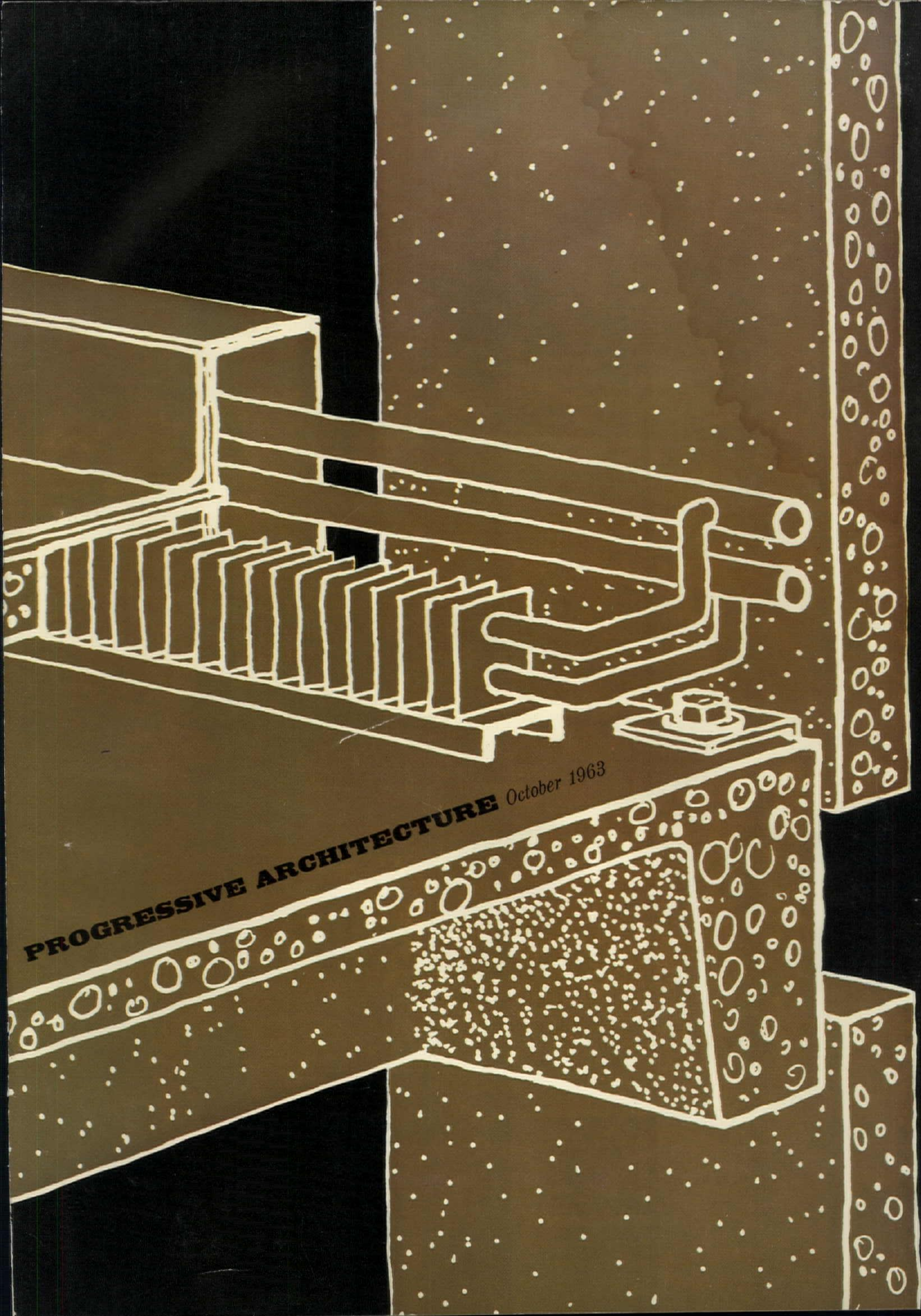
PROGRESSIVE ARCHITECTURE October 1963

THIS MONTH IN P/A

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VOLUME XLIV, No. 10

REINHOLD

VIEWS

The Creative Act

Dear Editor: I would like to add a comment to your Editorial on "Quality in Architecture" (JUNE 1963 P/A): *amen.*

As for myself, I quit the security of architectural school after one year, left my first office job after four months, and decided that it was better to struggle a bit alone on an unknown natural path than to become a quick success as still another machine in an age of machines unmastered.

It has been a struggle—but each time very much worth it. A true birth is accompanied by labor pains. This explains, I suppose, why so many architects prefer to adopt weak children than to have their own.

But if you and your excellent magazine continue as you have begun, there is no doubt that more and more of them will heed the deep urgings of their own beings and realize that the only satisfaction in any work comes *only* from a creative act—which, if honestly allowed to happen, is always beautiful. And the clients need have no worry. Economy is the very essence of beauty and the natural product of integrity. If we but express a problem in its simplest terms, the solution will most eloquently speak its —and our—piece.

This I believe to be the essence of beauty: When the soul of a thing created appears as strength in its bones, order in its system, and radiance upon its face, he who is also alive finds there joy in the recognition of truth.

LARRY A. BERNSTEIN
Carmel Valley, Calif.

"Profession" Defined

Dear Editor: Your thought-provoking Editorial on "Intraprofessional Disputes" (AUGUST 1963 P/A) was written, I am sure, to illustrate the lack of focus that is much too characteristic of professions generally.

An overly simplified definition of a profession could be: "that type of thinking and action that is best for the client or the public over the longest period of time." This, in a broad sense, takes all of the factors of professionalism into account and yet puts strong focus on the true value of service.

The engineering profession, perhaps because of the diversity of its technical interests, has many specialized societies. This splintering from the more basic engineering societies is not desirable, I believe. It tends to limit the individual and to detract from the broad concept of the profession. For the sake of your clients and the profession, I hope that architects will not fall prey to this limiting viewpoint.

E. C. KOERPER
President, Koerper Engineering Associates
Milwaukee, Wisc.

Milestones in Design

Dear Editor: The El Monte Apartments (JULY 1963 P/A) must be tremendously important to builders and designers working with problems of economics, client wishes, and governmental regulations.

At first glance, I thought that they merited publication because of the curve, but in retrospect I realize that other factors make these buildings milestones in design for this hemisphere. The use of the vertical 8 in. shear wall may sound like an ordinary technique but it is unusual in the extreme, eliminates bumps and bulges in the apartment

Continued on page 11

Continued from page 6

rooms, and requires a great deal of work on the part of the structural engineer.

The curve serves as more than a visual gimmick; it is a lesson we all can use on long buildings: it removes a good design from the level of clever boredom and in the long run it probably can be proved that it did not cost a nickel more.

Last, and most impressive, is the use of the external corridor or "elevated streetway" of the 1920 textbooks. The English have been using this element for 15 years both in duplex buildings and in buildings with conventional layouts. I think experience will prove that this corridor can be estimated at ½ to ⅔ that of the normal interior corridor, thus freeing a great part of the budget for use in other parts of the building.

Many thanks for publishing this fine building. I hope it can be taken as a lesson in practicality as well as visual excellence.

SYDNEY SISK
Columbia, S.C.

Collector's Item

Dear Editor: Congratulations on your Theme Issue on Wood (JUNE 1963 P/A). These articles on wood construction are among the finest I have had the pleasure of reviewing. The issue should become a collector's item in every office.

ROBERT BILLSBROUGH PRICE
Tacoma, Wash.

Louis Curtiss Revisited

Dear Editor: Congratulations to you and Fred T. Comee for a first-rate discovery and article ("Louis Curtiss of Kansas City," AUGUST 1963 P/A). I regret those postage-stamp size illustrations, though —can't make slides from them, you see.

CARROLL L. V. MEEKS
Professor of the History of Architecture
Yale University
New Haven, Conn.

Dear Editor: I found the article on Louis Curtiss enormously interesting because it was a good job in a neglected and hard-to-nail-down period, and because my first teaching job was at the University of Kansas City and the scene was familiar.

J. D. FORBES
President, The Society of Architectural Historians
Charlottesville, Va.

Dear Editor: All of us in the Kansas City area are delighted with your publication of Fred Comee's article. I sincerely hope that it will be of interest to your general readership as well.

ANGUS McCALLUM
Director, Central States Region AIA
Kansas City, Mo.

Continued on page 12

Continued from page 11

Swelling or Growth?

Dear Editor: Thank you for your piece on the Panther Hollow project (NEWS REPORT, JULY 1963 P/A). As a former Pittsburgher, I have been puzzled and perturbed by the articles in other publications and your more complete coverage gave me my first real idea of what was up.

I am still perturbed. I think that present-day Pittsburgh tends to mistake swelling for growth. I think that, unlike certain times in the past, it also has the knack of making or importing good architecture. In the present instance, I think that the filling of Panther Hollow with artifical real estate will be of great aesthetic loss to the neighborhood. The Hollow, as such, is not a sight worth coming half a mile to see. There is nothing spectacular or beautiful about it as a piece of "nature." It does, however, do two good things. In the first place, it serves as a natural fosse to isolate Schenley Park from Oakland, which can be a raucus place, with two main-traveled streets and a welter of small and ungenteel houses. Carnegie Tech, Flagstaff Hill, and the Phipps Conservatory gardens now enjoy a peaceful remoteness, while remaining perfectly accessible from all directions. When a hive of functionaries is set down beside them, the world will be very much with them, at least from 9 to 5 on weekdays. In the second place, the ravine now gives a grand visual support to the most prominent building of Hornbostel's Carnegie Tech quadrangle, Machinery Hall. The handsome, if dated, architecture of the Hall rises from the side of the ravine to end in a central tower, which is, and acts like, a large chimney. The composition is one of the architectural sights of Pittsburgh, as seen from Forbes Street and Schenley Bridges, and, in a certain way, very much a Pittsburgh kind of sight, a landmark. The landscaped deck of the new project will have to be carefully done to offer a substitution, let alone an improvement. And I wonder whether the designer of Philharmonic Hall and the Columbia Law School (both Abramovitz designs) will be capable of the necessary straightforwardness and restraint.

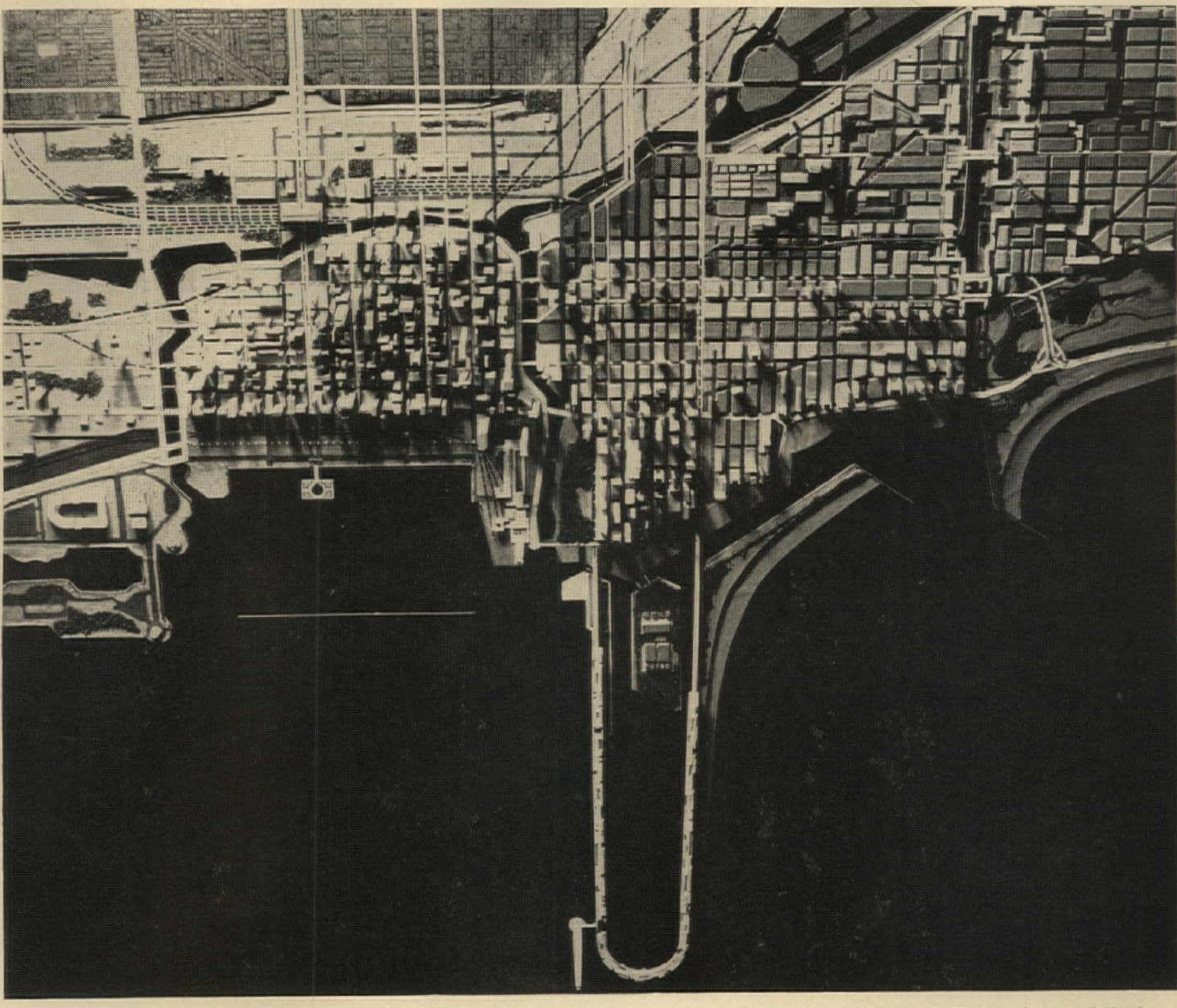
WALTER C. KIDNEY
New York, N.Y.

CORRECTION—P/A was in error in failing to credit Julius Shulman as the photographer for the article on the McFarland Clinic (pp. 120–127, AUGUST 1963 P/A).

PROGRESSIVE ARCHITECTURE OCTOBER 1963

NEWS REPORT

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



Chicago's Loop becomes an island extended by a causeway in imaginative plan by students of University of Illinois.

For more information, turn to Reader Service card, circle No. 402

PROPOSAL FOR CHICAGO: MIDWEST VENICE?

CHICAGO, ILL. The common picture of Chicago as a bustling strip along the Lake Michigan shoreline backed up by vast stretches of unrelieved monotony has challenged the imaginations of graduate students in architecture and city planning at the University of Illinois, and they have come up with an admirable proposal for the toddlin' town. The project was worked out under the sponsorship of the Graham Foundation, and excited quite a bit of local comment, including a large model display in the windows of Carson-Pirie-Scott.

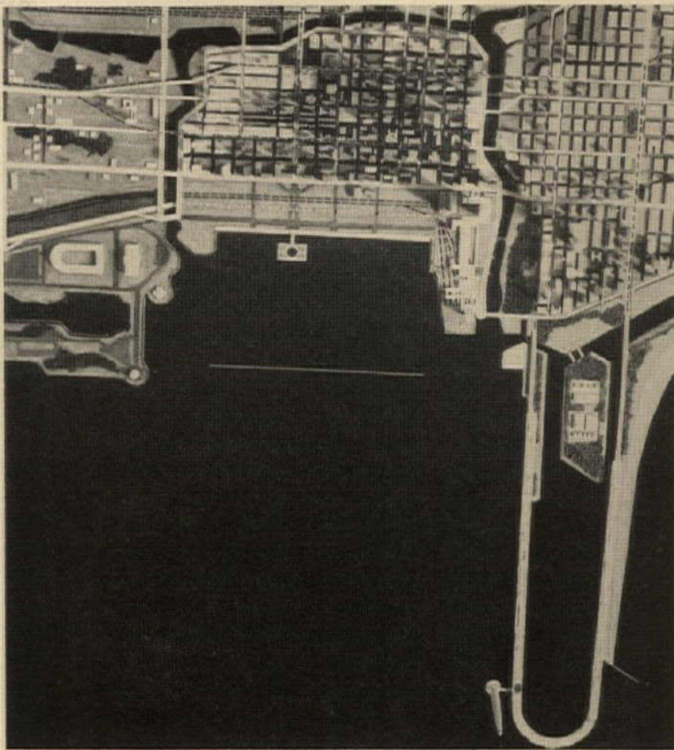
To properly develop the lakefront and at the same time give character and focus to the never-never land that lies behind it, the proposal uses three main elements: the introduction of canals and Greenway streets within the city, three Causeway Community structures extending into the lake, and extensive new beach development convenient to urban areas.

Canals would run east and west, between Lake Michigan and the Chicago River, on the north side, and the lake and a major north-south canal on the south side. A typical "community" would be bounded and defined by its Greenway streets, and the canal would function as a focal point for the development of a real community central area (2). Major canals would be located on the rights-of-way of present streets, obviating much property acquisition. From major canals, minor canals would branch off to thread the community, and in some instances lakes (3) would occur at the juncture of the main canal and the river.

In the "Loop," Chicago's central business district, a proposed canal at the southern boundary of the area would complete the water frame now existing on three sides due to the lake and the Chicago River (1). An expanded Grant Park and creation of "green buffers" around the area would make it a fitting gateway to a great city.

Three "Causeways" (4) are proposed to expand Chicago's water use, provide needed housing, and complement the extensive inland development of the plan. The U-shaped causeways—one on the north side, one on the south side, and one near the Loop (1)—would be built 75 ft above water level, be connected at both ends to city transportation and utility systems, and would provide housing for about 20,000 persons, each in the form of private apartments in the air rights above the transportation levels.

Student group consisted of Walter E. Bliss, David P. Brors, Wichit Charernbhak, Paul T. Davis, Paul J. Magierek, Bir Bal Malik, Carl K. Mark, Ernest O. Porps, Ronald E. Schmitt, Lakshmi C. Sharma, and Edward P. Womack. They worked under the direction of Professors Robert D. Katz and A. Richard Williams.



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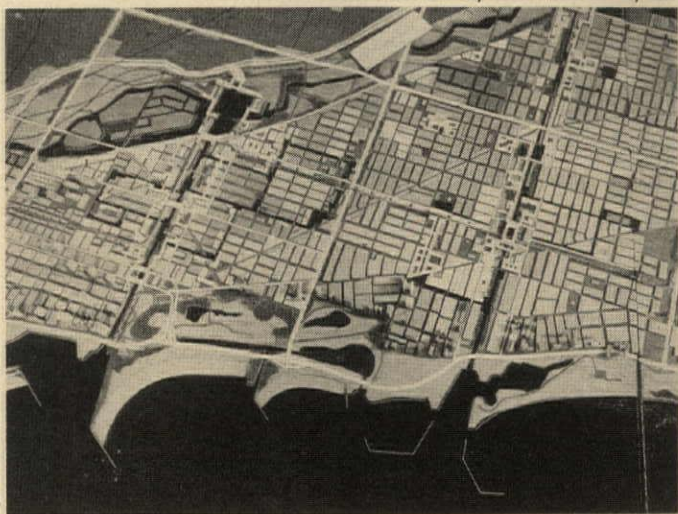
Photos: Bill Muncke, Astra Photo Service, Inc.



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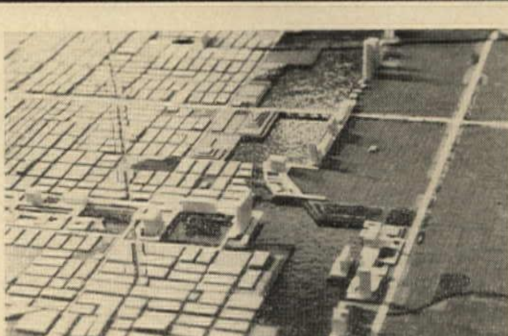

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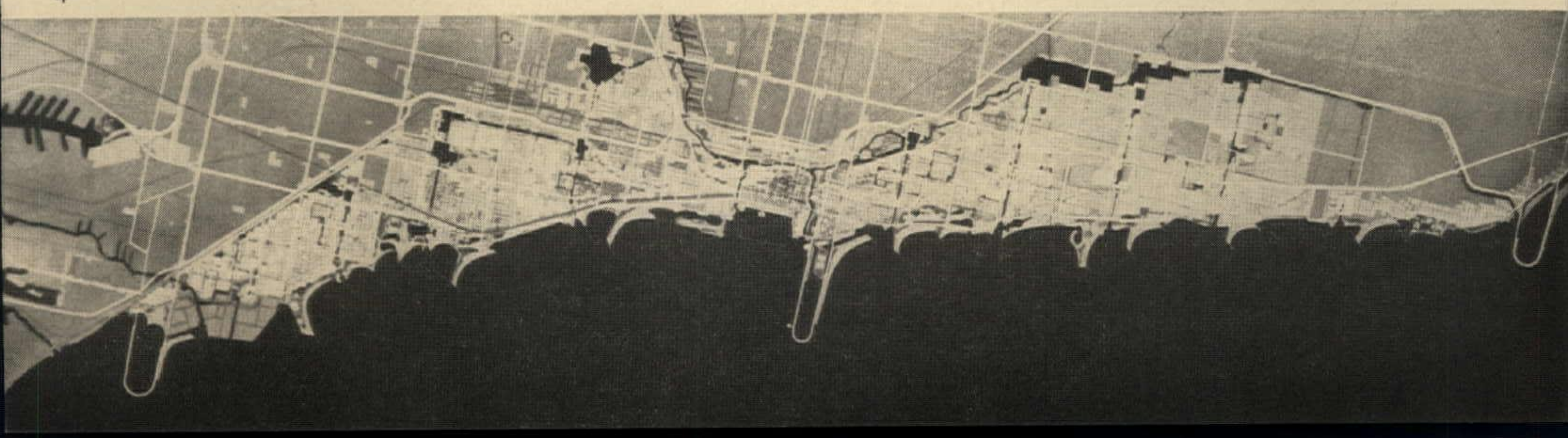
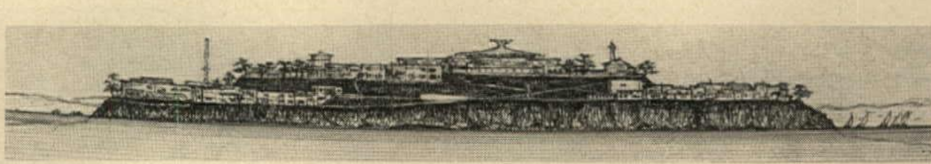
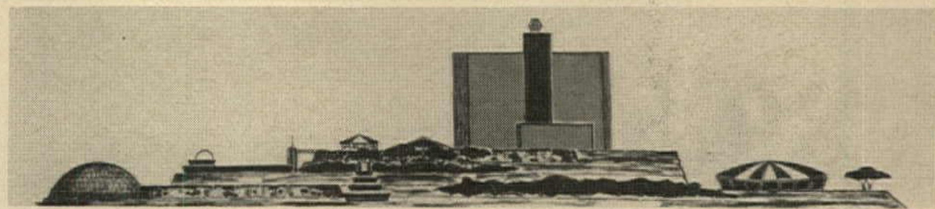
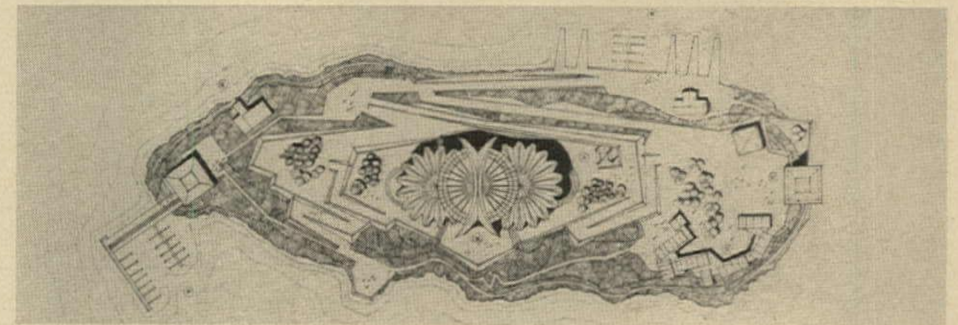
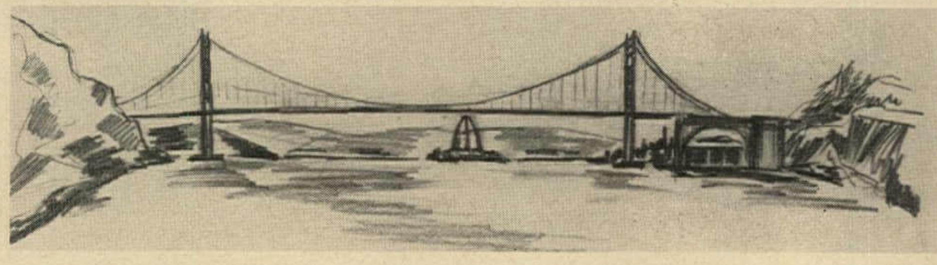


How to Use the Rock





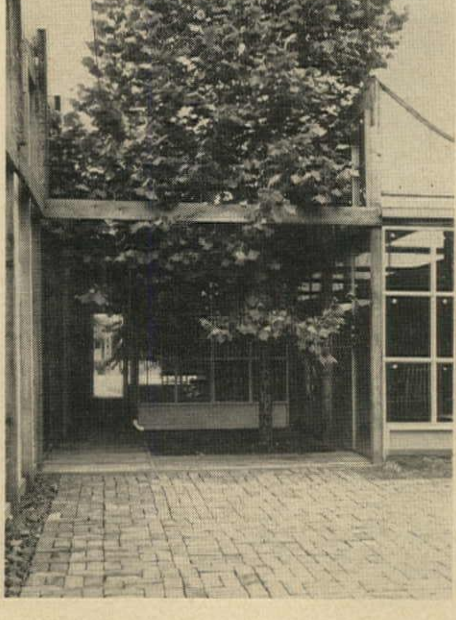




SAN FRANCISCO, CALIF. In a laudable effort, the Northern California Chapter AIA recently conducted a design problem on what use should be made of Alcatraz Island in San Francisco Bay now that the felons have been moved out.

