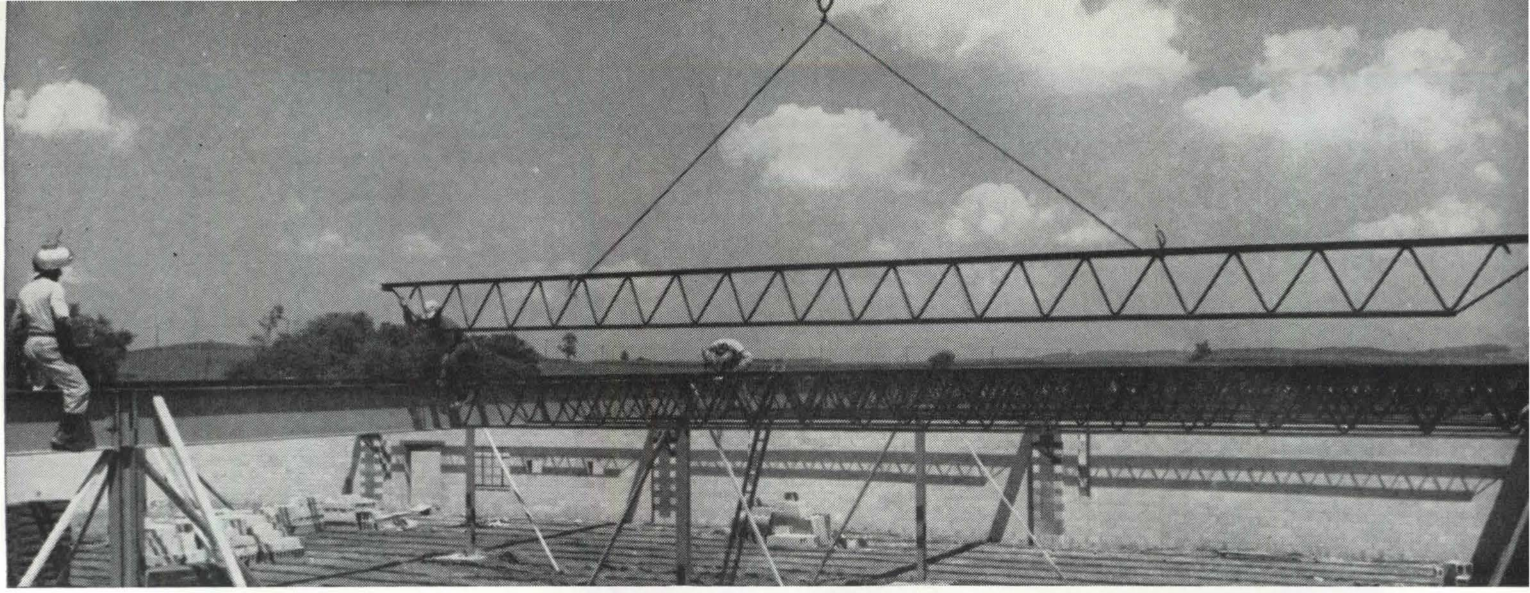

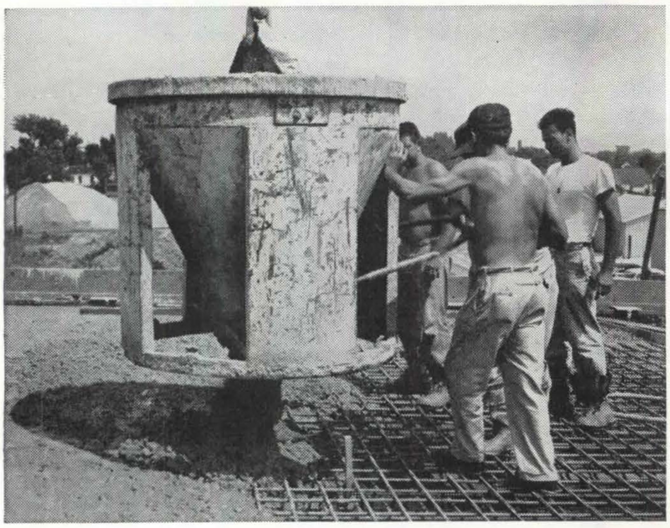

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becomes standardized (as in the case, say, of television sets) these advantages tend to fade in contrast with the lower wage rates of other regions and the transportation advantages of the Midwest. New York's electronics industry tends to be concentrated in product development (where the brains and skills of the region can be fully utilized) or in the production of unusual components (where the complexity of resources of the region becomes vital) rather than in series production of standardized items.

In printing and publishing, this same pattern is reflected in New York's growing concentration of editorial offices, as contrasted with its continuing losses in the production aspects of the industry. The writers, editors, artists, photographers, and other brain-workers of the printing industry need the mutual contacts that they can only get in New York; by means of air freight and other forms of shipment, their products can be speedily sent to other areas where the process of reproduction can be undertaken more cheaply.

Just as there is a trend on the part of the repetitive production aspects of manufacturing to go out of the New York region to lower-cost areas of the nation, so within the region the pattern of manufacturing location is also outward, toward the less developed Outer Ring counties where land is cheap and transportation is less difficult. Increasingly, the manufacturing activities carried on in the Core counties are tending to be confined to specialized aspects of production, for which the high access values of the Core can overcome the higher costs associated with central location. Thus far, urban renewal has affected this trend to only a very limited degree.

The oversimplified summaries given above are only an imperfect sample of the wealth of material presented in *Made in New York*. Among the many strengths of this volume are its detailed projections of future levels of activity in the three industries, in many cases for the entire nation as well as for the New York Metropolitan Region. These will be of use to planners and economists who must face similar questions in other cities without the research resources of the New York Metropolitan Region Study.

One implication which has struck this reviewer regards the future role of the immigrants who traditionally have occu-

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infrared inferno!