Some of the proposals cited are seen here. From top to bottom: (1) a suggestion by Jack Hermann that the area become a recreation island which would include a marina, assembly hall, overnight accommodations, and a library and museum. (2) Max Garcia's proposal was for a convention center, auditorium, restaurant, and music hall to take the place of the old prison. (3) A center for conservation, welfare, and protection of human and natural values for use by historical societies, conservation groups, and the like was proposed by James Hancock. (4) Peter A. Sabin suggested a monument composed of intersecting arches with major compass points as axes supporting a beacon 600 feet above sea level. An 85-ft-high statue of the city's patron saint, St. Francis, would stand on the highest point of the island.

Real Building Forms Student Design Problem



CARBONDALE, ILL. A recent student problem in the design department of Southern Illinois University has resulted in more technical knowledge on the part of the students involved, as well as a usable building for the campus.

Objectives of the project were to explore the possibilities and uses of certain materials in ways those materials are not ordinarily used, and also to create an enclosure to serve as an auditorium-exhibition hall for use by student and faculty groups.

Post and beam frame, mainly of uncured white oak, supports a series of thin steel bands hung across beams to serve as slings. These, in turn, support 8′ x 14′ roof panels of thick, compressed waste-paper fibers coated with asphalt. Materials used on walls and clerestory openings include the roof material, rigid styrofoam panels, corrugated fiber glass, and glass. Floor is cold-process asphalt with a cement-surface filler.

Since the new building is located between two old war-surplus-type barracks, the students have named it "The Space Between."

Photos: Laurence E. Tilley

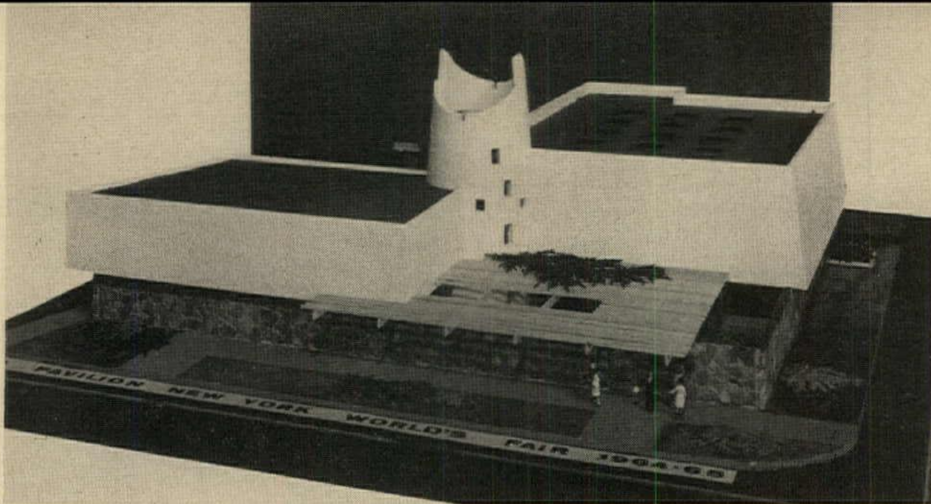
Three-Ring Terminal Opens in Providence

PROVIDENCE, R. I. The new Short Line Bus Terminal by Millman Associates is the first private project in the Downtown Providence Master Plan. The owners and designers therefore wished it to perform the dual duties of providing a fitting entrance to the new downtown as well as serving to encourage other private redevelopment.

The terminal is basically three circular forms connected by a lower, flat roof covering circulation and waiting spaces. The largest drum contains dining room, snack bar, and cocktail lounge; the central drum has ticket counters and offices with mechanical equipment above; the third circular structure contains baggage room and driver's lounge. The circular forms developed from an examination of the turning requirements of the busses on the site, and were emphasized to become the dominant element of the composition. Siting will take advantage of a proposed convention center north of the terminal. Placement of the building also allows it to serve as a significant closure to Mathewson Street, the main cross street of the retail core.

Short Line President George Sage has acclaimed the finished building as a great advance over the usually depressing bus stations of this country. He intends to reconstruct and refurbish other buildings of his line, as a result of the success of this one.

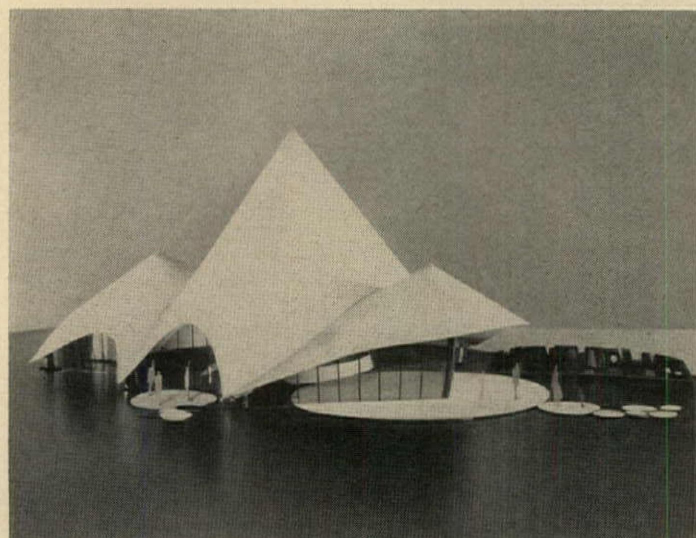
Structural Engineer: Garfinkle & Marenberg; Mechanical Engineer: Buerkel & Company, Inc.; Electrical Engineer: Morris Staller; Graphics Designer: Malcolm Grear; General Contractor: H. V. Collins Company.



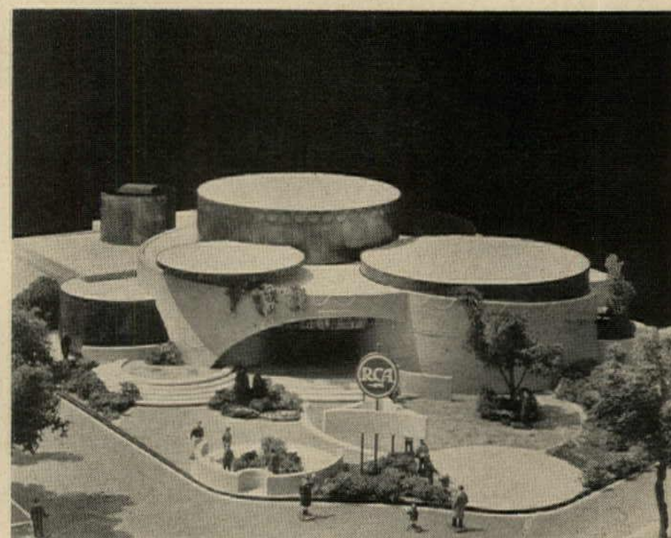
Irish Pavilion is situated around a rugged tower that may recall the one near Dublin where Joyce's Ulysses *begins. Walls are panelled with Irish stone; tower is gunite-sprayed. Architect: Robinson, Keef & Devane; Associate: George Nelson.*

Flushing Meadows Communiqué

NEW YORK, N.Y. According to General W. E. Potter, executive vice-president of the 1964–65 New York World's Fair, major pavilions not already in an advanced state of preparation cannot be ready for the opening of the international exposition next April. This means that we have now seen what the Fair will probably look like. The selection of pavilions on these pages furnishes a pretty good cross-section idea of the design quality of the Fair which, as with most such conclaves, will range from thoughtful good through inoffensive acceptable to jazzy spectacular. Since, as you remember, there were no design criteria set for this fair, we should be thankful for whatever good things we get.



Three asymmetrical cones distinguish roof of Sierra Leone Pavilion; forms give circular feel to a rectangular pavilion. Architect: Costas Machlouzarides; Associate: Ransford Jarrett-Yaskey.



Circular forms of RCA Pavilion, designed by Malcolm B. Wells, house reception, color TV studio, control room, and stereo demonstration. Materials: cement, copper, brick.

Skidmore, Owings & Merrill's Equitable Life Assurance Society Pavilion will be a clean classic form housing machine to record U.S. births and deaths as they occur.

Dramatic Museum of Science of New York City has lower exhibit floor and upper 80-ft-high Great Hall. Wallace K. Harrison-designed permanent pavilion is concrete, glass.

. . . and then we have . . .

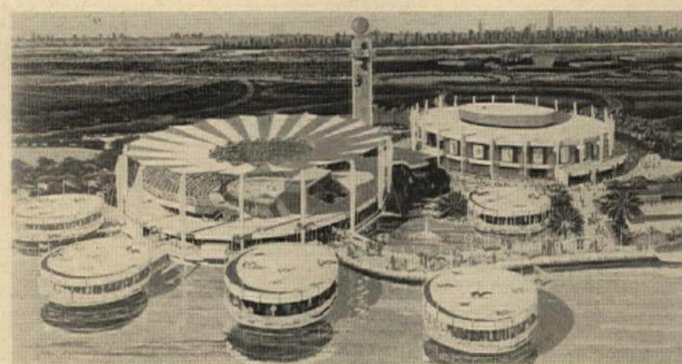
Philippine Pavilion has form of "salakot," a native hat. By Otilio Arellano and Jeffrey Ellis Aronin.

Picture screen marks insurance pavilion by Gordon Powers.

Missouri Pavilion is one vast, glass-enclosed room in a serene, columned enclosure. Architects: Kivett & Myers.

Huts recalling native architecture and a larger structure showing future form Guinea Pavilion by Noel & Miller.

Motoring Safety Center by Lyras, Galvin & Anaya features diorama showing highway and countryside road network of U.S.

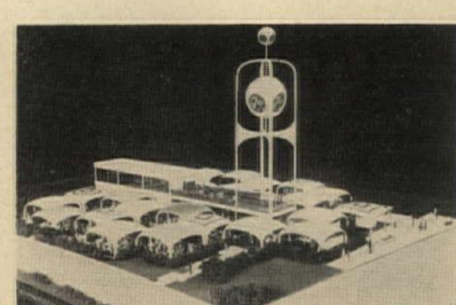


Florida's recreation and citrus industries will be emphasized in pavilion by Pancoast, Ferendino, Skeels & Burnham.

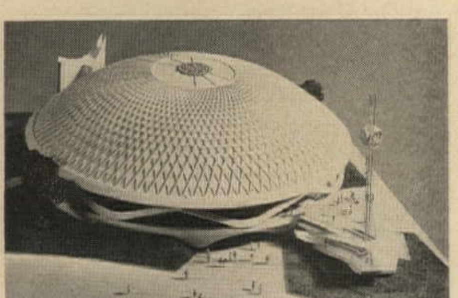
. . . and finally we have . . .

Mormon Pavilion by Fordyce & Hamby has replica of Mormon Temple.

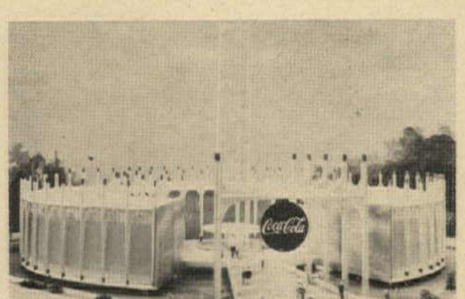
Domed Alaska Pavilion by Mandeville & Berge has Aurora Borealis show.



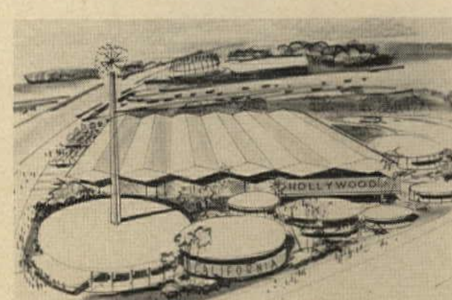
24 multipatterned shells will cover 7-Up Pavilion designed by Becker & Becker.



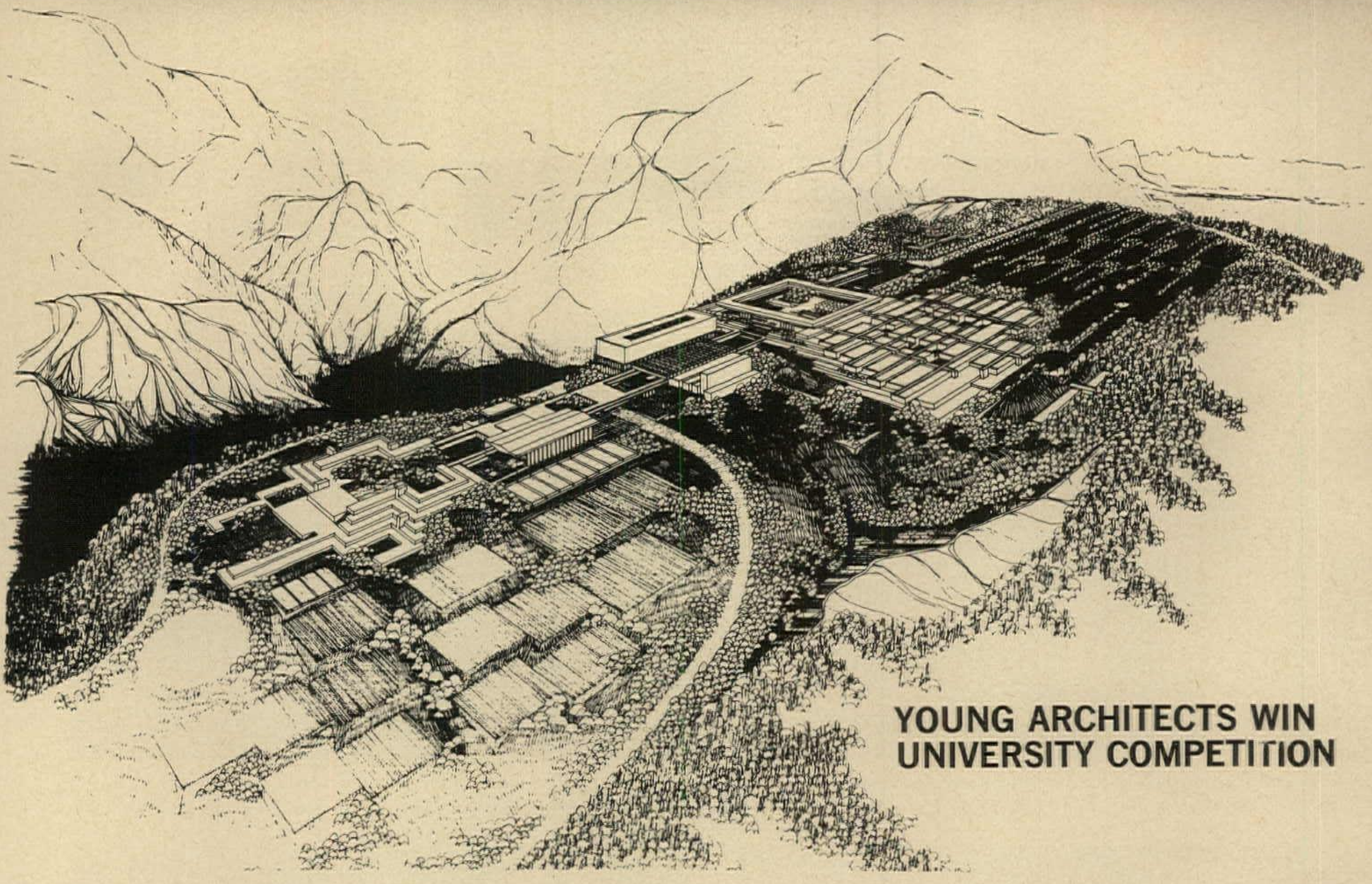
General Electric Pavilion by Welton Becket & Associates. Disney will do show.



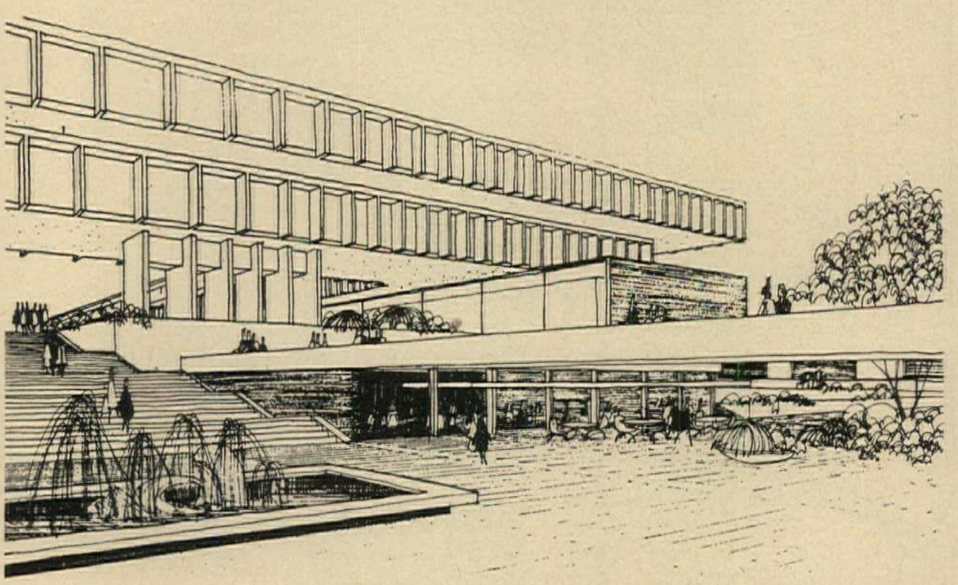
Welton Becket and Displayers, Inc., are responsible for Coca Cola's pavilion, tower.



Hollywood and California pavilions are, once again, by Becket—quite a busy man.



YOUNG ARCHITECTS WIN UNIVERSITY COMPETITION

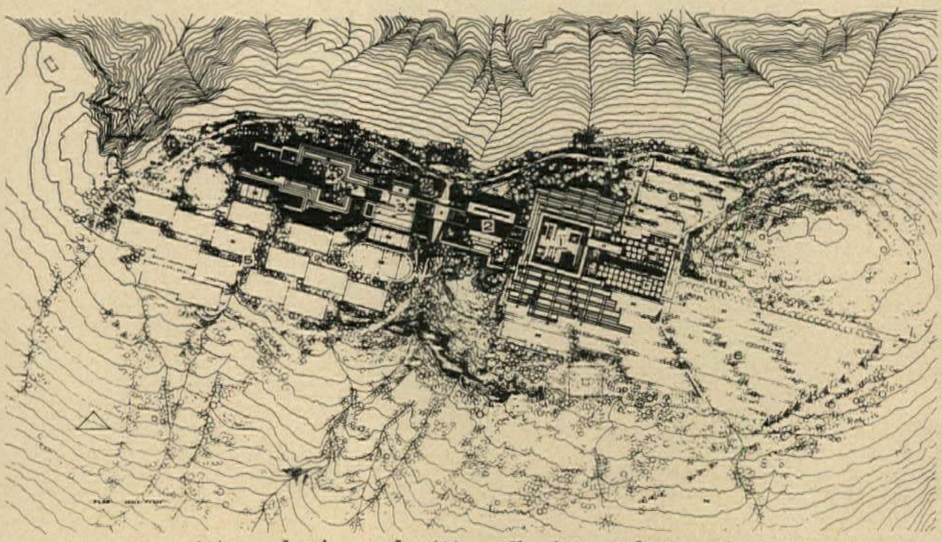


VANCOUVER, B.C., CANADA Two young architects, Arthur Erickson and Geoffrey Massey (son of Raymond), have won a competition to create a completely new university near Vancouver. Competing against a field of 70 other designs, mostly by British Columbia architects, the Erickson-Massey proposal for Simon Fraser University was chosen unanimously.

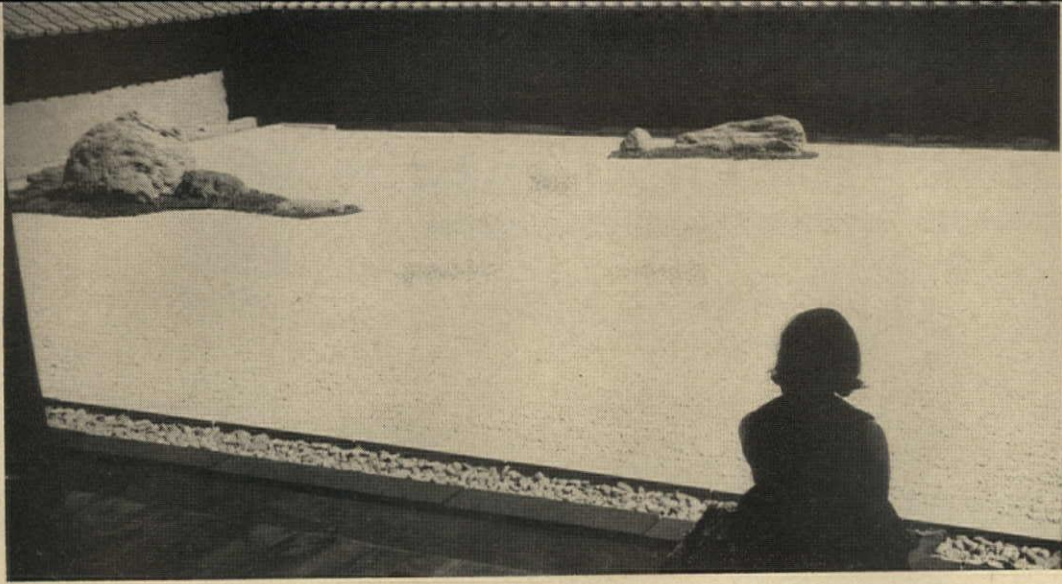
The spectacular site below Burnaby Mountain and the strong horizontal approach to the design will inevitably call forth comparisons to Skidmore, Owings & Merrill's U.S. Air Force Academy. But where the SOM design is really groups of differing facilities (academic, faculty housing, utilities, etc.) widely separated, the Canadian scheme is "a single complex built up from the differing necessary spaces."

There will be four major subdivisions within the over-all complex (*below*): academic quad, mall, student center, and housing. Ancillary spaces will be for playing fields and parking.

All teaching and research functions will be grouped around the academic quad. Faculty offices and seminar rooms will be located at the top rank, with lecture rooms and labs falling away in terraces on either side. The mall will be the "heart" of the campus, containing library, bookstore, auditorium, playhouse, exhibition area, and cafeteria. Club rooms, campus newspaper, lounges, meeting rooms, and other social and sports facilities will be found in the student center. Male and female student residences will be separated by landscaped areas; the faculty housing will occur at the opposite end of the complex.



(1) academic quad; (2) mall; (3) student center; (4) residences; (5) playing fields; (6) parking.



Photos: Reg Van Cuylenberg

TEMPLE GARDEN REPRODUCED IN BROOKLYN

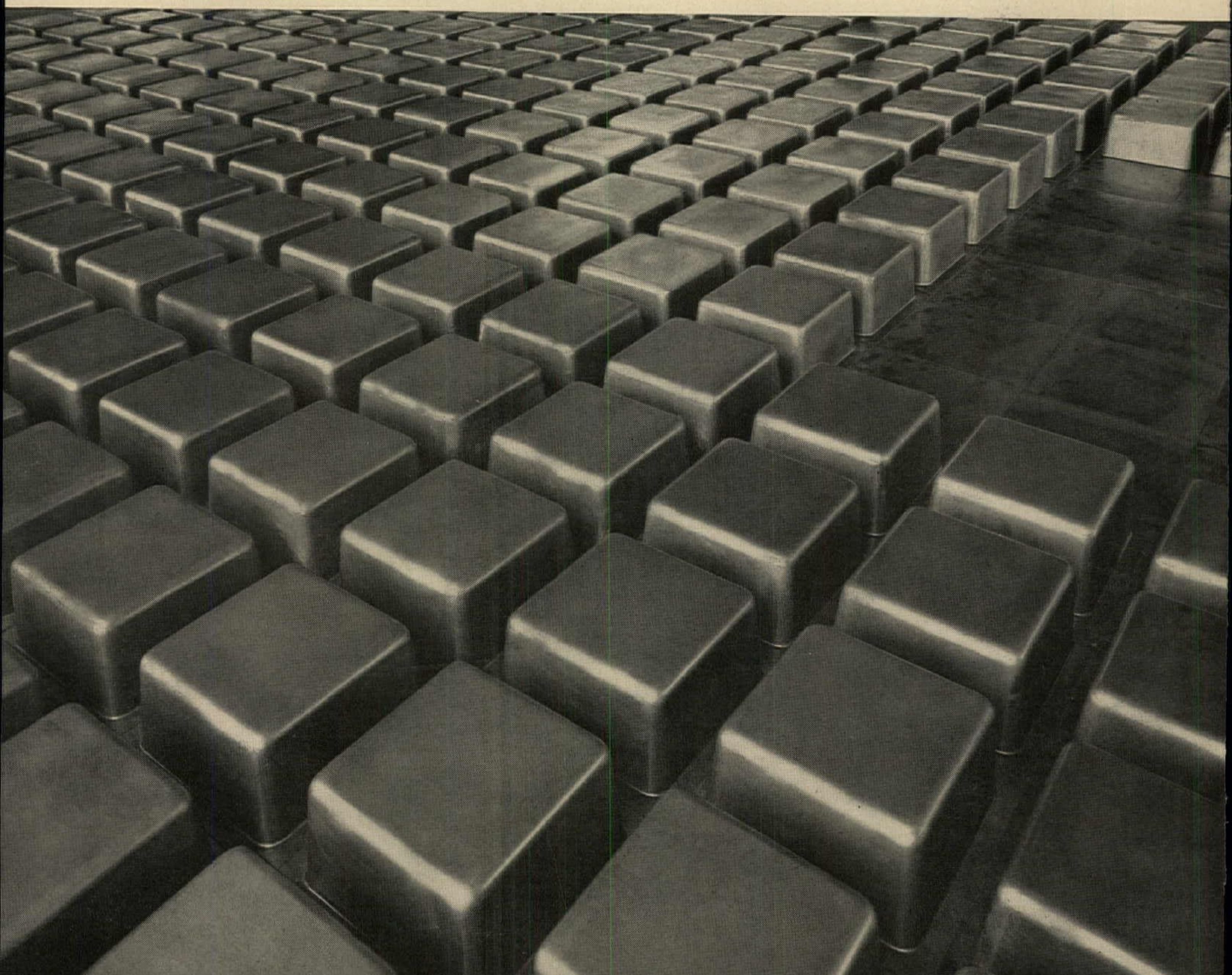
BROOKLYN, N.Y. Take 15 good-sized stones, add thousands and thousands of tiny white pebbles, and what do you get? The average Westerner will get just what he started with: 15 good-sized stones and thousands and thousands of tiny white pebbles. Using the same materials, the Zen Buddhists of Ryoanji Temple in Kyoto, Japan, created in the 15th Century an outdoor space (for lack of a better term) that has become a visual hallmark of traditional Japan's ofttimes serene viewpoint.

Now, the Ryoanji stone garden has been recreated in loving detail in the Brooklyn Botanic Garden. The garden, featuring its 15 stones arranged in 5 groups in a "sea" of swirling white pebbles, is an oasis for contemplation in the uproar of the New York metropolitan area. Sheltered by a structure of imported Japanese materials that also serves as a viewing platform, the garden is in curious contrast to the picturesque lake-and-island Japanese garden (actually dating back to the Chinese) nearby. If Brooklyn gets a tea garden, it will possess the three major types of Nippon gardens.

As one New Yorker, Al Van Starrex, commented, the garden "should serve as a tranquilizer for atom-age New Yorkers. As such, it should serve better purpose than the Civil Defense shelter nearby."

Another CECO first!

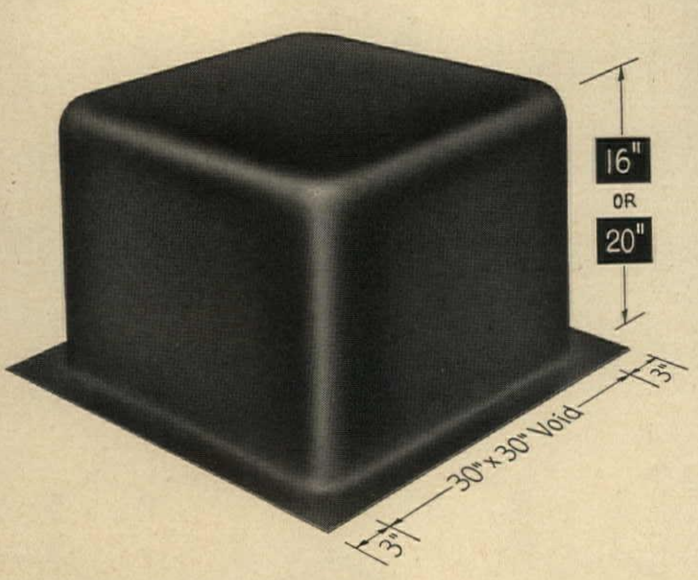
Deeper Steeldomes fill the need for longer spans . . . stronger waffle slabs!



Longer spans . . . stiffer floors . . . heavier loads . . . now made possible with CECO'S new Deep Steeldomes. This is a typical layout of 16" deep 30" x 30" Steeldomes ready for placement of reinforcing steel. For full particulars, see your Ceco man or fill out the coupon.

Now you can design spans in the 50-ft. range . . . in *monolithic* reinforced concrete waffle flat-slabs . . . using Ceco's new 16″ or 20″ Deep Steeldomes. Combined with Ceco's regular depths, these Deep Steeldomes offer architects and engineers a complete range of standard Steeldomes to meet the needs of any project.

All Ceco Steeldomes—from depths of 4″ through 20″ —are one-piece units—the best for waffle construction. More rugged and rigid. No excessive deflection—no excessive concrete — no excessive clean-up problem. And the ceiling finish of the last-poured slab is as good as the first.



Ceco's two new Deep Steeldomes are 16″ and 20″ in depth.

CECO'S FULL LINE OF STANDARD STEELDOMES

SYSTEM	30″ x 30″ voids	19″ x 19″ voids
MODULE	36″ x 36″ overall	24″ x 24″ overall
DEPTH OF DOMES	8″, 10″, 12″, 14″, 16″ and 20″	4″, 6″, 8″, 10″ and 12″

Waffle flat-slabs formed with Ceco Steeldomes make the most efficient use of concrete and steel—reduce deadload over comparable systems—give additional savings throughout the structure in beams, girders, columns and footings.

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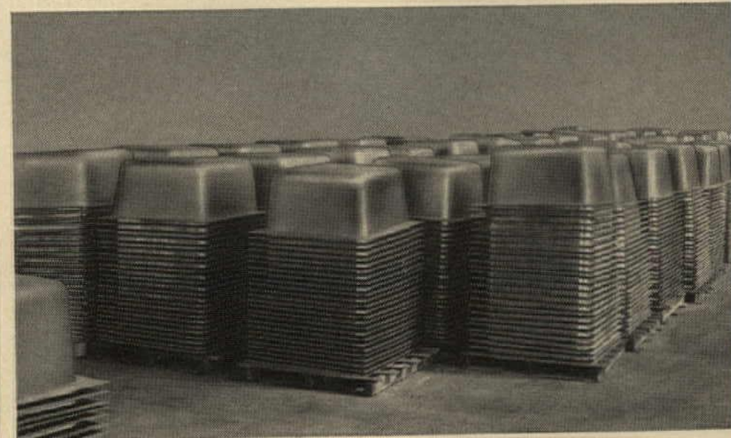
Start of new Mormon Temple Plaza parking garage in Salt Lake City. Here Ceco is forming nearly three-quarters of a million sq. ft. with 16″ and 20″ Deep Steeldomes. Church of Latter Day Saints, owners / George Cannon Young, architect / George S. Nelson, engineer / Jacobsen Construction Company, general contractor.

Below—Typical supply of Ceco's new Deep Steeldomes



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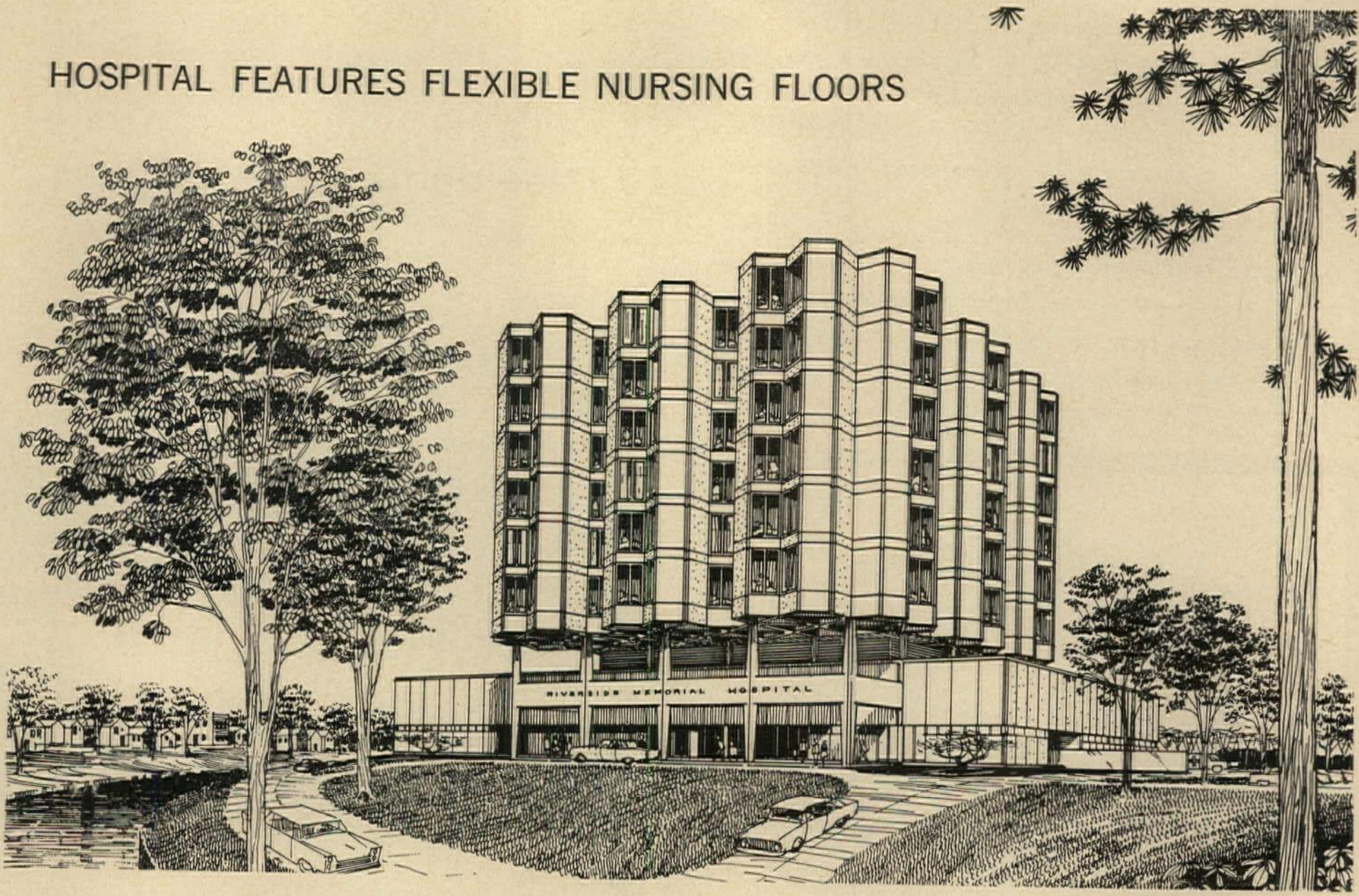
HOSPITAL FEATURES FLEXIBLE NURSING FLOORS

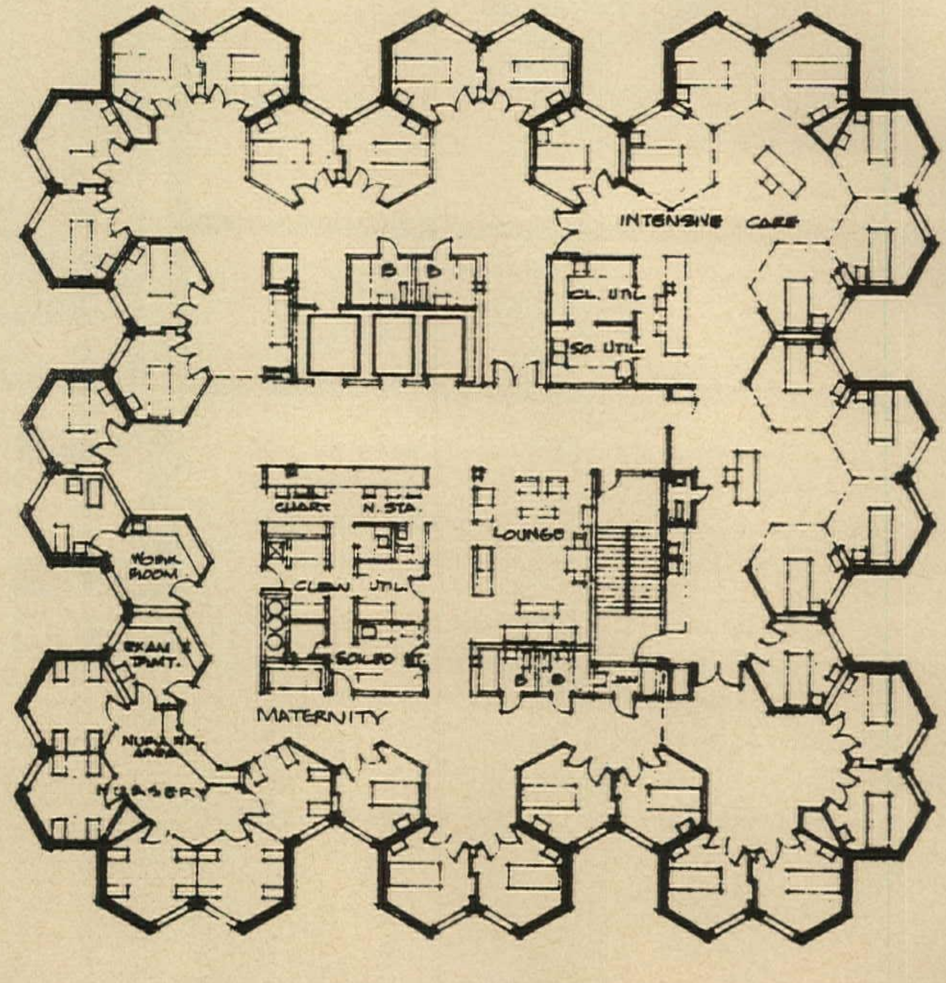


MARION, IND. The proposed Riverside Memorial Hospital, designed by the associated Chicago firms of Harry Weese & Associates and John van der Meulen, will consist of a rectangular administrative and operative base surmounted by a multifaceted, six-story nursing tower.

The two-stories-plus-basement base, in addition to offices and operating rooms, will contain laboratories, emergency treatment areas, dining room, records, radiology, labor rooms and delivery theatres, and recovery areas.

Particularly noteworthy is the hospital's arrangement of patient rooms. Up to 40 hexagonal-shaped one-patient rooms can be arranged in a sort of cluster or pod pattern around the centrally located nurses' station, pantry, lounge, linen, and other facilities. Rather than providing a large bathroom for each patient room, or the inconvenience of common toilet facilities, the architects have installed a redesigned Pullman toilet that can be easily pulled down by the patient and then pushed back into place.

The pod plan is uniquely flexible, as shown at right in the maternity and intensive care floor. By closing off different pods in a variety of ways, a nursery area or an intensive care wing can be formed. In many cases, also, two or more rooms can be combined for special purposes.



Architect Heads N. Y. C. Planning Commission

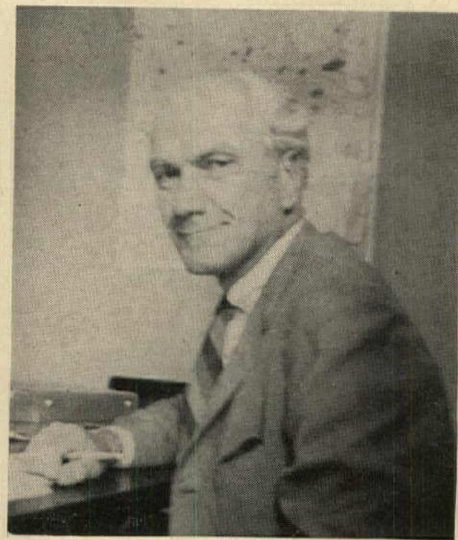


Photo: D. Jeanne Graham

New York's City Planning Commission, long headed by political appointees or real-estate-oriented businessmen, has gotten a new chairman in the person of Architect William F.R. Ballard. Ballard, who is president and chairman of the Citizens Housing and Planning Council, matriculated at Columbia University and Fontainebleau and received his M.F.A. at the Princeton School of Architecture in 1932. He worked in the office of Clarence Stein for the next two years, then was assistant technical director of the New York City Housing Authority. He became director of architecture for the authority (1941–42) after designing its Queensbridge Housing project. A principal in the New York firm of Ballard, Todd Associates, the new chairman in 1951 co-authored a new zoning plan for New York that was the basis of the one finally adopted two years ago. Ballard stated that he hopes the City Planning Commission now will be able to "make some strides" towards a comprehensive master plan for the city.

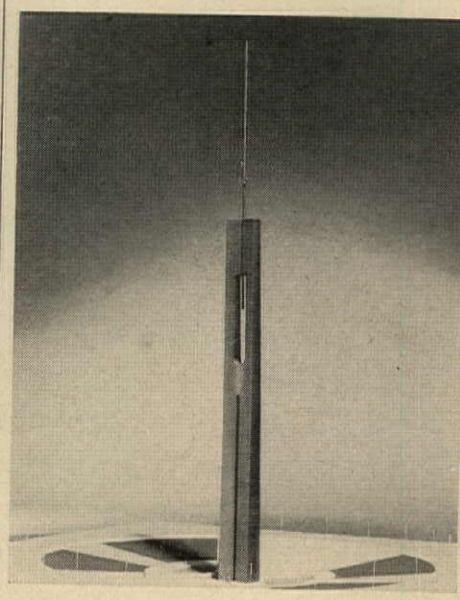
On the commission, he joins another New York architect, Harmon H. Goldstone, who has been a member since last year.

OVERLOOKING DESIGN

Conrad Hilton, in his recent round-the-world hotel opening spree, seems bent on perpetrating the "Ugly American" picture. Three hostelries, at least are now in operation repellently close by or overlooking major European monuments: Buckingham Palace, the Vatican, and the Parthenon. Latest report has it the French are disturbed over reports that Connie is planning a hotel hard by the Eiffel Tower. As long as this incontinence has started, we suggest a few sites Hilton may have overlooked: under the main dome of Hagia Sophia; in the Piazza San Marco; floating in Xochomilco; underwater at Abu Simbel; in New York's Washington Square; suspended under the Golden Gate Bridge; and overlooking Mme. Nhu in Saigon. One suspects that Hilton behaves the way he does only because a rival chain one-upped him with a name-calling masterpiece when it de-canonized the venerable old St. Charles Hotel in New Orleans into Sheraton-Charles.

Competition for Pittsburgh Square

The Urban Redevelopment Authority of Pittsburgh has announced an international competition for the design of a major public square in the Allegheny redevelopment area of the city. Jury will include Gordon Bunshaft, Hideo Sasaki, and Dahlen K. Ritchey, plus Pittsburgh civic leaders H. J. Heinz and Adolph W. Schmidt. Five finalists will be chosen and will receive \$5000 each. A grand winner will then be selected from the finalists to prepare working drawings for the project and to supervise construction. Allegheny Public Square, as it will be called, will consist of three acres bounded by the North Side Carnegie Library and Music Hall, the Buhl Planetarium and new commercial and apartment buildings. Closing date for registrations is November 15, and drawings must be submitted by March 13. Correspondence should be addressed to Paul Schweikher, Professional Advisor, Allegheny Public Square Competition, Department of Architecture, Carnegie Institute of Technology, Schenley Park, Pittsburgh, Pa.



Tower to Highlight California Campus

The new campus of the University of California at San Diego by Robert E. Alexander & Associates will have as a focal point a communications tower sheathed in cast aluminum of a design and alloy developed by sculptor Malcolm Leland under a Graham Foundation Fellowship. The 350′ tower will be

Continued on page 95

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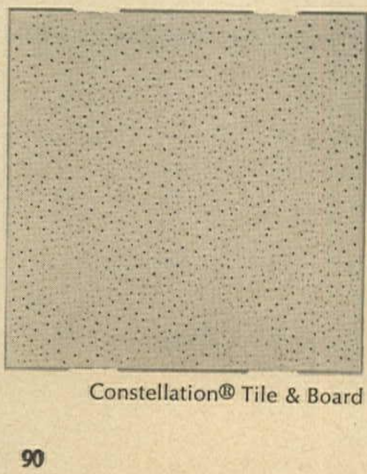

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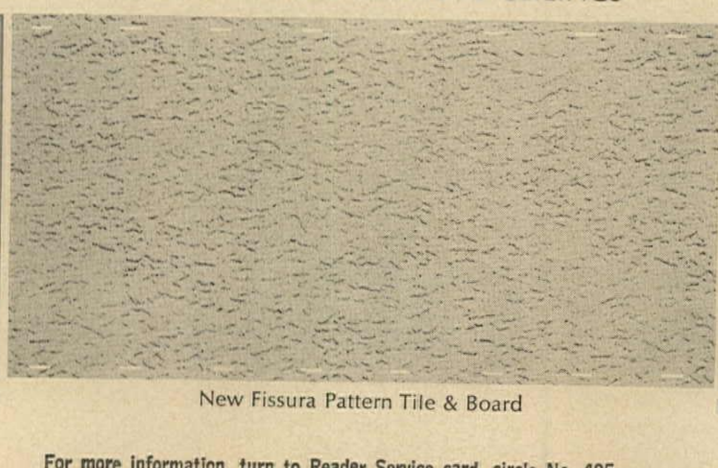
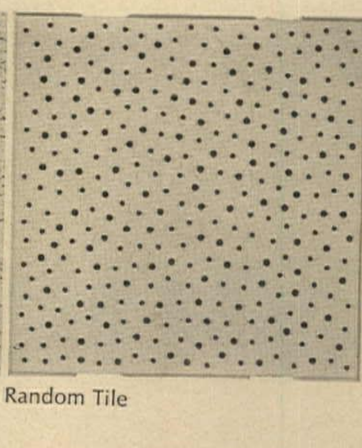


New Fissura Pattern Tile & Board



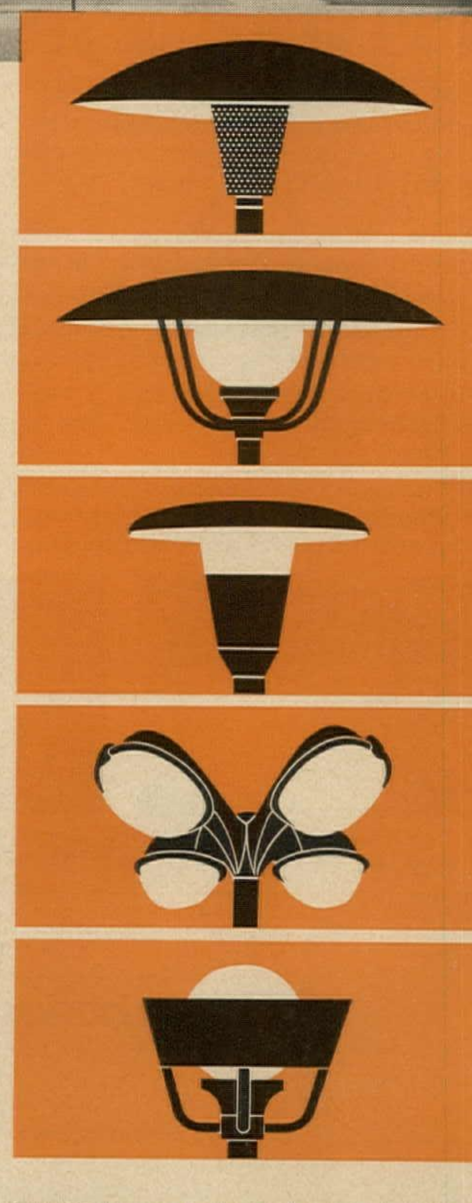
Random Tile

For more information, turn to Reader Service card, circle No. 405

The Pharaoh Tutankhamen and his wife — gilt and painted woodwork. Circa 1350 B.C. Cairo Museum.