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pied the residential areas near the region's core. The continuing nationwide decline in central city manufacturing employment may mean that the labor migrant stream may find itself restricted to the low-paying service jobs that remain in the central city. To a considerable extent this has already occurred in New York and other cities. Alternatively, room may be opened up for new blood in certain central city industries by upward mobility of older immigrant groups. The study indicates, for example, that the departure of Jews from the New York apparel industry has left a vacuum which has been filled by Italians and, more recently, by Puerto Ricans and Negroes. A third alternative is that the new immigrants will find jobs in manufacturing plants located outside the central city; thus far this tendency is reflected only to a limited extent in the New York industry studies.

To sum up, these volumes constitute an important contribution to the growing literature on urban development and change. The wealth of detail they contain and the valuable insights they provide for an understanding of the future pattern of urban life in the United States make them worthy additions to any library.

DAVID A. GROSSMAN
Cambridge, Mass.

Paean Sung Too Soon

The Shining Brow—Frank Lloyd Wright. *Olgivanna Lloyd Wright. Horizon Press, 220 W. 42 St., New York, N.Y. 1960. 300 pp., illus. $4.50*

Olgivanna Lloyd Wright has written a tribute to her late husband, Frank Lloyd Wright, whom she admired both as a man and as an architect. To write so soon after his death no doubt was of great therapeutic value to the author; the benefit to the public at large is questionable. *The Shining Brow* gives the distinct impression of being hastily concocted of bits and pieces.

Part 1, "Our Life," is a compilation of incidents of their life in Arizona and Wisconsin. The operation of the Taliesin Foundation is revealed as a stimulating affair, but unfortunately there is more about other people than about the great man himself. Part 2, "Our Work," contains personal sidelights on Wright's work, enveloped in an aura of sincere admiration. Of the ribbon-cutting ceremony at the opening of the Guggenheim Museum she writes, "A great mass of people stood on the street watching. The silence called them to enter and partake of a world of beauty; a new vision into the future; a new promise for a better life." (But there is no hint of the controversy that certainly is part of the building's fame.) Part 3, "Reminiscences," is more concerned with relatives, friends, students at the Taliesin than it is with Wright. Part 4, "Reflections," is composed almost entirely of the author's own speeches, thoughts, philosophies, on politics, marriage, religion, medicine—even cigarette smoking. The epilogue is sheer hyperbole—but at least is concentrated on Frank Lloyd Wright—himself the "shining brow."