PEMCO AREA LIGHTING

University of Chicago Law Building • Saarinen & Associates, Architects • Photo by Hedrich-Blessing



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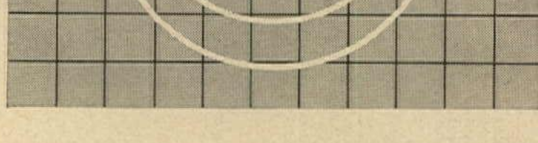
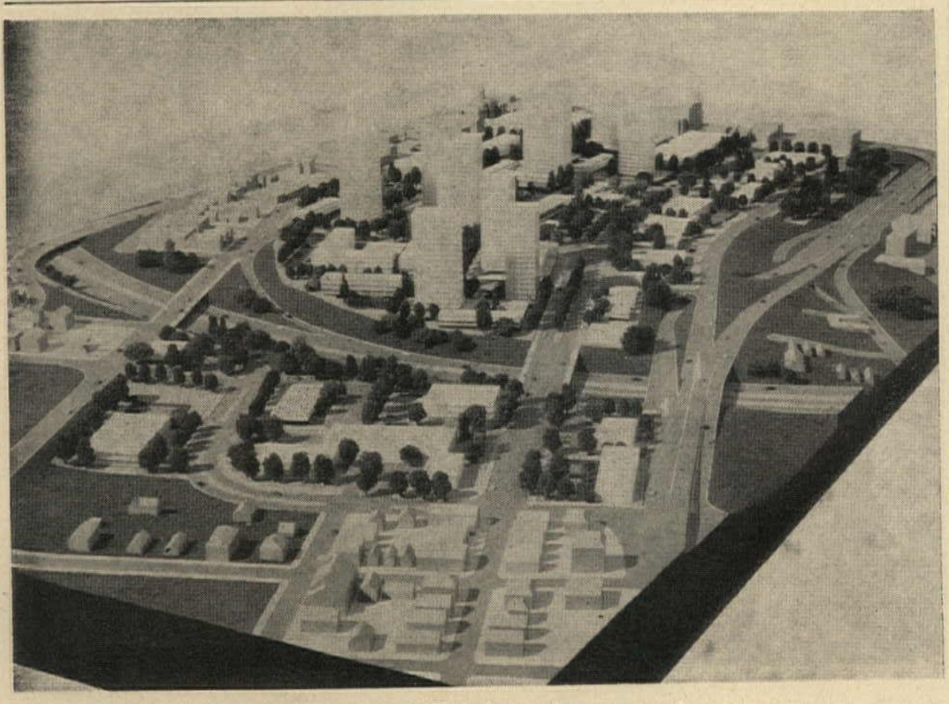


For more information, turn to Reader Service card, circle No. 428

Continued from page 88
a multiuse facility, with the top 30′ for educational TV, the next 30′ for FM, and utilities below for microwave reflector linkage to other University of California campuses. Using either the top platform or removable plates, various scientific experiments, including those with LASER light, will be possible. Other uses of the tower will include ship-to-shore communication, a call system for university employees, and time-signalling bronze chimes. The Alexander-designed San Diego campus also will have three smaller communications towers, each marking the center of a separate college on the campus.

Wall Street Tower by SOM

Among changes in New York's financial district are plans for a 40-story office structure at 140 Broadway by Skidmore, Owings & Merrill. This building, a tower occupying 40 per cent of the block-site (to be built under the city's new zoning laws) will employ two elements of the adjacent SOM Chase Manhattan scheme: (1) the closing off of Cedar Street, enlarging the existing Chase plaza into one shared by the new building and the Equitable Building (120 Broadway); and (2) the widening of Liberty Street along its site, creating a broad cross artery for the district. Total space provided—including underground shopping and banking concourse—will be 3,000,000 sq ft.



Portland Redevelopment

Portland Redevelopment Commission, Oregon, is sweeping clean a 54-block area on Foothills Freeway, south of its business core. Utilizing some existing buildings and demolishing unsuitable ones, the Commission has committed over 94 per cent of the area—dubbed South Auditorium Project—to renewal. Malls will penetrate newly created super-blocks, building sites will be landscaped and adjacent to public malls, parks will be centrally located on each super-block, and off-street parking will be provided. A council composed of Pietro Belluschi, Paul Hayden Kirk, and George Rockrise are supervising all designs; resident design consultant is Walter Gordon.

Main purchaser, Portland Center Corp., will create a "fully co-ordinated, self-contained residential and business community" with SOM as principal architect. Plans are for eight high-rise apartments, seven office buildings, a 300-room luxury motel, convenience stores and cultural areas. Other developers include IBM, New England Mutual Life Insurance, and Addressograph-Multigraph.

Raniero Corbelletti

PAEANS FOR PEI

Last month was a fine one for I.M. Pei. First he was informed that he had been selected to receive the coveted Medal of Honor of the New York Chapter AIA. Soon after, he learned that his firm had been appointed to create an entirely new $15,000,000 college (called appropriately enough, New College) in Sarasota, Florida.

Pei's appointment followed an unusual selection procedure by New College officials. First, they had a committee composed of Pietro Belluschi, Charles Colbert, Walter McQuade, and G. E. Kidder Smith devise an interview selection process for obtaining the right firm for the project (an EFL grant was given for carrying out the process). Then the architect-selection committee (David Lindsay, Jr., chairman; members: Trustees Philip H. Hiss and Dr. Marvin Halverson, Trustee and President D. George F. Baughman) applied the criteria to a long list of qualified firms, finally narrowing the candidates down to nine firms. After interviews and a period of soul searching, the committee announced its unanimous decision: Pei gets the job.

CITY AIA MEET THEME

"The City—Visible and Invisible" will be the theme of the professional program of the 1964 Convention of the American Institute of Architects in St. Louis next June 14–18. First session, on the morning of June 17, will cover the "invisible" part: namely the

Continued on page 98

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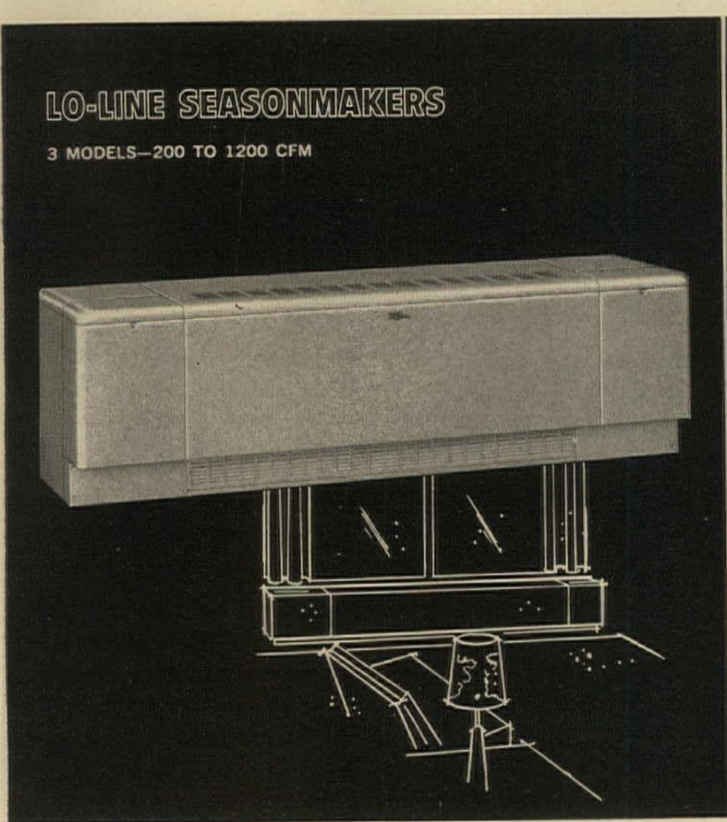

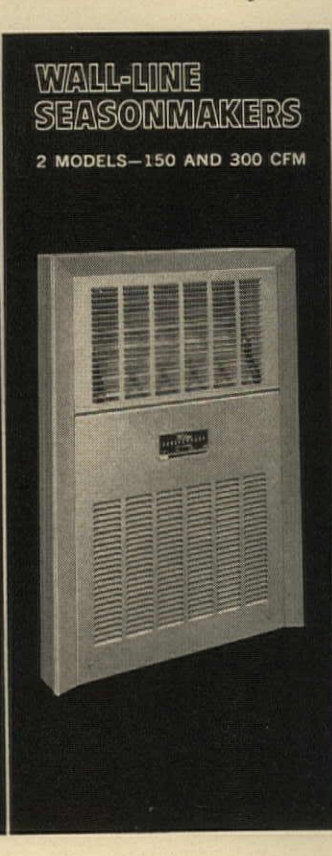

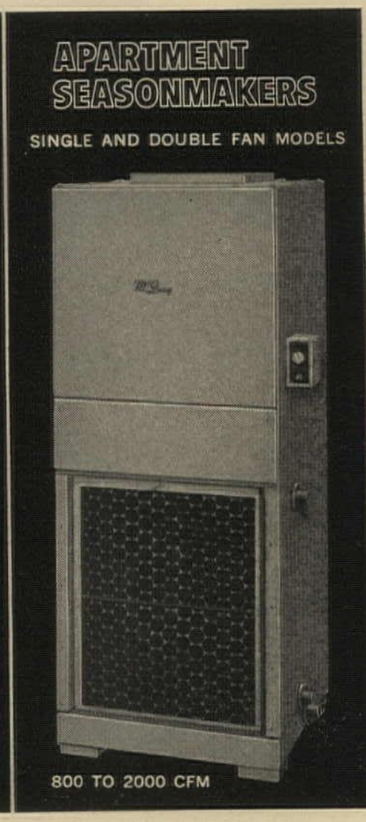

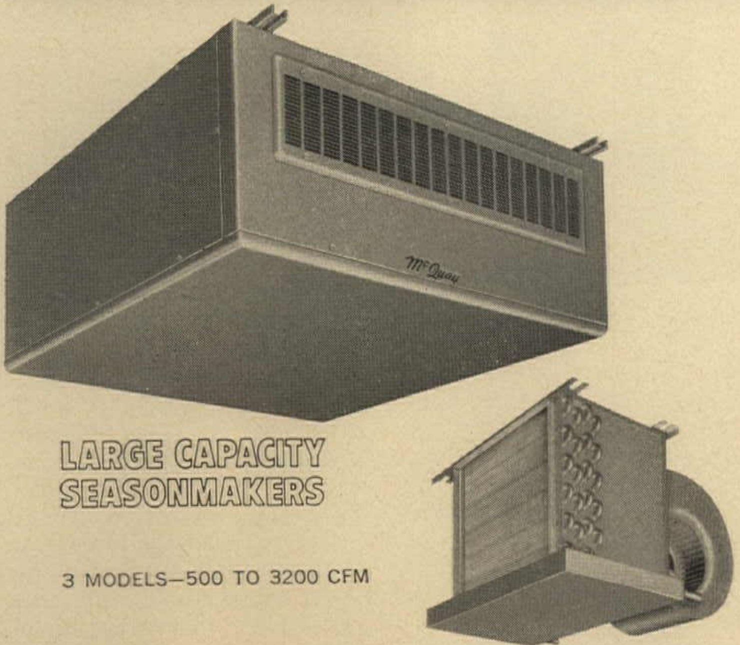

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Continued from page 95
psychological, sociological, legal, historical, cultural, family, and spiritual aspects of urban living. Quite a morning's listening. That afternoon, the more corporeal elements of the city will be discussed, particularly in reference to the relationship of government to the problems of cities. Convention headquarters will be the Chase-Park Plaza Hotel.

Justifying the Ways of Men to God

The Reverend Peter Hammond, noted British divine who is a frequent writer on religious architecture, was a featured panelist (Louis I. Kahn was the other) at the recent National Liturgical Week in Philadelphia. He stated that he sees nothing but mediocrity in religious architecture in the future "as long as the outdated 19th-Century concept of the architect-client relationship persists." He noted that "too often the client is full of assumptions about the kind of structure he wants," and the architect agrees to "make it stand up that way, no questions asked." Sometimes it would be better if the architect simply refused the commission, he suggested, since "the client is the least person to have assumptions." Only after such fundamental values as the nature of the community and the building's true use are carefully pondered and rethought can a good architect-client relationship begin, Rev. Hammond said.

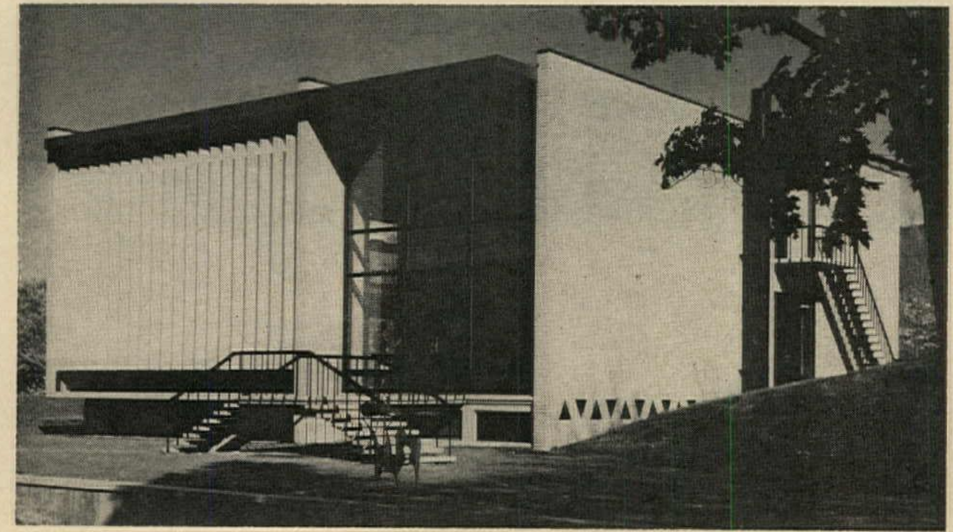
"Usually the best architect to choose for a church is one who has never done a church before," the minister suggested, "one who is passionately devoted to his profession, and who will stand for no nonsense. And most of the best architects have not built a church, because a few years ago they would not have been asked. . . . The situation is now changing," he added, "with the result we can now talk seriously about church architecture for the first time in a long while."

In an aside, commenting on the most famous new church in his homeland, Father Hammond mused, "I am convinced that Coventry Cathedral, insofar as it does have a theory, is derived from the novels of Henry James."

Banking Tower Of Exposed Aggregate

Four broad L-shaped columns will rise from the ground as "strong roots" supporting the office tower of the Hartford (Connecticut) National Bank over its 20′-high base. The

tower walls—floor-to-ceiling precast window sections of textured aggregate—will be exposed to provide exterior and interior wall finishes. Both base and 25th-floor penthouse will be recessed and glass-enclosed. The base, a banking floor, will also contain a wide entry gallery, a mezzanine employee's cafeteria and meeting room. The executive penthouse, bordered by an exterior walkway, will contain a central display room and garden court, meeting rooms and two dining rooms—with views of the Connecticut River. Architects are Welton Becket & Associates and Jetter & Cook, Hartford.



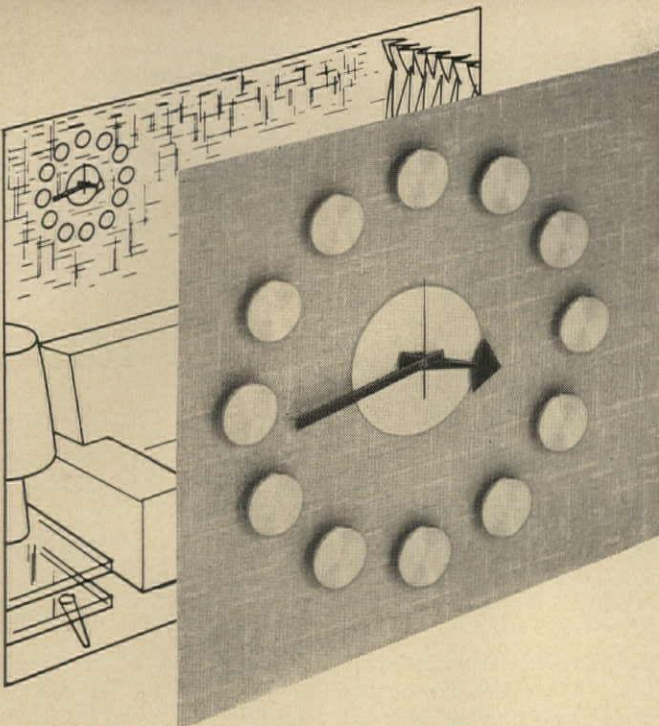
Art in the Country

The Bundy Art Gallery, Waitsfield, Vt., exhibits contemporary art in a scenic valley setting. The glass, sand-colored brick, and copper structure has a plan which—working within two major levels—drops floors and raises ceilings to suit each room's function. Main vestibule and gallery, for instance, are open to full 22′ height of two floors. A feeling of flowing space has been effected through variation in heights of classroom, studio, and workroom on the first major level; and of library and gallery on the second.

Sand-colored brick and natural wood beamed ceilings are exposed on all interiors. East and west walls of glass enable inside visitors to enjoy the surrounding sculpture park. A lagoon curves north and west around the building. Harlow Carpenter is designer and director of the museum.

Calendar

"Industrialized Building" will be the theme of 1963 International Building Exhibition in London, November 1–27. The display—to implement conferences—will outline principles with practical demonstrations by manufacturers and licensees of systems . . . Focus at U. of Florida's symposium on Caribbean architecture, December 4–7, will be on guest speakers Carlos Contreras, SAM, FAIA, Mexico City, and Martin Dominquez of Cornell University staff, along with exhibits of Mexican architecture and of Dominquez's work . . . 1963 Semi-Annual Meeting of the Consulting Engineers will take place October 30 through November 1 at the Disneyland Hotel, Anaheim, Calif. . . . National Lumber and Building Material Dealers Association will present "Sell-Power" Exposition, November 2–4 at Chicago's McCormick Place . . . The Building Research Institute will hold its Fall Conferences at the Mayflower Hotel, Washington, D.C., November 19–21. . . . The International Conference on Materials of the American Society for Testing and Materials is scheduled for the Philadelphia Sheraton Hotel, February 3-7.



Model 6773—Hour indicators in aluminum, brass or black; centers in white or aluminum. 13″ or 20″ diameter.

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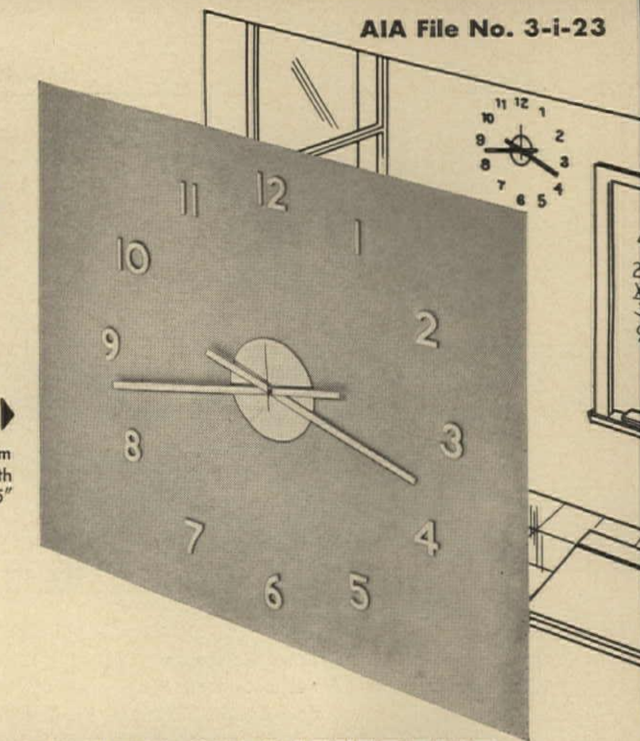

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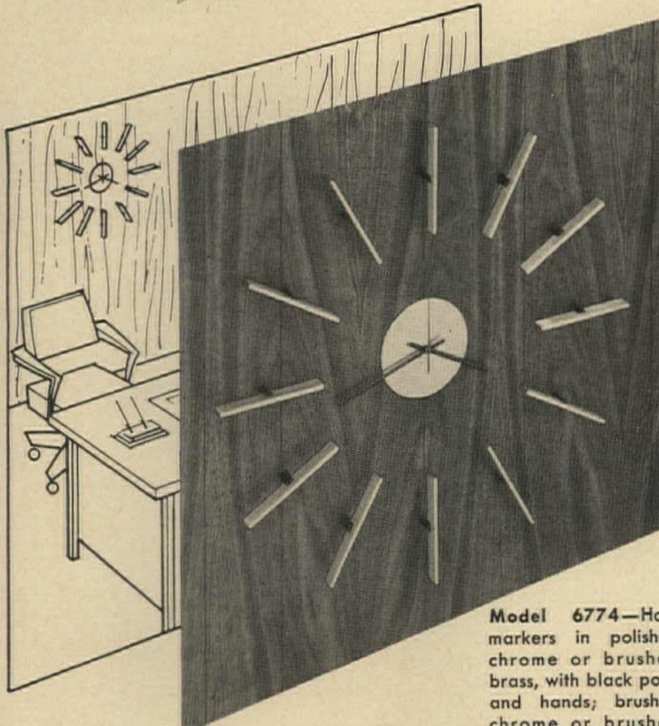

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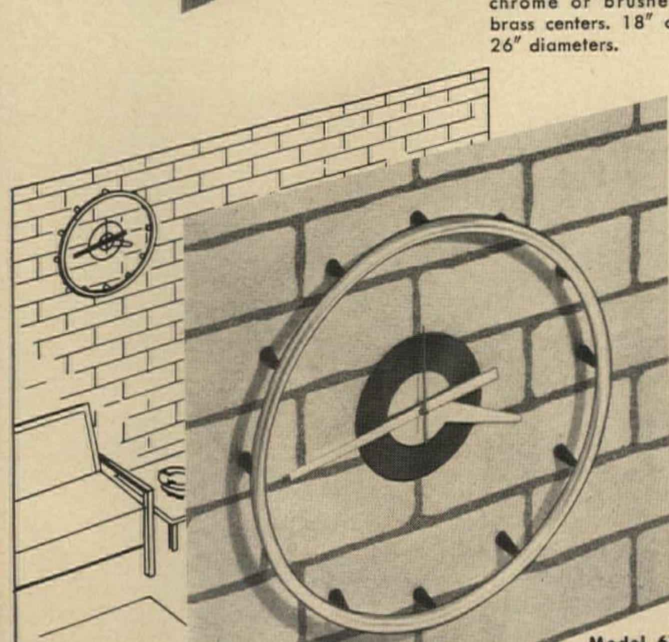
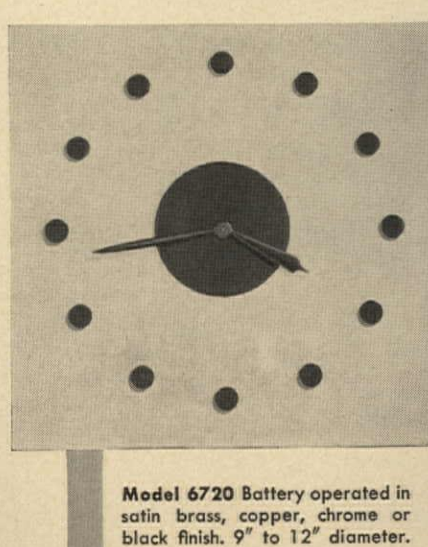
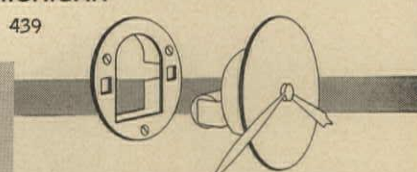


Model 6770
Ring in polished chrome or brass with black post and center disc; chrome or brass hands. 14″ diameter.



Model 6720 Battery operated in satin brass, copper, chrome or black finish. 9″ to 12″ diameter.



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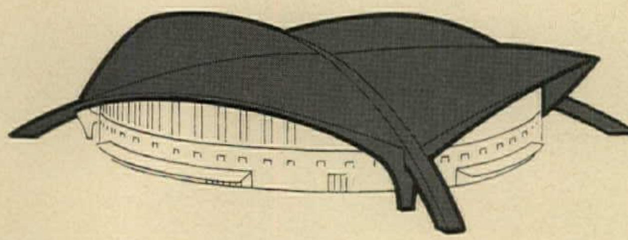
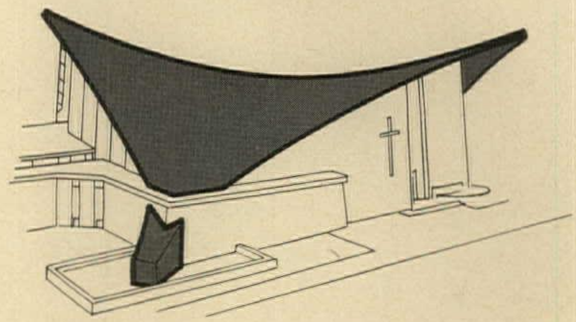
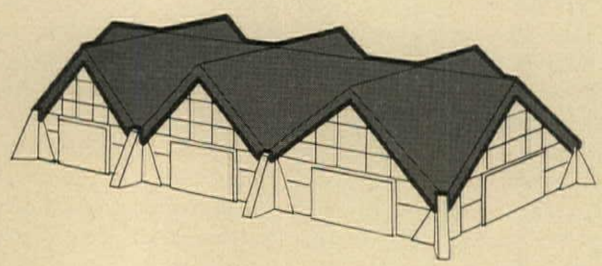


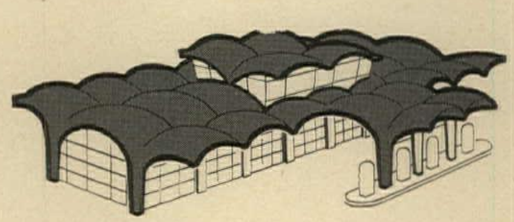
Athens Coliseum
Athens, Georgia
Arch.: Cooper, Barrett, Skinner,
Woodbury & Cooper



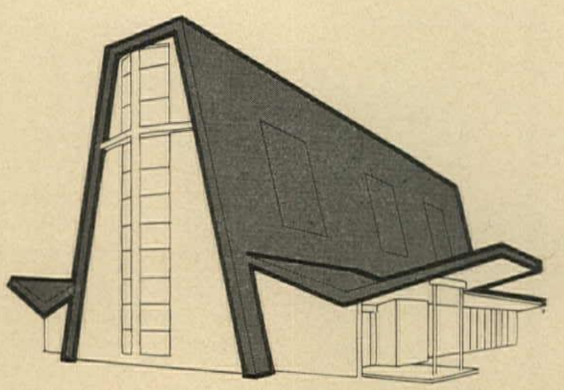
St. Charles Parish
Spokane, Washington
Arch.: Funk, Murray & Johnson



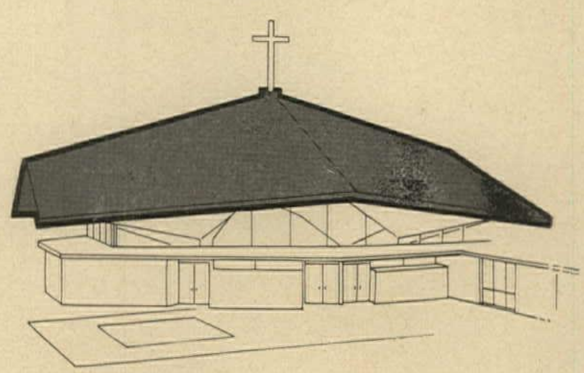
Minisa Park Shelter
Wichita, Kansas
Arch.: Claude Van Doren



Gulf Service Station
Atlanta, Georgia
Arch.: Tomberlin-Sheetz



Church of Christ the King
Sioux Falls, South Dakota
Arch.: Howard Parezo



Presbyterian Church
Mercer Island, Washington
Arch.: Paul Thiry

For more information, turn to Reader Service card, circle No. 414

ADJOURNMENT FEVER ALLAYED

by E. E. Halmos, Jr.

Traditionally, at this time of year, Congress catches the annual adjournment fever, and life becomes very dangerous for Washington correspondents as the lawgivers begin to cram all manner of legislation through the grinder in their rush to get home. But this year, there's no evidence of the adjournment disease at all; in fact, Senators and Representatives have engaged in a number of courtly, half-humorous word minuets about the very strong possibility that Congress will still be in Washington at Christmastime. Sadly enough, that will very likely be the case. And, far from being dangerous, life has become boring for Washington correspondents.

There's little to report so far: committees and one house or the other have taken some leisurely steps, but not much more can be said.

Item: The House Armed Services Committee approved a $175 million plan to spur fall-out shelter construction (incentive payments to public and nonprofit groups that provide shelter space), but no House action was scheduled as of early September.

Item: The Senate passed a bill extending the $75 million annual Federal Aid for Airports program for another three years, but no House action was scheduled.

Item: The House okayed, with some cuts, a $1.1 billion authorization bill for construction work for public and private colleges and universities, but House committee hearings hadn't been completed.

Item: The House Ways and Means Committee said it had completed work on a rewrite of the Administration's tax-cutting bill (including, for the construction industry, a limitation of capital gains to 21 per cent on sale of property held two years), but House action hadn't been set up and the Senate hadn't started work on its version of the measure.

Item: Nearly all of the major appropriations bills were still hung up in the House, the Senate, or in committee; Government agencies were still operating, for the most part, on "continuing resolutions" that authorize them to keep on spending at Fiscal 1963 levels.

There's no need to repeat the obvious reasons for this apparently lackadaisical Congressional attitude: the controversies over civil rights, Government spending, foreign aid, to name a few.

But a result has been an increase in activity of the Executive branch in trying to fill the legislative gap through the medium of Executive orders: the now-being-implemented directives on discrimination matters, for example; and the push for union organizations within the Federal departments.

And finally, it has resulted in getting nearly everything mixed up in rather unseasonal political activity: everything the Executive does gets criticized at once as a pre-emption of Congressional powers; and every Congressional balk is criticized as obstructionism.

Boost for Urban Post

The move to establish an Office of Community Development in the Executive Office of the President—started in the House a month or more ago—got a boost in the Senate with introduction of a new bill (S 2046).

Like the previous House bill (HR 4470), it would set up the Office as a co-ordinating agency to pull together the numerous activities in the field of urban development now being conducted by various Government agencies.

Central Data Source

The National Bureau of Standards is moving ahead to establish a "National Standard Reference Data System," to provide critically evaluated data in the physical sciences on a national basis. Establishment of such a system was recommended recently by the Federal Council for Science and Technology.

Idea is to develop a central storehouse of standard reference data on the physical and chemical properties of materials, authoritatively documented as to reliability, accuracy, and source. It could save endless search of source materials for architects and engineers (as well as chemists and others) in making decisions as to the properties of materials. Principal Data Center will be at NBS headquarters in Washington; satellite centers will be set up at universities, research institutes, and other locations.

In the Standards Bureau, note the retirement of Douglas E. Parsons, long-time staff member, after a final year as consultant to the director.

Over some 40 years, Parsons' chief interest has been research and standardization in building materials and building technology. He holds three American Concrete Institute awards, the Award of Merit of the ASTM as well as its Walter C. Voss award, and many other honors in the field of building technology; and has served as a director of the Building Research Institute.

Capitol Architect

Add this note to your file on the running battle between some Congressmen and the Architect of the Capitol.

Introducing a bill that would provide (among other things) for a "James Madison Memorial Library" on Capitol Hill, and for naming of Federal buildings for famous men (rather than more statues), Illinois' Senator Douglas added this comment:

"I hasten to add that, while this bill necessarily places administrative responsibility on the Architect of the Capitol, it also explicitly provides that the Architect must consult with qualified architects and others. . . ."

FINANCIAL

The construction industry was rocking along at just about its predicted pace through the summer, according to all indications: nothing spectacular, but healthy.

In July, said the Department of Commerce, value of new construction put in place was $5.9 billion—unchanged from June and up about 3 per cent over a year ago. That figure included a slight drop in the rate of new housing construction, now at a seasonally adjusted rate of 1.5 million, down about 3 per cent from June, but up 5 per cent over a year ago.

But there was ample prospect of continuing strength in housing. One indicator was a Commerce Department estimate that more than 1.4 billion lineal feet of sewer service pipe would be required to meet mostly housing needs from now to 1975.

Another sign of health was continuing evidence of easing of money markets: The FHA secondary market price for mortgages continued unchanged (at $98.5 per $100) for the third straight month. Costs of highway construction, measured by the Bureau of Public Roads, also remained unchanged for the second quarter of 1963, as compared to the first quarter (but up 2.6 points on BPR's index over the corresponding quarter a year ago).

For more information, circle No. 366 ➤

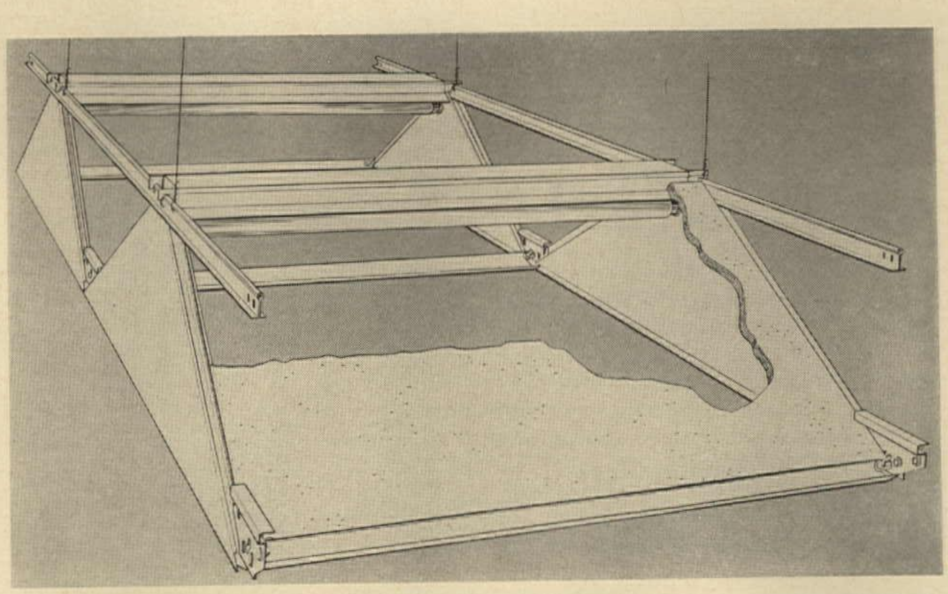
TOTAL INTEGRATED CEILING SYSTEM

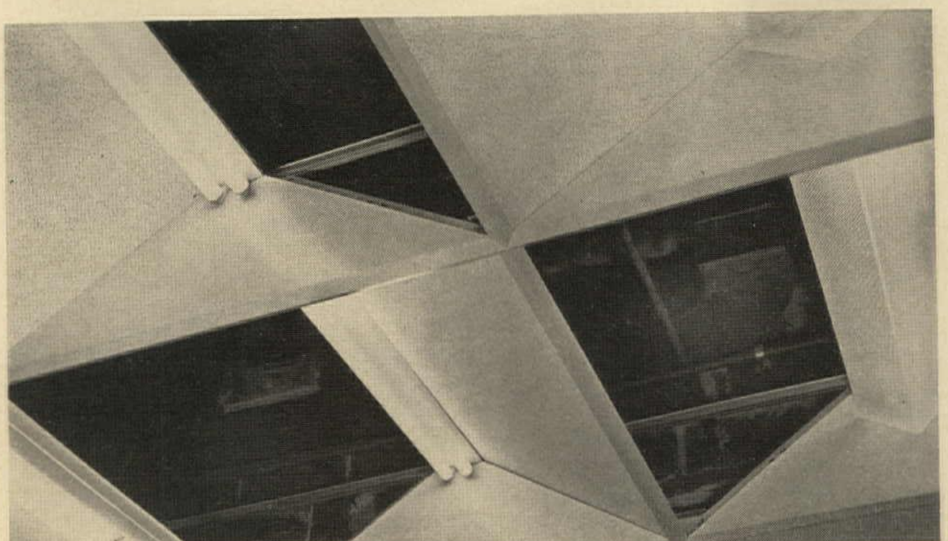
Recently developed is a totally integrated ceiling system which performs the functions of lighting, air distribution, acoustical control, space control, and decoration. "Luminaire A-50" system employs a modular dimension of 50"x50" based on 48" size of standard fluorescent tubes and 2" width of standard ceiling-height partitions. Horizontal width of suspension members is 2" which, when added to the length of the bulb, comprises the 50" module.

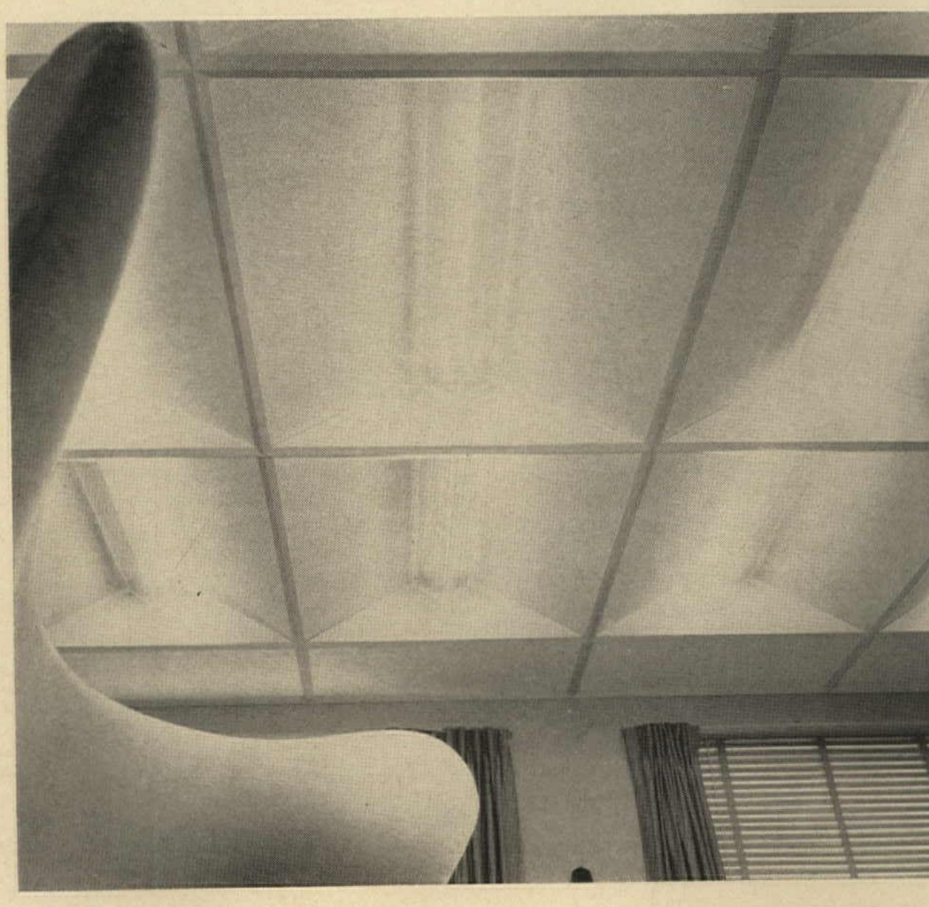
Luminaire system consists of following components: (1) Double module main runner that spans length of two complete modules. Runner, 100" long, 16" high, and 2" wide, is factory fabricated and assembled. It is hung by wires, or by rods or strap hangers in areas where code requirements specify such means of support. (2) Cross tees are inserted between main runners as in standard exposed grid suspension systems. Special cam locking action lifts and pulls tee in as it is installed. (3) Light fixture rests on top bar and is then keyed into the main runner for locking purposes. (4) Board surface is an incombustible mineral acoustical material, 26½"x 49" in size. It also performs ventilating function by delivering air through small perforations. (5) Arrow section main runners are employed to accommodate flat ceiling areas. (6) Wall molding carries out same basic shape as rest of suspension components. Flanges of arrow-shaped tees have lift of 33 degrees from the horizontal. Wall molding is especially fabricated to receive the flanges. Tees may be cut-off straight and inserted in notch of wall molding, thereby concealing the cut. (7) Lay-in panels, which provide complete accessibility to ceiling, are for maintenance of other mechanical equipment, inspection of junction boxes, access to plumbing pipes, valves, etc. (8) Light fixtures are available in one, two or three lamp models. By utilizing store hooks, lamps can be replaced from the floor. According to Electrical Testing Laboratories, Inc., light output (efficiency) rating for lens system is 75 per cent and for a bare lamp installation, 80 per cent.

Average selling price of Luminaire ceiling is about $2.50 per sq ft. This price includes lighting, ventilating, and acoustical control elements. Complete engineering data on ventilating and lighting functions is available. Armstrong Cork Co., Liberty and Mary Sts., Lancaster, Pa.

On Free Data Card, Circle **100**







Products For Air Conditioning

Rooftop Unit

Recently developed model 48/110 has been added to "Duopac" series of year-round air conditioners. Unit combines air-cooled electric air conditioner and gas-fired furnace in one compact package for outdoor installation on rooftops or ground-level slabs. This model is 27″ high, 30″ wide, 72″ long, and weighs 650 lbs. Completely factory-assembled and prewired, unit has cooling capacity of 48,000 Btu and heating capacity of 110,000 Btu. Fabricated from mill-galvanized steel, it is primed and finished in "Shasta White" baked enamel. Day & Night Mfg. Co., P.O. Box 1234, La Puente, Cal.

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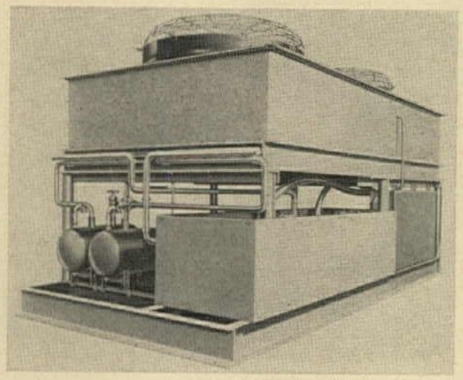


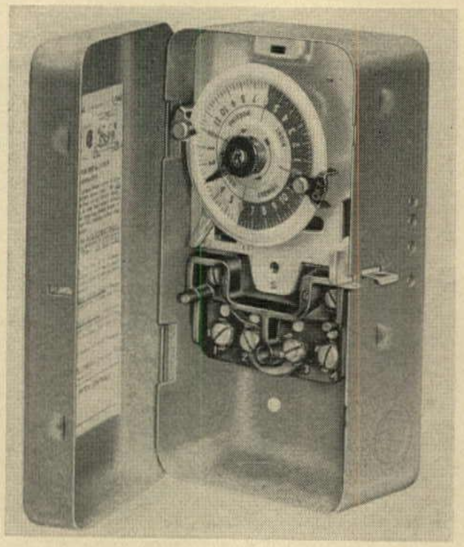
Water Chiller

Packaged air conditioning water chiller can be installed either on the roof or on an adjacent ground slab. "Air-Cooled Cold Generator" utilizes acoustical panels to attenuate sound of mechanical parts. Air is discharged vertically to reduce noise of rooftop operation. Unit is pre-engineered, factory assembled and weatherproofed. The Trane Co., La Crosse, Wis.

On Free Data Card, Circle **102**

Air-Conditioning Timers

Two automatic timers have been developed for operating heating, cooling, or ventilating system components. Timers can be used to run fans, valves, compressors, or furnaces. Units, which carry Underwriters Laboratories listings, are available for 7-day or 24-hour programming. Model for 7-day programming permits hourly settings for any specific day. Minimum switching periods are three hours, which means maximum of four-on and four-off periods during any one day. This unit includes man-



ual on-off switch to override programming sequences without interfering with timer operation. Model for 24-hour programming has 90-minute switching periods which means maximum of seven-on and seven-off periods during any one day. Honeywell, 2727 Fourth Avenue South, Minneapolis 8, Minn.

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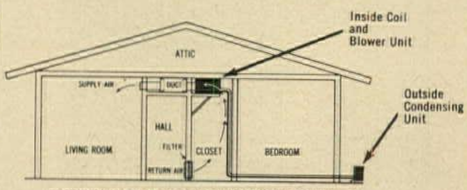


CLOSET SHELF INSTALLATION USES NO FLOOR SPACE

All-Electric Unit

All-electric, year-round air conditioner can be installed in wall, on slab outside structure, or mounted on roof. Condenser unit, 2 hp, is connected to evaporator coil and air handler with cooling capacity of 23,000 Btu. Conditioner is available in four sizes: 3.8 kw, 5 kw, 7.8 kw, and 8.8 kw. Heater elements are built into air handler with all necessary controls for single or two-stage operation. Hupp Corp., Perfection Div., 1135 Ivanhoe Rd., Cleveland 10, Ohio.

On Free Data Card, Circle **104**

Combination Fresh-Air Supply and Door Heater

Self-contained unit functions as gas-fired fresh-air-supply heater and door heater. "Wing Combination" unit is mounted above large industrial doors. When doors close, unit functions as fresh-air-supply-heater. When door opens, it converts automatically to a door heater. Unit is available in five models, with air handling capacities ranging from 8000 cfm to 35,000 cfm. Heating capacities are from 750,000 Btu/hr to 4,500,000 Btu/hr. L. J. Wing Mfg. Co., Linden, N. J.