Incidents of the couple's life together are high spots in the narrative—such as the day of their early married life when he took his wife boating and tested her courage by refusing to turn back from a swarm of mosquitoes, even when she had been bitten so thoroughly that one eye was swollen shut. Or the audacity of the Wrights in tandem, when as house-guests they rearranged their host's living room furniture. After the room was put back in

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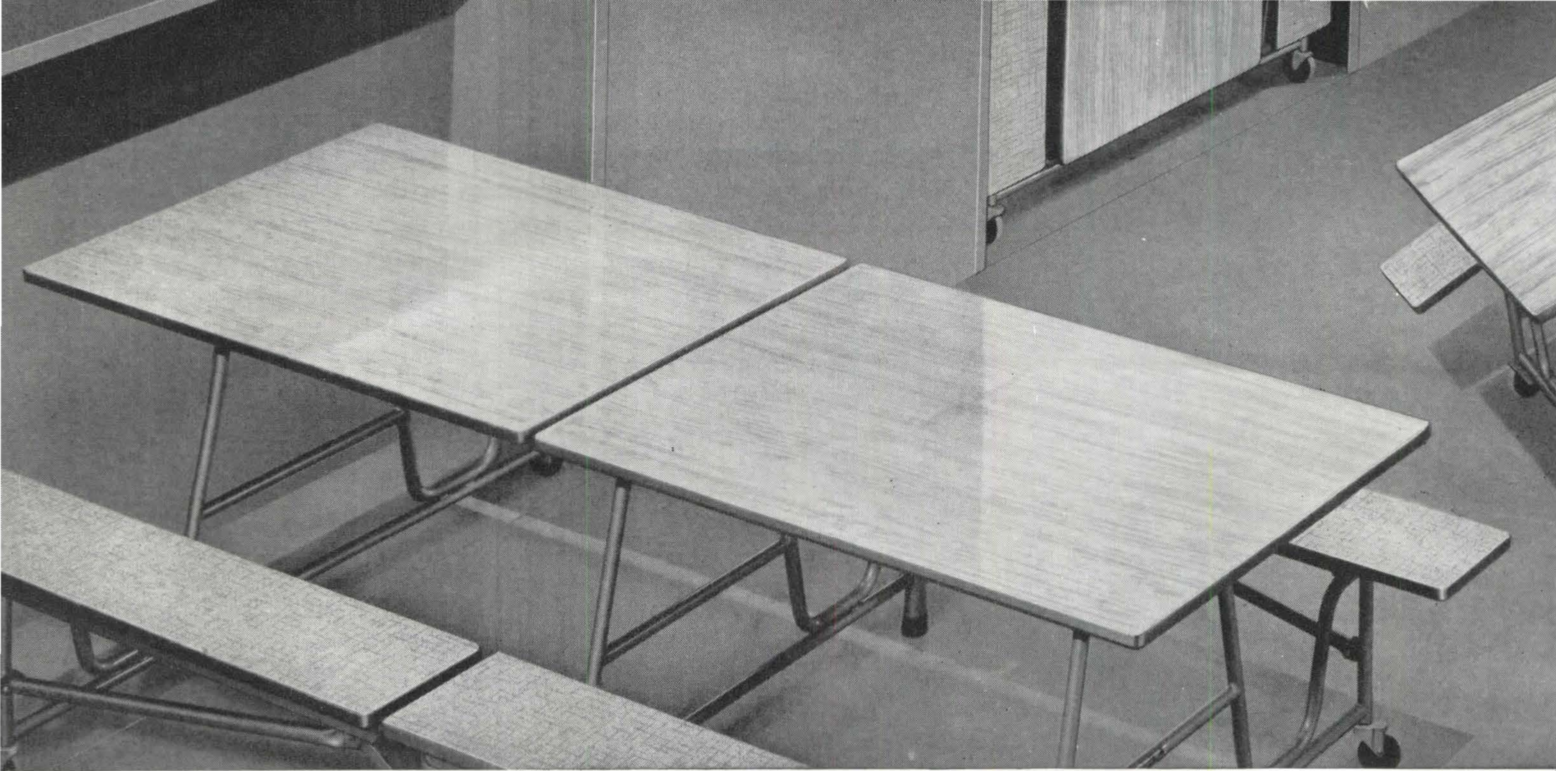