On Free Data Card, Circle **105**

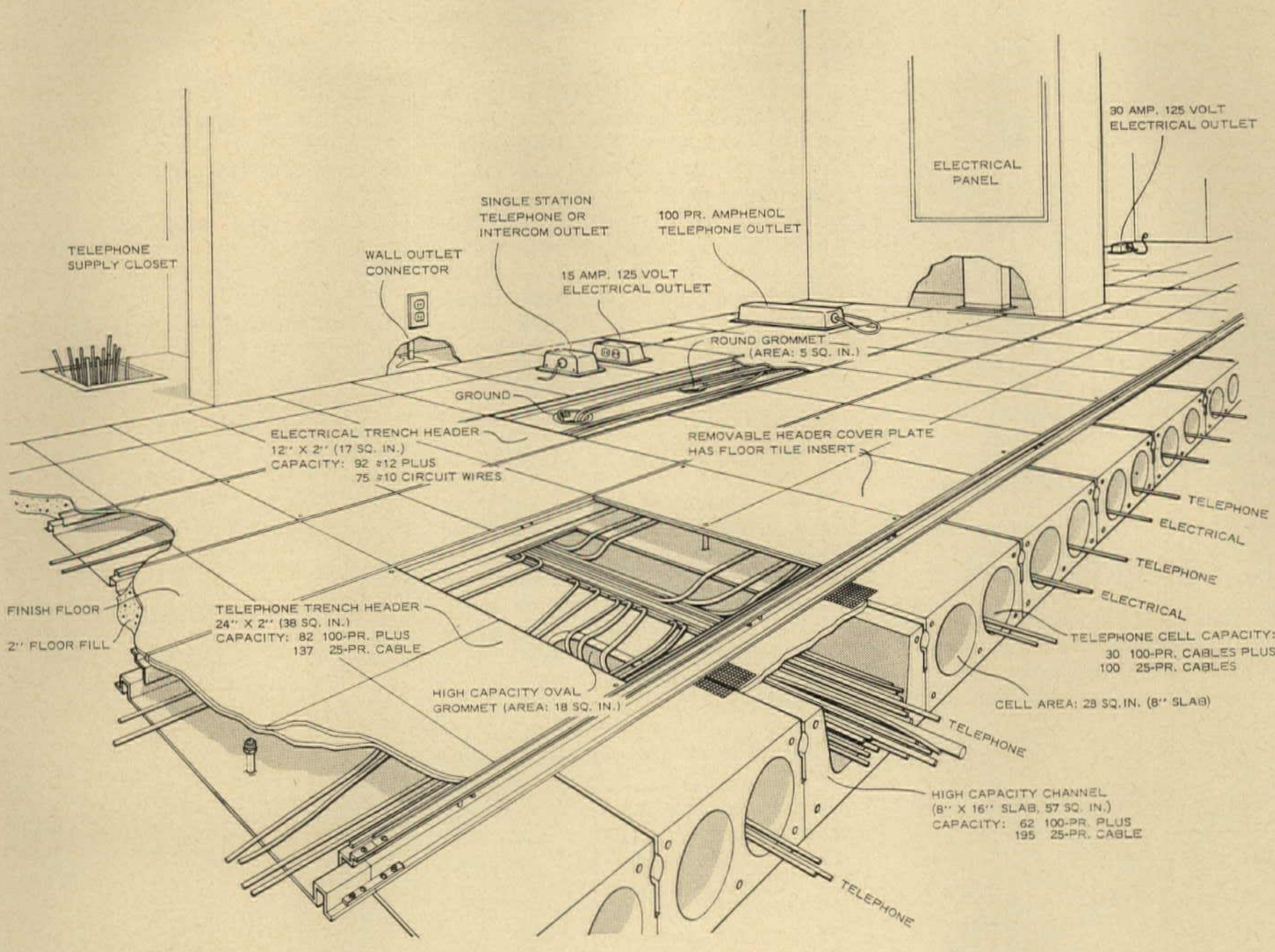
Spray-Type Humidifier

Spray-type power humidifier has adjustable capacity ranging from 0 to 44 quarts of moisture per day. Unit includes duct mounted humidity controller which contains built-in humidistat to control humidity level. It also has a "sail switch" so that humidifier will function only when moisture is needed and the furnace blower is operating. Humidity controller plugs into conventional 115 volt, 60 cycle outlet and humidifier plugs into special humidity controller plug. No other wiring is necessary. Mueller Climatrol, 2005 West Oklahoma Ave., Milwaukee 1, Wis.

On Free Data Card, Circle **106**

Thermostats

Three low-voltage, two-wire thermostats have been developed for combination heating or cooling installations or for individual heating or cooling use. Providing a 50 F to 90 F temperature-setting and thermometer range, these thermostats utilize hermetically sealed, dustproof mercury switches for trouble-free and quiet operation. Thermostats also feature readily accessible, easy-adjustment level located under outer cover of unit.



New Raceway System for Telephone Wiring Meets High Capacity Demands of Tomorrow's Office Buildings

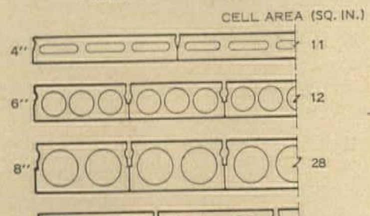
Most office phones today carry multiple lines, hold buttons and lights. They are wired with a 25-pair cable that is about half an inch in diameter. Many new offices are installing the new Call Director or Commander phones served by 75 or 100-pair cables up to ⅞-inch in diameter. These systems need big ducts.

The Flexicore-Flexiflor system shown above offers extreme high capacity through the use of channel slabs, trench header ducts and large cells in the slab. This telephone distribution system is designed to handle 82 100-pair plus 137 25-pair cables, or the equivalent in other sizes. The cables feed from the panel through the channel slab, transversely through the 24-inch trench header duct, then down into the cells of the Flexicore slabs. Wiring can run in either direction to telephone floor outlets located at any point along the cells. Every second cell is assigned to telephone, providing lines of availability only 16 inches apart.

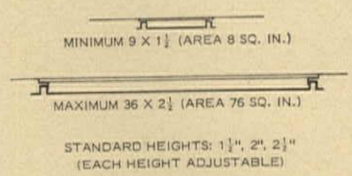
Electrical distribution is handled through the high capacity trench header duct system shown. Many variations of both systems are possible, using Underwriters' approved Flexicore floor decks and Flexiflor electrical fittings. Cost is low because most of the ductwork is a part of the structural floor.

For more information ask for "Underfloor Electrical Distribution." Write or phone The Flexicore Co., Inc., Dayton 1, Ohio, The Flexicore Manufacturers Association, 297 S. High Street, Columbus 15, Ohio, or look under "Flexicore" in the white pages of your telephone book.

FLEXICORE DECKS

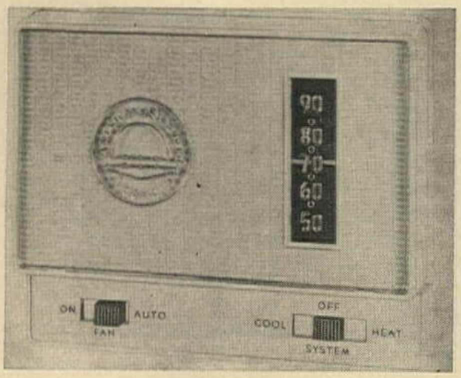


FLEXIFLOR TRENCH HEADER DUCTS



flexicore®
PRECAST CONCRETE DECKS

For more information, turn to Reader Service card, circle No. 411

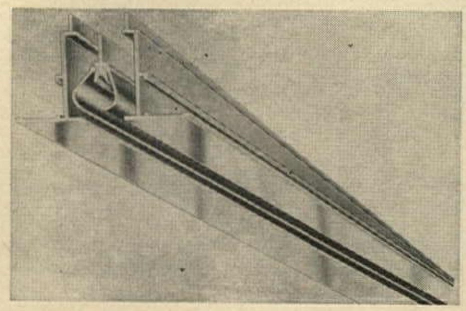


Instant reading, easy-setting **linear** temperature indicator on visual panel makes lining up actual temperature a simple matter in comparison with temperature setting. American-Standard Controls Div., 5900 Trumbull Ave., Detroit 8, Mich.

On Free Data Card, Circle **107**

Ceiling Diffusers

Line of extruded aluminum linear ceiling diffusers has been introduced in which one set of fully adjustable vanes controls both air pattern and air flow



rate. "MODULinear Ceiling Diffusers" can be incorporated into modular units of most ceiling systems. Diffuser vanes can be quickly, easily positioned from diffuser face to adjust air pattern a full 180 degrees and to set desired air flow rate. Because only one set of vanes is involved and no separate dampering devices or blank-off strips, both air pattern and flow can be set at any time before, during, or after installation. Titus Manufacturing Corp., Waterloo, Iowa.

On Free Data Card, Circle **108**

Lighting/Air System

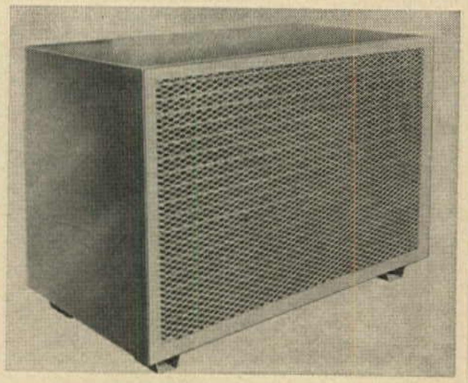
"Heat-of-Light System" permits high lighting levels without excessive air quantities because heat of light is extracted before it gets into occupied space. System utilizes room air introduced into ceiling cavity through heat transfer light units for tempering and reheat. Room air picks up as much as 85 per cent of lamp heat as it passes through light units into ceiling cavity. Portion of this warm air in cavity is then employed to reheat cold supply air delivered to space for temperature control. "Jetronic" unit mixes up to 50 per cent warm air from ceiling cavity with conditioned primary air to meet space needs. Resistance type dynamic sensing element measures temperature of room air being drawn through fixture. Temperature signal positions a motor operator on the Jetronic unit to maintain desired space conditions. Temperature set point is adjusted by a remote set point adjuster which may be placed in any convenient location. Barber-Colman Co., 1300 Rock St., Rockford, Ill.

On Free Data Card, Circle **109**

Air/Floor System

Cellular steel deck called "Mahonaire Floor System" integrates air distribution system with structural floor. System contains complementary mechanical accessories to provide, within structural floor system, modular air distribution capacity. Distribution system can be used for both high and low velocity air distribution in "all-air" or air "reheat" systems. Cell depths to 7½" are available to allow air pressure losses. Flat, one-piece cell bottom and cell hat section covered with concrete affords construction which can be utilized with undetectable leakage for highest air pressures. Cell sizes of 12" module units are 9⅝" wide by nominal 3", 4½", 6" or 7½" depths. Cell areas are 28, 42.6, 57, and 71.5 sq in. respectively. R. C. Mahon Co., P.O. Box 4666, Detroit 34, Mich.

On Free Data Card, Circle **110**



Precharged Units

"QC Series" of precharged summer air conditioners feature quick connecting refrigerant couplings to reduce installation time. Models QC-30 and QC-36 are available in four sizes. Series has units for upflow, counterflow, vertical flow, and horizontal flow installation. Capacity ratings with an outdoor temperature of 85 degrees, range from 13,900 to 33,000 Btu. Thatcher Furnace Co., Dept. 146P, Center St., Garwood, N. J.

On Free Data Card, Circle **111**

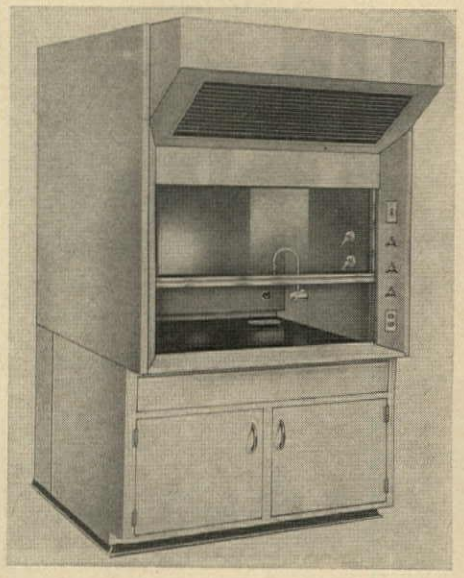
Narrow Diffuser

Recently developed extruded aluminum diffuser is as narrow as 1". It can be mounted either in ceiling or side-wall. Diffuser can also be employed as a supply outlet for cooling, heating, and ventilating or for return air. Neck widths are available in 1" increments from 1" through 12" on one-way deflection, 2" through 12" on two-way deflection, and 3" through 12" on two-way uneven deflection. One piece maximum length is 8 ft for either separate or continuous installation. Carnes Corp., Verona, Wis.

On Free Data Card, Circle **112**

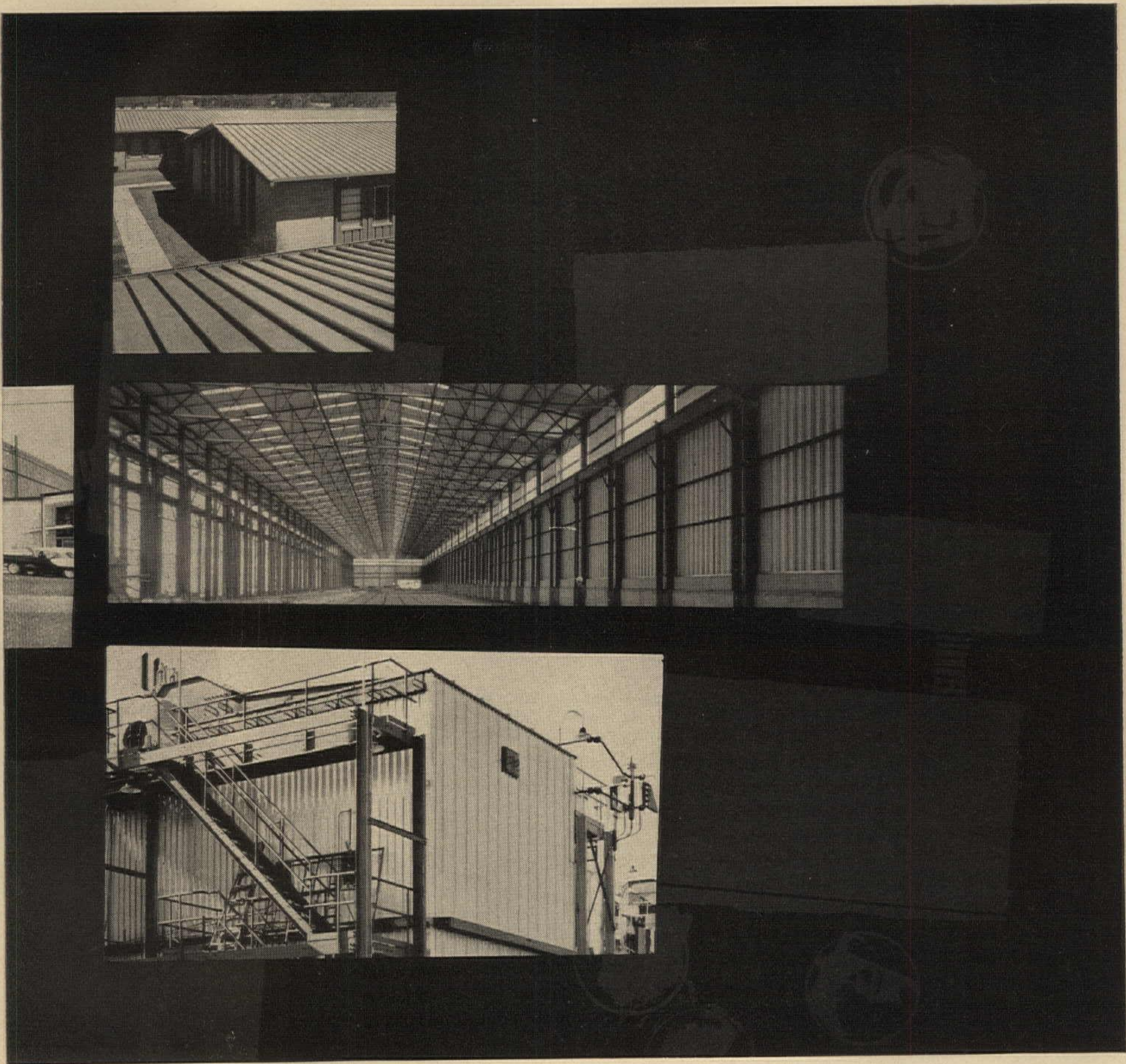
Fume Hood

Induced air fume hoods (Series FH-300) have been designed for air-conditioned laboratories. Hood utilizes



only 50 per cent of its own air from room itself, with the balance being ducted in from the outside. This situation provides complete exhaustion of undesirable fumes while reducing load on air conditioning system by half. Outer air is induced into room in front of and above sash of hood. By special design, as much as 75 per cent of conditioning air or heat may be conserved. To provide controlled face velocity and constant air removal with any sash position, by-pass grilles in induced air fume hood operate automatically with sash movement. Units, 96" and 32⅞" deep, are available in widths of 35", 47", 59", 70", and 94".

Continued on page 116



Continued from page 112
Laboratory Furniture Co., Inc., P.O. Box 590, Mineola, L. I., N. Y.
On Free Data Card, Circle 113

Units For Coastal Areas

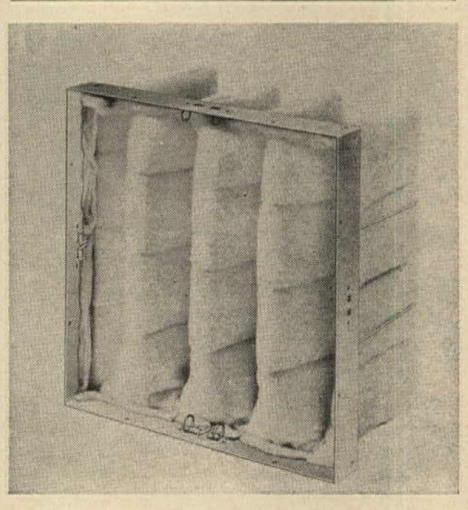
Corrosion-resistant "Zoneline Heat Pump" units have been developed for coastal installation within 1000 ft of salt-water conditions. Units include all copper condensor surface and end plates, all stainless-steel hardware and compressor mounting springs, enclosed fan motor housing, additional protective treatments of an epoxy covering on compressor, and acrylic enamel on all metallic parts. Manufacturer says that these corrosion-resistant heat pumps will last 15 years under seaside conditions as compared to about 3 to 5 years for conventional aluminum condensor surfaces. General Electric, Appliance Park, Louisville, Ky.
On Free Data Card, Circle 114

Heating/Cooling Roof

Combination rooftop heating-air conditioning units feature fresh-air control system called "Power Saver" and down-stream duct furnace with balanced flue. There are 75,000 and 100,000 Btuh of heating available with 3-ton units. There are 120,000; 160,000; 215,000; 255,000; and 300,000 Btuh duct furnaces available for 8- and 11-ton units. Power-saver, fresh-air system provides control for heating, cooling with outdoor air, and mechanical cooling. This assembly handles entire cooling load whenever outdoor air is cold enough to handle heat gain. It also provides for any minimum ventilation or code-required fresh air quantity automatically, and at same time makes available flexible quantities of outside air as required by heat-gain or heat-loss situation encountered. Lennox Industries, Inc., 200 South 12 Ave., Marshalltown, Iowa.
On Free Data Card, Circle 115

Water Chillers

Model RM "Flow-Cold" packaged liquid chillers of 40 to 100 tons capacity have been introduced. Unit features: (1) four-step start and control to minimize starting equipment and demand charge requirements; (2) coolers with removable heads and replaceable star-insert tubes; (3) full operating refrigerant charge in all water-cooled models; (4) completely independent circuits; and (5) built-in circuit breaker and compressor temperature protection. Chiller is available in 12 water-cooled or air-cooled models in six different sizes. Acme Industries, Inc., 600 North Mechanic St., Jackson, Mich.
On Free Data Card, Circle 116



Air Filter

Intermediate air filter, called "Hi-Cap," has been designed to fill gap between low efficiency panel and high

efficiency air filters. Filter consists of permanent frame, heavy duty media retainer, and preformed media cartridge. It is made of modified fiber, treated to make it fire resistant. Hi-Cap is available in standard sizes, with capacities up to 2500 cfm and face velocities up to 625 fpm. Cambridge Filter Corp., P.O. Box 1255 Syracuse 1, N. Y.

On Free Data Card, Circle **117**

Compact Chiller

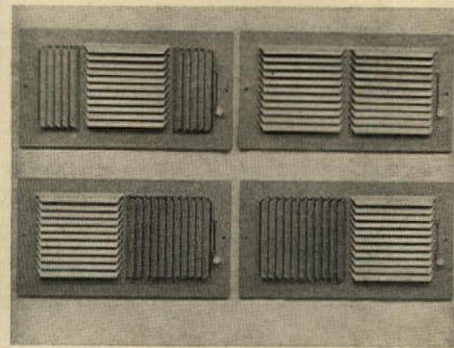
Compact chiller, designed for high capacity systems, solves many problems concerned with equipment isolation and space requirements. According to manufacturer, chiller (6′-8″ in length) is only 100 hp unit occupying 19 sq ft of floor space and weighing less than two tons. Compressor muffler is acoustically tuned to frequency of refrigerant gas. Further acoustical insulation and isolation are provided by optional cabinet enclosure (manufacturer says only one available for single compressor chillers above 30 hp). Cooler and condenser tanks are utilized as structural backbones of chiller, eliminating unnecessary supporting material. Chrysler Corp., Airtemp Div., 1600 Webster St., Dayton, Ohio.

On Free Data Card, Circle **118**

Condensing Unit

Air-cooled condensing unit features waterless operation. Available in eight sizes ranging from 20 to 50 nominal hp, it occupies only 60 sq ft of roof area. Unit includes low-speed fans, spring-mounted hermetic compressor, and rippled in fin coils for maximum heat transfer. McQuay, Inc., 1600 Broadway N.E., Minneapolis, Minn.

On Free Data Card, Circle **119**



Supply Registers

Curved blade supply registers have been developed for ceiling installation near inside walls. They eliminate need of running supply duct to center of the room or expensive wall installations in old or new construction. Units are designed for both air conditioning and heating, with no air waste or drafts in occupied zones. They come in four patterns and in six standard sizes. Dry Mfg. Co., Winters, Texas.

On Free Data Card, Circle **120**

For more information, turn to Reader Service card, circle No. 306

For more information, turn to Reader Service card, circle No. 394

Data on Air Conditioning Equipment

Roof-Mounted Units

Pamphlet, 4-pages, covers "Typhoon" line which offers 98 roof-mounted units of air conditioning equipment consisting of cooling units, heat pumps, and combination heating and cooling units. Illustrated are horizontal air cooled types, packed air cooled models for cooling only, packaged air-to-air heat pumps, and a variety of combination gas-electric heating and cooling equipment. Hupp Corp., 505 Carroll St., Brooklyn 15, N. Y.

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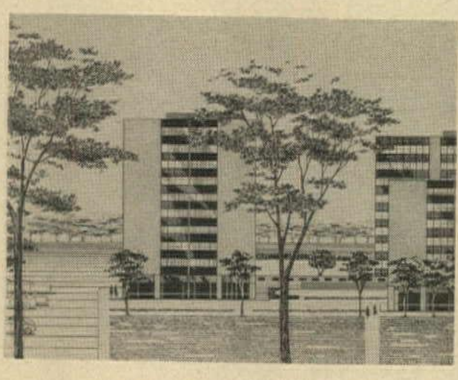


High-Rise Air Conditioning Equipment

Heat pumps and air conditioners designed for high-rise buildings are introduced in 12-page brochure. Details, dimensional charts, and specifications are given. Westinghouse Electric Corp., Air Conditioning Div., Box 510, Staunton, Va.

On Free Data Card, Circle **201**

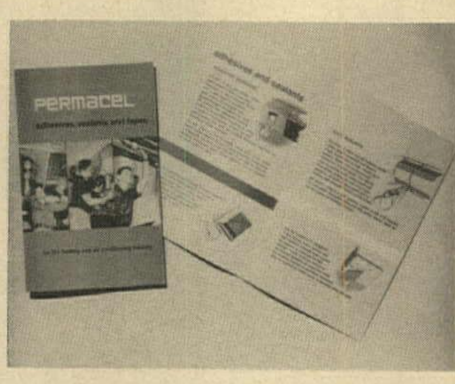
In-Wall Units

Flier, 2-pages, discusses in-wall air conditioning units. According to manufacturer, "Power King" unit has 50 per cent greater throw and 46 per cent less noise. For installing unit in existing structures, a telescopic sleeve is used which expands 10″ to handle thick walls and telescopes 5½″ for thinner walls. Flier contains specifications, details, and illustrations. Chrysler Corp., Airtemp Div., 1600 Webster St., Dayton, Ohio.