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the old way, Mrs. Wright said, "What a pity they could not rise to your gift. The room was so beautiful!"

On the debit side of *The Shining Brow* are the several outbursts of moralizing on a cliché-ridden level; dull spots—for instance, the details for baking Baba at Easter; the fact that although Mrs. Wright knows a great many famous and interesting people, she tends to be a name-dropper with an everybody-has-a-heart-of-gold attitude; her lavish use of similes in praising her husband. One talk was "like fresh mountain streams." Another time he seemed "hewn of granite." And in the epilogue she categorically declares that he was the "perfectly balanced entity."

Readers with only a sketchy knowledge of Wrights' personal life will find this book confusing; those who fail to share Mrs. Wright's unqualified admiration may not find her enthusiasm catching. One must read between the lines to glimpse the truth about Wright's stature. Somehow it comes through; one gets the idea, almost obliquely, that "here was a man." Perhaps the very best of *The Shining Brow* can be discovered in the direct quotations from Frank Lloyd Wright himself, which scarcely need embellishing.

Mrs. Wright is a talented speaker, teacher, writer. But she might have waited awhile to construct her Taj Mahal.

J.W.F.

Guide to Published Articles

The Architectural Index for 1959. *Compiled and edited by Ervin J. Bell. The Architectural Index, 517 Bridgeway, Sausalito, Calif., 1960. 56 pp. $5 (paperbound)*

Including references to all 1959 issues of seven leading magazines—*Architectural Forum, Architectural Record, Arts and Architecture, House and Home, Interiors, Journal of the American Institute of Architects,* and *Progressive Architecture*—this valuable publication lists each article according to building type, location, and name of designer or architect. The index is useful in many ways: reviewing a remembered article, researching a building type, gaining information on a building technique or material, and eliminating the complicated system of clipping and filing special articles.

E.P.

Books Received

Art and Architecture in Spain and Portugal and Their American Dominions: 1500-1800. George Kubler. Penguin Books, Inc., 3300 Clipper Mill Rd., Baltimore 11, Md., 1959. 445 pp., illus. $12.50

The World Beneath the City. Robert Daley. J. B. Lippincott Co., E. Washington St., Philadelphia, Pa., 1960. 223 pp., illus. $3.95

Mixed Blessing: The Motor in Britain. C. D. Buchanan. Leonard Hill, Ltd., Leonard Hill House, Eden St., London, N.W. 1, 1958. 221 pp., illus. $4.20

Serbian Legacy. Cecil Stewart. Harcourt, Brace & Co., 750 Third Ave., New York 17, N. Y., 1960. 135 pp., illus. $6

Stained Glass. E. L. Armitage. Charles T. Branford Co., 75 Union St., Newton Centre 59, Mass., 1959. 216 pp., illus. $15

Utilization of Space in Dwellings. M. B. Blackshaw, P. Blokhine, and M. Lebegge. Secretariat of the Economic Commission for Europe, Geneva. Distributed by Columbia University Press, 2960 Broadway, New York 27, N. Y., 1959. 210 pp. $1.50

Data Book for Civil Engineers, Volume I, Design (third edition). Elwyn E. Seelye. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 1960., illus. $24

Practical Prestressed Concrete. H. Kent Preston. McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N. Y., 1960. 340 pp., illus. $11.50

American School and University 1959-60: School Plant Reference and Purchasing File. Edited by Walter Cocking. Buttenheim Publishing Corp., 470 Fourth Ave., New York 16, N. Y., 1959. 846 pp., illus. $10

Dorfplanung und Bauernhof. Enstipp & Peters. Distributed by Wittenborn & Co., *1018 Madison* Ave., New York 21, N. Y., 1959. 246 pp., illus. $12.75

New York Metropolitan Region Study, Volume 4. Wages in the Metropolis: Their Influence on the Location of Industries in the New York Region. Martin Segal, Harvard University Press, Cambridge 38, Mass., 1960. 211 pp. $4.75

Nuclear Radiation Engineering: An Introduction. F. W. Hutchinson. Ronald Press Co., 15 E. 26 St., New York 10, N. Y., 1960. 155 pp., illus. $6

Residential Renewal in the Urban Core. Chester Rapkin & William G. Grigsby. University of Pennsylvania Press,, 3436 Walnut St., Philadelphia 4, Pa., 1960. 131 pp. $3.75

Appraisal and Valuation Manual 1959. Volume 4. Edited by Paul B. Coffman, American Society of Appraisers. Comet Press Inc., 200 Varick St., New York, N. Y., 1959. 525 pp. $15

Architectural Rendering: The Technique of Contemporary Presentation. Albert O. Halse. F. W. Dodge Corp., 119 W. 40 St., New York 18, N. Y., 1960. 277 pp., illus. $15.75

Recent Italian Architecture. Agnoldomenico Pica. Distributed by W. S. Heinman, 400 E. 72 St., New York 21, N. Y., 1959. 139 pp., illus. $5.50

Modern European Architecture. A. Dorgelo. D. Van Nostrand Co., Inc., 126 Alexander St., Princeton, N. J., 1960. 244 pp., illus. $27.50

The Art of India: Temples and Sculpture. Louis Frederic. Harry Abrams, Inc., 6 W. 57 St., New York 19, N. Y., 1960. 464 pp., illus. $17.50

Lalibela: the Monolithic Churches of Ethiopia. Irmgard Bidder. Frederic A. Praeger, 15 W. 47 St., New York 36, N. Y., 1960. 138 pp., illus. $12.50

The Non-Objective World. Kasimir Malevich. Paul Theobald & Co., 5 N. Wabash Ave., Chicago 2, Ill., 1959. 103 pp., illus. $4.50

Town Design. Frederick Gibberd. Frederick A. Praeger, Inc., 64 University Place, New York 3, N. Y., 1960. 316 pp., illus. $15 (revised and enlarged edition of book first published 1953)

Verdemberge-Gildewart: A Visual Biography: Documents, Photographs, & Pictures. Edited by Richard P. Lohse. Distributed by Wittenborn & Co., 1018 Madison Ave., New York 21, N. Y., 1960. 80 pp., illus. $4.50