On Free Data Card, Circle **202**

Insulation For Air Conditioners

Brochure describes products for heating, ventilating, and air conditioning.



They include insulation and foam bonding adhesives; duct sealants, for both low and high velocity ducts; contact cements; and several pressure-sensitive tapes. Permacel, New Brunswick, N.J.

On Free Data Card, Circle **203**

Dehumidifiers

Booklet, 32-pages, presents line of sprayed coil dehumidifiers for cooling and dehumidifying, evaporative cooling, air cleaning and odor control. Advanced eliminator design of equipment allows higher air velocity through the unit, thereby resulting in reduced floor space requirements. Booklet includes construction details, application data, related equipment, formulas, chilled water selection data, direct expansion selection data, dimensions, and psychromatic chart. American-Standard, Industrial Div., 8111 Tireman Ave., Detroit 32, Mich.

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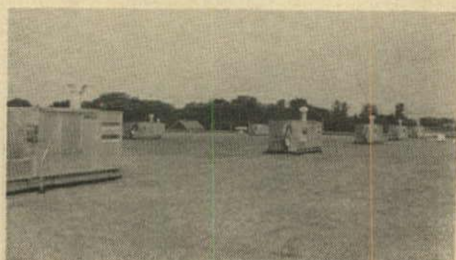

Rooftop Units For Single Stories

Flier, 4-pages, describes "Melco" rooftop air conditioners for single-story buildings. By locating all equipment on the roof, both boiler and compressor rooms are eliminated, creating more floor space. Each unit of multi-unit system is mounted over area to be conditioned. This eliminates horizontal ductwork and waste space between ceiling and roof, and reduces building height, bearing wall thickness, and construction costs. Utilizing air as a condensing medium instead of water eliminates initial cost and maintenance of water towers and water conditioning. Unit is completely packaged, prewired, and prepiped. Capacity, dimensional, and operation data as well as specifications are given. Melchior, Armstrong, Dessau, Inc., Ridgefield, N.J.

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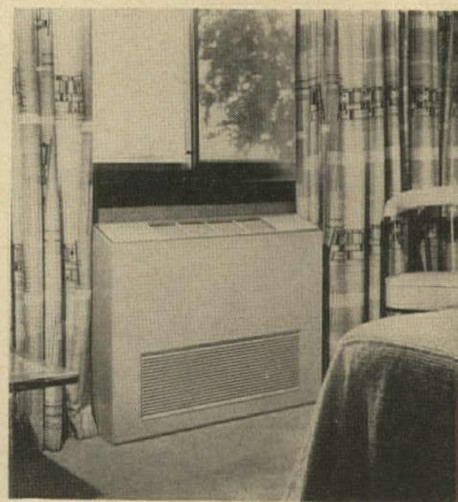


Through-Wall Units

Booklet, 8-pages, shows through-wall air conditioners. "Weathermaker" unit employs four heating methods including hot water, steam, electric strip, and heat pump. Slide-in cooling section is air cooled, self-contained and separate from heating section. It can be installed when heating section is installed or later. Both sections are automatically controlled by single, built-in thermostat and four part switch. Booklet contains illustrations, specifications, wiring diagrams, physical data and capacity ratings. Carrier Air Conditioning Corp., Carrier Parkway, Syracuse 1, N.Y.

On Free Data Card, Circle **206**

Through-Wall Terminal Units

Brochure, 12-pages, describes "Remotaire" Type 41 through-wall terminal air conditioner. Integrated heating and cooling unit can be located in each room or module. As long as heat is supplied to the system, either heating or cooling from the individual unit can be chosen. Heating section offers choice

Pittsford Plaza Shopping Center, Pittsford, N. Y. Gen. Contr.: Wilmorite, Rochester; Consulting Engr.: J. L. Bettinger, Rochester; Heating Contr.: A. Burgart, Inc., Rochester

The Music Lovers' Shoppe at Pittsford Plaza is heated by Janitrol duct furnaces, ceiling-suspended in the rear storeroom. Heat is efficiently distributed to the retail area through inconspicuous, circular, ceiling outlets. Manager Vince Meleo reports, "During winter months our heat is turned down overnight. About 5 minutes after opening in the morning, temperature is back to the comfort stage."

In the Pittsford Plaza Sherwin-Williams paint store one compact Janitrol 67-Series gas-fired unit heater effectively heats the entire sales area. The ceiling-suspended unit uses no valuable floor space and its modern, functional design does not detract from the decor.

The new Pittsford Plaza combines the charm of authentic Early American design, a one-stop selection of quality merchandise or services and over 30 acres of convenient parking for residents of Rochester's eastern suburban area. Thirty-two stores heat with top efficiency and economy. Ceiling-suspended Janitrol gas-fired unit heaters and duct furnaces turn the trick. These compact heating units with individual thermostatic control are sized to give fast, evenly-distributed heat in smallest shop or largest retail store.

Being ceiling-suspended, these Janitrol units don't need floor space or an "equipment room." Store operators can utilize more floor space for sales or stock. Janitrol unit heaters install *fast.* And they're easily moved, readily adaptable for future expansion and modernization needs.

FREE INFORMATION—Janitrol commercial-industrial specialists will gladly supply latest data on heating and air conditioning equipment. Call them without obligation. They're listed in the Yellow Pages. For your files, we offer an informative 16-page brochure covering commercial product lines and applications. Write for Form JS-151P.

JANITROL® DIVISION MR

MIDLAND-ROSS CORPORATION, COLUMBUS 16, OHIO of steam, hot water, or electric heating coils. Cooling section is available in capacities of 9000, 11,000, and 14,500 Btu/hr. One basic wall sleeve adapts to wall 5″ to 24″ thick. Unit may be either wall- or floor-mounted. Brochure gives details, illustrations, specifications, and charts listing dimensions and ratings. American-Standard, 8111 Tireman Ave., Detroit 32, Mich.

On Free Data Card, Circle **207**

Water Towers

Folder, 4-pages, introduces "W" series cooling towers. Enclosed, low pressure type water distribution system prevents algae growth, excludes dirt, and assures uniform water distribution under all weather conditions. Grid-type plastic supports for fill and eliminator batts position each batt precisely, eliminate use of nails in fill members, and present less obstruction to incoming air. Fan stack, constructed of heavy duty plastic sheet affixed to redwood framing, permits a noncorrosive material to be in contact with warm, moist outgoing air, minimizing maintenance costs. Pritchard Products Corp., 4625 Roanoke Parkway, Kansas City 12, Mo.

On Free Data Card, Circle **208**

Gas Engine Units

Booklet, 12-pages, discusses gas-engine-driven air conditioning equipment which includes compressor units, condensing units, and chiller packages. All parts of equipment from gas engines to bases are illustrated and explained. Ready Power Co., 11231 Freud Ave., Detroit 14, Mich.

On Free Data Card, Circle **209**

Sound Traps/Return Air Vent Silencer

"Aircoustat" return air vent silencer and sound traps are described in four booklets, respectively. (1) Silencer, available in three configurations and seven sizes, can be installed in a wall or ceiling, or hung on a wall or door. (2) Corrugations in perforated passage of "Mark II" sound trap tend to straighten air flow, add structural strength to the unit, and provide increased face area to improve acoustical performance. (3) Low resistance sound traps reduce noise at fan and in conjunction with broad band silencing further along in the system. They may also be used in return air systems where moderate noise reduction must be coupled with extremely low pressure drops. (4) Circular sound traps are used in ultra high velocity air conditioning systems. All booklets give air flow tables, illustrations, and specifications. Metal Products Div., Koppers Co., Inc., Sound Control Dept., Baltimore, Md.

On Free Data Card, Circle **210**

Thermoelectric Heat Pumps

Series 54-760, 14-pages, gives application data on thermoelectric heat pumps with matching power supplies. Information covers unit selection, construction, dimensions, characteristic curves, and schematic diagrams. Westinghouse Corp., Semiconductor Div., Youngwood, Pa.

On Free Data Card, Circle **211**

Ceiling Heaters

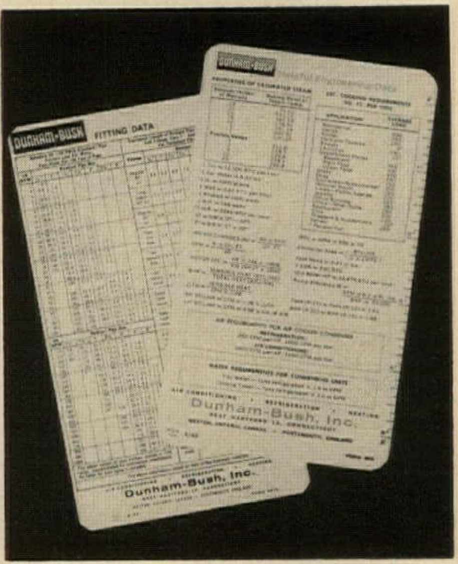
Brochure, 4-pages, describes surface mount and lay-in type glass ceiling heaters. Units can be dropped into 2′ x 4′ modular T-bar ceilings, suspended with chains from high or irregular ceilings, or surface-mounted to almost any ceiling. Brochure contains rating information, physical data and installation procedures, and specifications. Corning Glass Works, Heaters Dept., Technical Products Div., Corning, N.Y.

On Free Data Card, Circle **212**

What Is Humidity?

Brochure, 12-pages, defines and examines humidity and the problems it engenders. Differences between dew-point and relative humidity, wet-and dry-bulb temperatures, and how to make sense of psychrometric charts are discussed. Brochure explains specific humidity sensors and controls, including performance and pricing data. Other sections cover recent developments in field of humidity sensors and controls as well as factors affecting accuracy of humidity sensors and total system performance. Honeywell, Special Sensor Products, 2747 Fourth Ave. South, Minneapolis 8, Minnesota.

On Free Data Card, Circle **213**



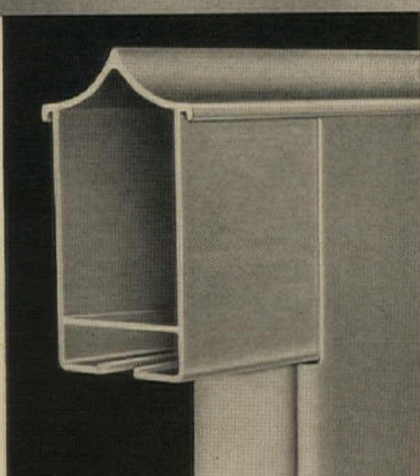
Pocket-Size Engineering Data

Two pocket-size, plastic laminated cards contain handy engineering data for air conditioning, refrigeration, and pumps. Air conditioning and refrigeration card includes pressure temperature table, carrying capacity of refrigeration lines, suggested temperatures to operate coolers and refrigerators, properties of saturated steam, estimated cooling requirements for condensing units. Pump card includes fitting data tables, pump engineering data and layout diagram. Cards are available at 10¢ each. Dunham-Bush, Inc., 179 South, West Hartford 10, Conn.

Air Purifier

Brochure, 6 pages, describes air purifier. Prefilter is provided to mechanically strain out soot, dirt, and dust. Air passes into purifier where odors and contaminates are absorbed by purple pellets and then chemically destroyed. No potentially dangerous ozone is generated or released, no liquids are employed, and no accumulation of odorous material is in the filter, which

Continued on page 126



Pat. Pending

New Anti-Grip headrail discourages gymnasts — adds strength

A quick glance at the illustration of this new Weis headrail and you can almost "feel" the uncomfortable grip that awaits the youngster who has planned some extra-curricular gymnastics—a dangerous prank, common in public toilet rooms. Integral protective channels in the one piece extruded aluminum headrail cover the top edges of the stile to add greater strength, safety and improved appearance.

SPECIFY **WEIS**

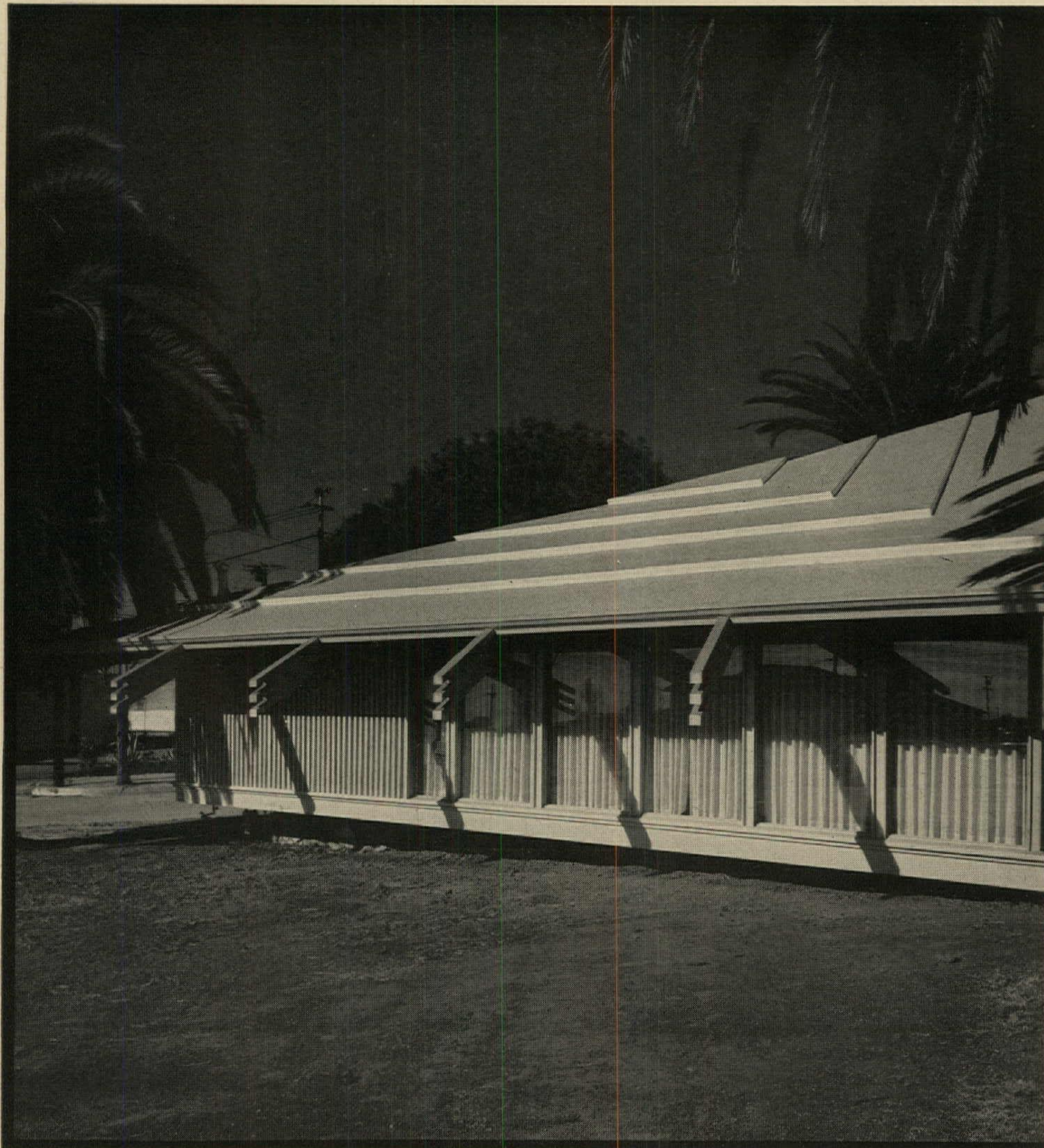
Prefabricated, Prefinished Products for the Building Industry

Weis belongs where toilet compartments really take a beating

HENRY WEIS MFG. CO., ELKHART, INDIANA

For more information, turn to Reader Service card, circle No. 413

JOHNS-MANVILLE ANNOUNCES **LAST-O-ROOF**... *THE NEWEST DEVELOPMENT IN MEMBRANE ROOFING*

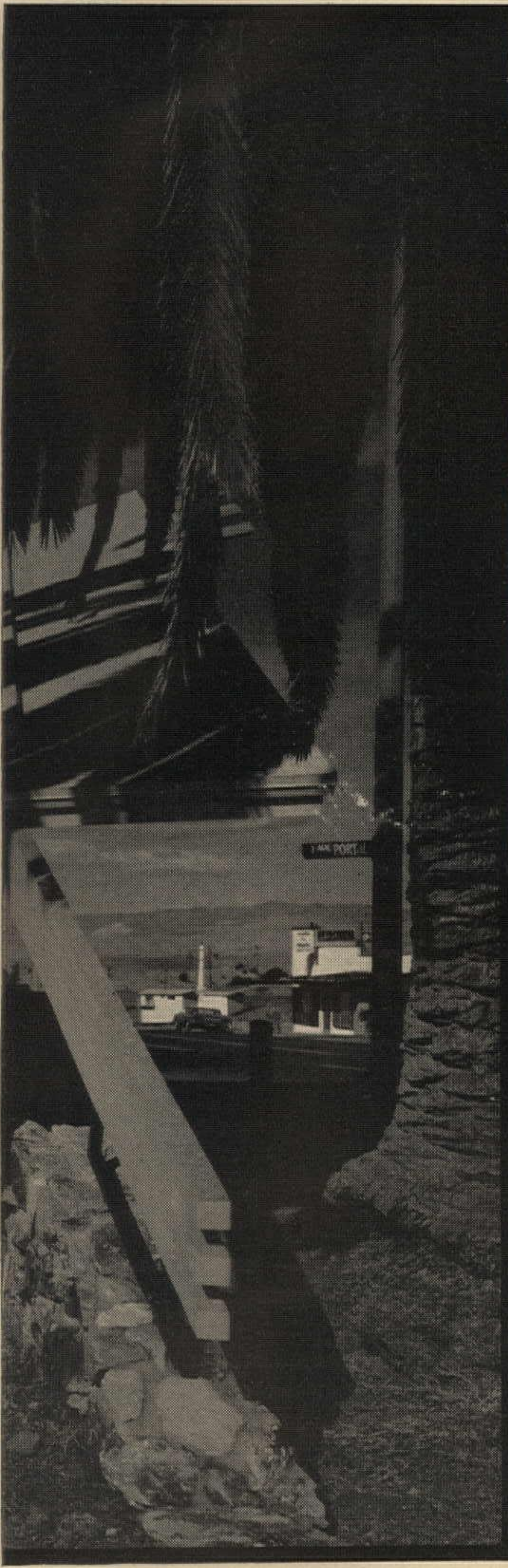


CHAMBER OF COMMERCE BUILDING, SAN CLEMENTE, CALIF. ARCHITECTS: CHRIS ABEL AND ASSOCIATES.

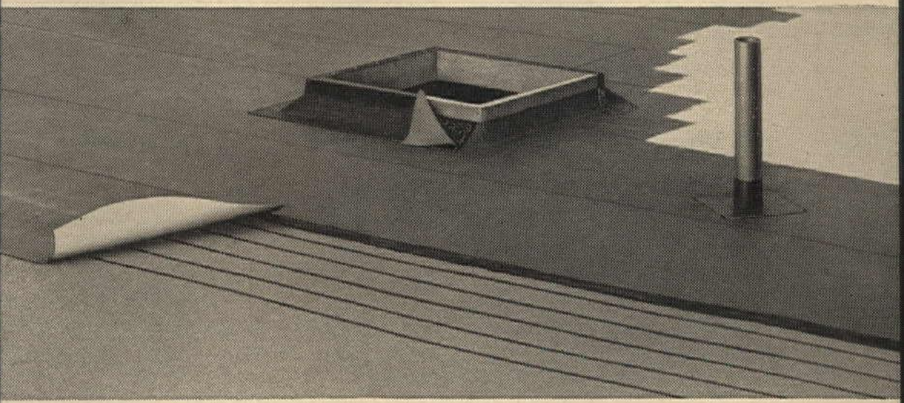
Now, you can design a "skin-tight" roof in any configuration, any slope, and in white or colors... with new **LAST-O-ROOF!**

Here's the newest development in a roof that conforms to any configuration or slope of the most imaginative roof design . . . and in color, too! New Johns-Manville LAST-O-ROOF is a *one-ply* plastic elastomer roof designed for one-step cold application . . . a roof that gives monolithic protection and lasts for years.

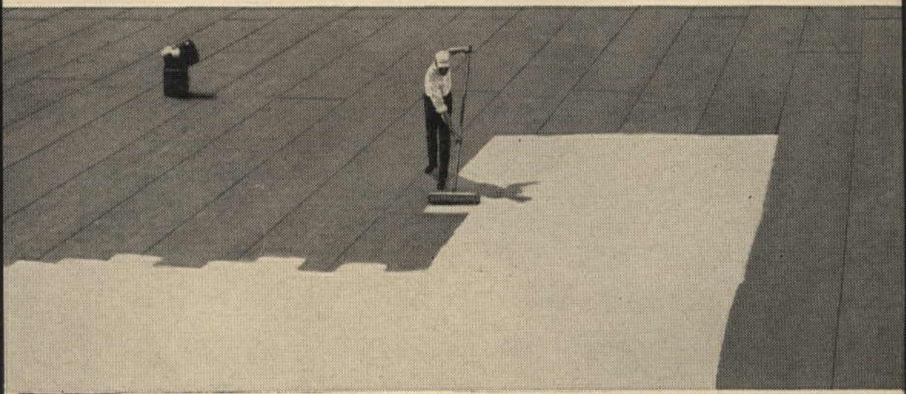
LAST-O-ROOF is light in weight,



SIMPLICITY IS THE PRINCIPAL FEATURE OF **LAST-O-ROOF**



Last-O-Bestos, the one-ply roofing membrane, is the main component of Last-O-Roof . . . consists of a weathering surface supported by an asbestos reinforcement. These are combined by a method that makes them inseparable so they form a true, one-ply membrane. Black in color, the weathering surface is a tough, durable polyisobutylene film. The light-colored supporting reinforcement is made of plastic-elastomer-bonded asbestos. Last-O-Bestos is applied in ribbons of **Last-O-Bestos Cement,** a pourable polyisobutylene adhesive that sets in a short time and gives a lasting bond. Side and end laps of Last-O-Bestos are sealed with **Last-O-Lap,** a brushable polyisobutylene adhesive reinforced with asbestos fibers for flow control . . . For use as through-wall flashing and at parapets, eaves or skylights, the one-ply membrane **Last-O-Flash** is provided. It has a weathering surface consisting of a heavy polyisobutylene film supported by a woven glass scrim and is adhered with **Last-O-Flash Cement,** an adhesive of heavy consistency . . . For roof projections such as vent pipes, **Last-O-Film** provides an elastic polyisobutylene film which is easily stretched and shaped to give a tight, weatherproof fit.



Last-O-Lume, the reflective surface finish, is an elastomer-based coating, formulated for compatibility with all Last-O-Roof membranes and adhesives. It's available in durable aluminum, white and metallic pastel colors to harmonize with any building design. The highly reflective surface will aid in lowering roof and interior temperatures.

Get the full details on this newest development in membrane roofing. Ask your J-M man about LAST-O-ROOF. Or call or write Johns-Manville, Dept. PA 4, Box 111, New York 16, N. Y. Cable: Johnmanvil.

actually *stretches* to accommodate normal stress and distortion. And, it's a roof that's reflective and colorful, too. LAST-O-ROOF is made up of compatible components based on the elastomer, polyisobutylene . . . and this roof is approved by Underwriters Laboratories, Inc., for Class A construction.

What's more, it's a roof that can be speedily applied to permit quick building closure. The result is a smooth, water-tight, completely homogeneous roof that will not crack, blister or shrink under extremes of heat and cold.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

Continued from page 122
eliminates risk of odors being reintroduced into the room. York Corp., York, Pa.
On Free Data Card, Circle 214

Three-Pipe System

Booklet, 8-pages, describes three-pipe perimeter air conditioning system. Each room unit has a source of heating and cooling available at all times in which the flow of either is modulated to suit room requirements. System rapidly lowers or raises room temperature and provides flexibility to maintain each room at desired temperature under varying loads. Return ducts are also unnecessary. System is available in ceiling and floor models. York Corp., York, Pa.
On Free Data Card, Circle 215

Floor Air Distribution System

Bulletin, 4 pages, describes "Mahonaire" air-distribution systems. Components of combined structural floor and air system are described and schematically illustrated. Catalog No. AF-63, R. C. Mahon Co., 6565 East 8-Mile Road, Detroit 34, Mich.
On Free Data Card, Circle 216

Room Air Conditioner Directory

Final "Directory of Certified Room Air Conditioner Models" for 1963 has recently been released. Directory lists a total of 1321 models. For each manufacturer's model listed, model numbers, volts, Btu/hr, amps, and watts are given. Write on letterhead to John Page, Executive Secretary, Room Air Conditioner Certification Program, National Electrical Manufacturers Assn., 155 E. 44 St., New York 17, N.Y.