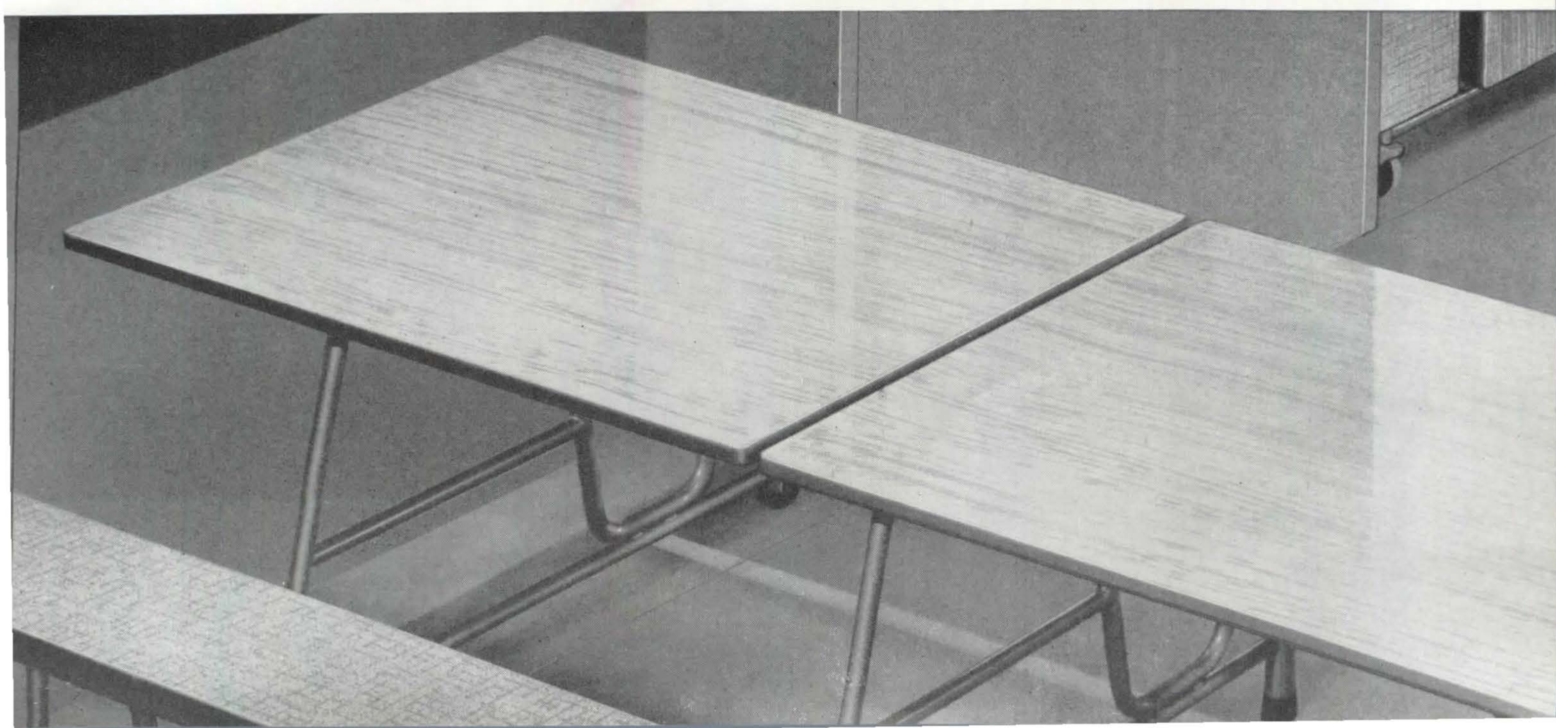
The South Builds: New Architecture in the Old South. Edward & Elizabeth Waugh; Henry L. Kamphoefner, Advisor. University of North Carolina Press, Chapel Hill, N. C., 1960. 171 pp., illus. $12.50

The Early Churches of Rome. Emile Mâle. Translated by David Buxton. Quadrangle Books, Inc., 119 W. Lake St., Chicago 1, Ill., 1960. 110 pp., illus. $12.50

Housing Issues in Economic Stabilization Policy. Leo Grebler. (Occasional Paper 72). National Bureau of Economic Research, Inc., 261 Madison Ave., New York 16, N. Y., 1960. 129 pp., tables. $1.50

Planning Your School Dollar. Carl H. Stautz. Chilton Co., 56th & Chestnut Sts., Philadelphia 39, Pa., 1960. 119 pp., $2.75

Colour on Buildings. Konrad Gatz & Wilhelm O. Wallenfang. Distributed by Wittenborn & Co., 1018 Madison Ave., New York 21, N. Y., 1960. 264 pp., illus. $15



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