Glass Fiber Vibration Material

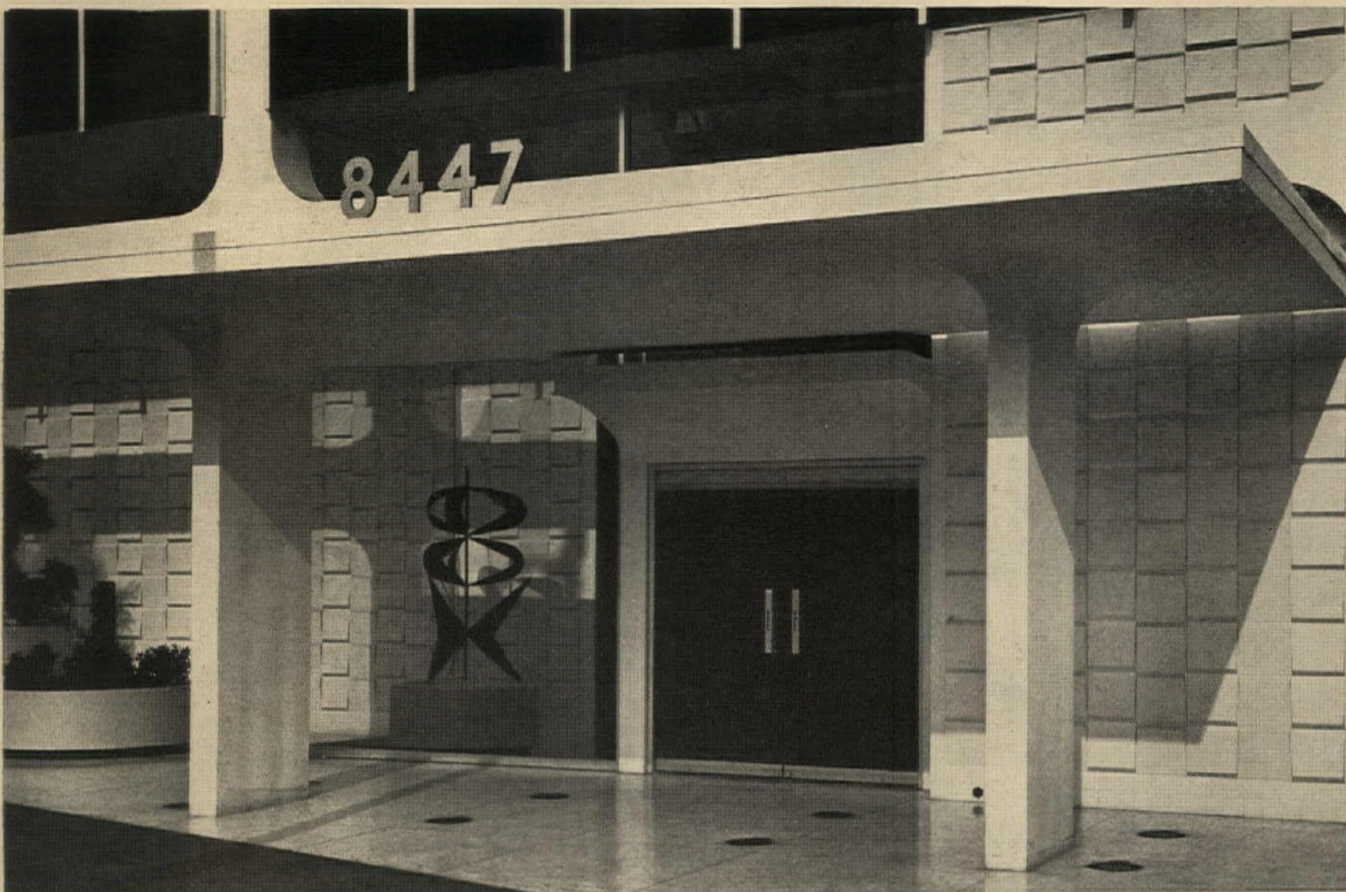
Bulletin, 6-pages, contains information on glass fiber vibration material for floor isolation and equipment mounting. "Vibra-mat" is a compressed, resilient glass fiber material. It has a predictable and reproducible spring rate which varies with density and thickness. Material will withstand millions of cycles of compression and release force within specified loads and deflections. Vibra-mat is moisture proof, nonshrinking, and nonswelling. It does not rot, mildew or oxidize. Performance curves, illustrations, and specifications are given. Pall Corp., Fibrous Glass Products, Inc., Mountaintop, Pa.
On Free Data Card, Circle 217

Air-Cooled Condensing Units

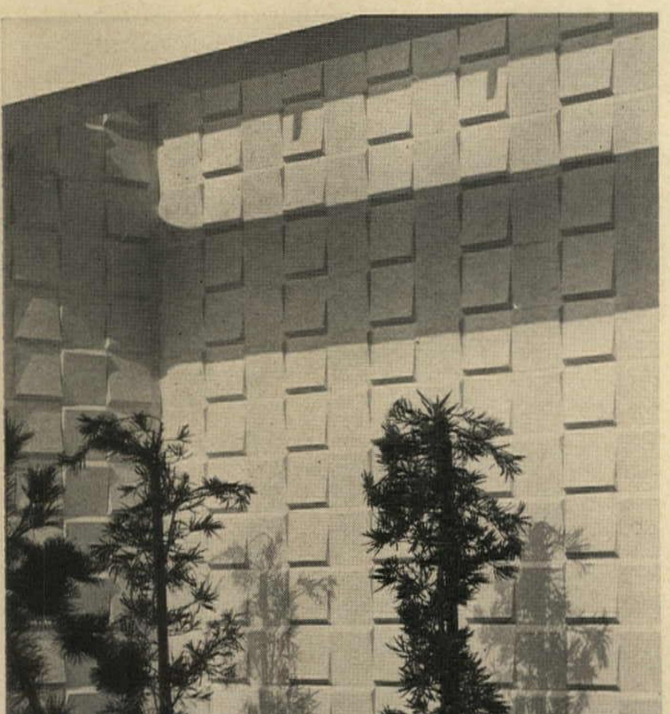
Catalog, 20-pages, describes air-cooled condensing units rated from 20 to 50 nominal hp. It includes capacity curves, dimensions, physical data, specifications, unit operation, and winter operation. McQuay Inc., 1600 Broadway N.E., Minneapolis 13, Minn.
On Free Data Card, Circle 218

Air Conditioning Equipment

Booklet, 16-pages, covers heating and air conditioning equipment. Included are gas, oil, and electric furnaces; cen-



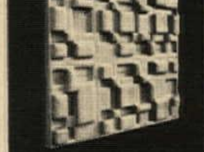
Ceramic Facing with Third-Dimensional Allure



Bas-relief or incised patterns, in **Contours CV**, subtly vary the shadow-play as lighting changes, to give exterior walls unusual beauty and textural interest. Shown in the photos is a custom design used by architects Kite & Overpeck Associates on the new Hamilton Towers Building, Wilshire Blvd., Los Angeles. Design and die charges for any custom creation are nominal.

Thirteen standard designs (and matching flat-surfaced pieces) are also currently available, in nineteen colors ranging from rich tones to pale pastels. Many varied textural treatments thus are feasible, without the modest expense of custom creations.

Contours CV offers lasting beauty, minimum maintenance, and all other advantages of high-fired ceramics. It is modular (11¾" x 11¾"), lightweight, and easily applied like glazed wall tile or adhesion-CV. Yet it is priced to fit the budgets of most jobs. Write for literature showing patterns and specs. Better, visit one of our salesrooms where you can see and feel the beauty of **Contours CV** itself.



CONTOURS CV®

A Gladding, McBean building product by

INTERPACE

INTERNATIONAL PIPE & CERAMICS CORPORATION

LOS ANGELES/SAN FRANCISCO/PORTLAND
SEATTLE/SPOKANE/SALT LAKE CITY/PHOENIX

Distributed east of the Rocky Mountains by

CERAMIC TILE American Olean

American Olean Tile Co., Landsdale, Pennsylvania—a subsidiary of National Gypsum Company

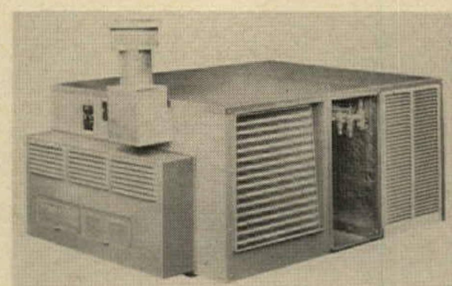
tral air conditioning equipment; combination heating-cooling units; air-to-air heat pumps; and electric air filters. Specifications and illustrations are given. American Furnace Co., 1300 Hampton Ave., St. Louis 10, Mo.
On Free Data Card, Circle **219**

Multi-Room Units

Folder, 4-pages, describes "Flow-Temp" (C-Series) air conditioners for multi-room buildings. Units are available in four models and in 200, 300, 400, and 600 cfm capacities. Units can be wall-hung, ceiling-mounted, free-standing, and cabinet-enclosed. Unit includes auxiliary electric strip heat package. Folder also gives performance data, fan and motor data, dimensions, specifications, and illustrations. Acme Industries, Inc., 600 North Mechanic St., Jackson, Mich.
On Free Data Card, Circle **220**

Air Distribution Floor System

Flier, 2-pages, describes "A-E" floor system which provides air and electrical distribution. System consists of finished floor supported by main structural slab. Floor rests on adjustable steel supports, thereby creating a plenum for conditioned air to be carried to floor and ceiling diffusers. Plenum can be varied in height to meet any capacity requirement. Baffles zone air to desired areas. By distributing air to interior and exterior zones through a plenum, a considerable amount of horizontal ductwork is eliminated. Floor also provides horizontal and vertical wiring flexibility through large capacity cells fed by headers originating at central electrical shaft. Granco Steel Products Co., 6506 N. Broadway, St. Louis 15, Mo.
On Free Data Card, Circle **221**



Forced Air Furnace and Air Conditioner

Brochure, 4-pages, describes "Graff-Pak" horizontal forced air furnace and matching air conditioner. Unit can be installed in a roof, in a floor slab construction or in a crawl space. Condensing unit may be installed and air conditioning added at later date. Brochure gives specifications, dimensions, and installation procedures. Gaffers & Sattler, 4851 S. Alameda St., Los Angeles 58, Cal.

On Free Data Card, Circle 222

Ductwork

Series of three folders describe "Thermaflex" lightweight, flexible ducts for low and high velocity air conditioning systems. Wire-reinforced ducts have factory-installed sound attenuation material and thermal insulation. Ducts have a temperature range which permits them to carry either hot or cold air. Thermoflex is available in three types: ST, K, and KA. Folders include sizes, specifications, and charts concerning air friction loss in straight runs and air friction loss in 90 degree bends. Flexible Tubing Corp., Guilford 2, Conn.

On Free Data Card, Circle 223

Roof Mount Heating/Cooling Unit

Flier, 2-pages, discusses "Plan'd-Aire" roof mount heating and cooling unit. Flier lists and describes parts of unit. Specifications, illustrations, and dimensions are given. Miller-Picking Corp., 1 Messenger St., Johnstown, Pa.

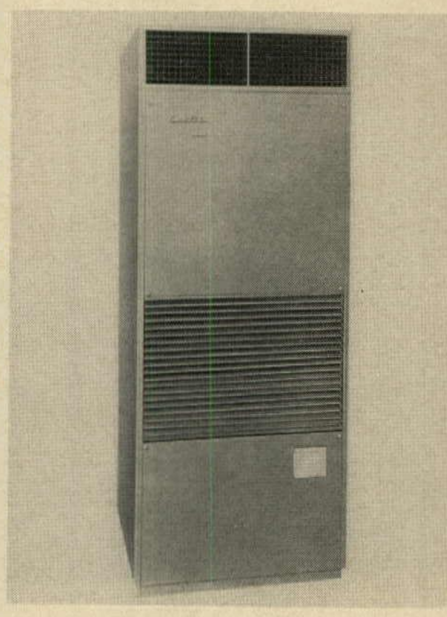
On Free Data Card, Circle 224

Louver System For Conditioning Air

Folder, 4-pages, presents recently-developed concept in climate control. "Hydroshade" is a system for control of radiant heat gain, heat loss, and natural light. It is composed of hollow aluminum louvers connected top and bottom to hidden pipe manifolds. Cool

For more information, turn to Reader Service card, circle No. 388

or warm water circulated through louvers absorbs or radiates sensible heat. According to manufacturer, Hydroshade eliminates $1/3$ or more of mechanical refrigeration, carries 100 per cent of heating requirements in most applications, and reduces floor-to-floor height and mechanical equipment space. It can be finished in anodized colors or with vinyl, paint, or flexwood. Radiant Hydronics, Inc., 467 Hamilton Ave., Palo Alto, Cal.
On Free Data Card, Circle **225**



Packaged Air Conditioning Unit

Brochure, 4-pages, presents air-cooled packaged air conditioning unit. System provides continuous circulation of cool air for maximum summer comfort with selective thermostat control. Only refrigerant and electric line connections are necessary. Unit is sized with extra large remote condenser for economical operation. Brochure includes illustrations and specifications. Curtis Manufacturing Co., 1905 Kienlen, St. Louis 33, Mo.
On Free Data Card, Circle **226**

* * *

(End of Air Conditioning Equipment Data)

CONSTRUCTION

Flake-Type Wood Panel

Guide, 16-pages, describes properties and uses of "Timblend" flake-type wood panels. Timblend resists warping; has high strength, good screw-holding strength, and tight, smooth edges. Panel is available in stock sizes

from 2′ x 4′ to 4′ x 16′, and in thicknesses from $3/8''$ to $1\,3/16''$. Panels also can be produced in any intermediate decimal thickness with widths to $51\,13/16''$, lengths to 196″, or cut to size. Timblend panels can be edge-glued or laminated together to further expand their size range. Brochure includes data on types and sizes; physical properties and specifications; working and finishing; fastening, veneering, and laminating; and joint and edge treatments. Weyerhaeuser Co., Wood Products Division, Tacoma 1, Wash.
On Free Data Card, Circle **227**

Watertight Concrete

Report, 6-pages, discusses basic requirements for using water-reducing agent, "Pozzolith," in concrete. It reduces shrinkage, bleeding, and segregation. Report includes charts, illustrations, and specifications. The Master Builders Co., Division of American-Marietta Co., 2490 Lee Blvd., Cleveland 18, Ohio.
On Free Data Card, Circle **228**

ELECTRICAL EQUIPMENT

Transformers for High-Rise Apartments

Booklet, 8-pages. describes cast-coil transformers that meet need for more economical electrical distribution systems in high-rise apartments with heavy load concentration. Utility reports show up to 35 per cent savings when utilizing primary voltage distribution with dry-type transformers

Lighting News ★ ★ ★ ★ ★ ★

at SANDOZ PHARMACEUTICAL RESEARCH BUILDING

HANOVER, NEW JERSEY

Epple & Seaman, Architects **Irving Mencher, Consulting Electrical Engineer**

...another installation by **KLIEGL**

Lobby and reception area lighting that is aesthetically pleasing and warm . . . yet is compatible with high-intensity exterior overhang lighting has been achieved for Sandoz by Epple & Seaman, architects, and Irving Mencher, consulting engineer, in collaboration with our representative, S. V. Keyian. Kliegl units were specially designed to meet both architectural and illumination requirements!

In more than 60 years, Kliegl has helped designers, architects and engineers with thousands of applications ranging from very small to the most spectacular. The sum total of this pioneer experience in the design of lighting equipment and controls to meet requirements of color, space, optics and peculiar area difficulties is yours for the asking. Call in your Kliegl representative today—no obligation.

As used in the Sandoz installation, new Kliegl Lens Downlights have no hinge and have a minimum of ceiling trim. They permit full service access and, at the same time, a flush ceiling effect.

Our lighting advisors will be pleased to assist in the planning of any installation, using standard or special units to meet your requirements. Full details on request.

lighting

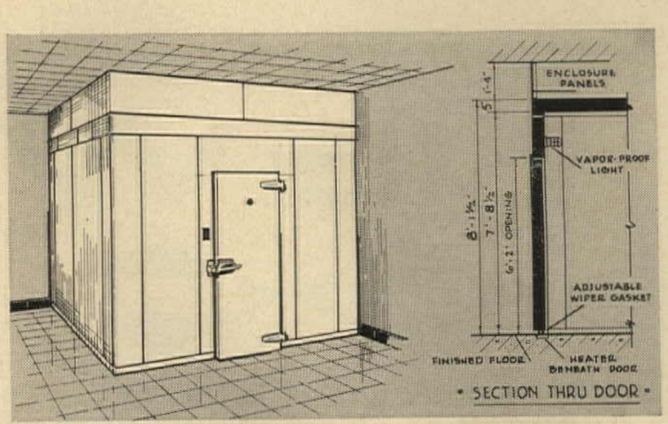
KLIEGL BROS.

Originators and Manufacturers of Klieglights

32-32 48TH AVE., LONG ISLAND CITY 1, N. Y.

Phone: Area Code 212, STillwell 6-7474

For more information, turn to Reader Service card, circle No. 422



Normal temperature Walk-In installed at **Geneva Elementary School,** Geneva, Alabama.

Specifications prepared by **Joseph L. Donofro & Associates, Architects,** 721 Oates St., Dothan, Alabama.

Bally pre-fab walk-ins

all-metal coolers and freezers

World's most advanced design. New materials and construction techniques offer architects an opportunity to provide tremendous refrigeration advantages to their clients.

Urethane 4" thick (foamed-in-place) has insulating value equal to 8½" fibreglass. Standard models can be used as freezers with temperatures as low as minus 40° F. Urethane has 97% closed cells . . . cannot absorb moisture . . . ideal for outdoor use.

Speed-Lok Fastener designed and patented by Bally for exclusive use on Bally Walk-Ins. Makes assembly accurate and fast . . . easy to add sections any time to increase size . . . equally easy to disassemble for relocation.

New foamed door, so light in weight it ends forever the "hard pull" . . . the "big push". Door is equipped with new type hand lock (with inside safety release) and convenient foot treadle for easy opening. Also has special hinges that close door automatically. Magnetic gasket guarantees tight seal.

Self-contained refrigeration systems combine balanced capacity condensing units and refrigeration coils. Mounted and hermetically sealed with necessary controls on small wall panel. Simplifies installation. Four-hour factory test assures quiet, efficient, trouble-free operation.

Write for Free Architect's Fact File which includes 12-page brochure . . . Specification Guide . . . and sample of urethane wall construction.

See Sweet's File, Section 25a/Ba

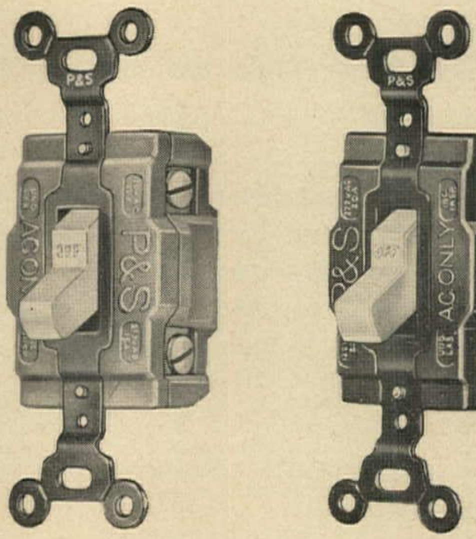
Bally

Bally Case and Cooler, Inc.
Bally, Pennsylvania

Address Correspondence to Dept. PA

For more information, turn to Reader Service card, circle No. 323

NEW
P&S SUPER DEVICES
for the job where only the best will do



1001-I
15A, AC

1021-I
20A, AC

One look tells you that these aren't run-of-the-mill switches. They look different. They are different. And they're designed to take years of rough usage.

Arc-resisting molded urea forms their sturdy, shallow bodies. Compact units that can be side or back wired with up to No. 10 wire and installed in any position. Large silver alloy contacts assure long life under continuous heavy-duty service.

The nodal point principle means quiet, positive action. Finally, there's no confusing 15 and 20 amperes, they're color-coded*, anyone can tell the difference!

*15 amp. switches are coded blue; 20 amp., red.

For further information on 1001 and 1021, write Dept. PA-1063

P&S PASS & SEYMOUR, INC.
SYRACUSE 9, NEW YORK
BOSTON • CHICAGO • LOS ANGELES • NEW YORK • SAN FRANCISCO

For more information, turn to Reader Service card, circle No. 384

SPECIFY **fm** TEMPERED
plate glass framed **MIRRORS**

Where impact and shock resistance must be evaluated for specific mirror installations in hospitals, schools, institutions and other locations — specify FM framed *tempered* plate glass mirrors. Impact resistance is eight times greater than ordinary glass. Under terrific impact, the glass will shatter, but disintegrates into blunt fragments — not sharp. Available in a wide range of framed sizes.

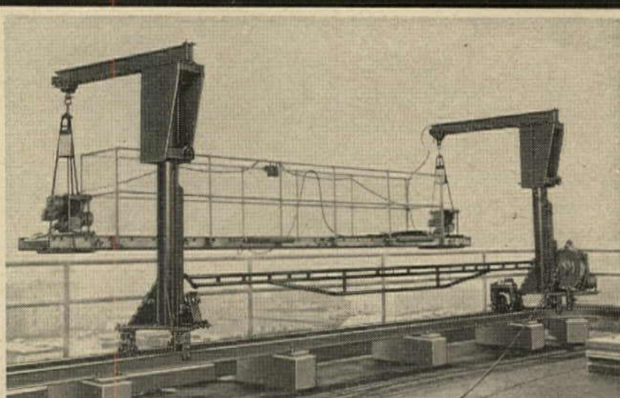
Please write

Faries-McMeekan, Inc.
P. O. Box 35, Elkhart 2, Indiana

For more information, turn to Reader Service Card, circle No. 342

ALBINA

POWERED WINDOW WASHING SYSTEMS



FEATURES: Carriage — Swing Platform runs on narrow gauge continuous track around perimeter. Track switches for roof storage.

WRITE FOR POWER SCAFFOLDING and ROOF CARRIAGES brochures, engineering data and installations.

ALBINA ENGINE & MACHINE WKS.
2100 N. Albina Ave., Portland, 17 Oregon

For more information, turn to Reader Service card, circle No. 309

located near loads. They are compact, lightweight, and fit into a minimum of space. They do not require expensive fireproof vaults. Cast-coil units reduce vibration and feature high impulse levels up to 95 kv. Booklet contains wiring diagrams, details, and charts concerning prices, sound levels, dimensions, and weights. General Electric, Specialty Transformers Dept., Fort Wayne, Ind.

On Free Data Card, Circle 229

Lighting with Wood

Fluorescent lighting fixture, called "Madera," utilizes oil-finished woods and prismatic lens diffusers. Fixture can be surface- or stem-mounted, individually or in rows. Silhouette is only 3½″ deep, 12″ or 16″ wide. Unit is available in birch or walnut, as well as in metal finishes and other materials on request. Walnut or birch is permanently bonded to the sides and end plates. Chassis and sides are die-formed of one rigid section. End plates are aluminum die castings for perfect alignment. Raceway cover snaps out for easy access to ballasts and wiring. Lens, in either acrylic or styrene, uses female prism pattern. Silvray Lighting, Inc., 100 West Main St., Bound Brook, N. J.

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FINISHERS/PROTECTORS

Wall Flashings and Waterproofing Fabrics

Wall flashings and waterproof fabrics are discussed in 8-page brochure. Copper, plastic, and wire flashings, as well as mastics, are described. Chart containing information on properties, details, and specifications is presented. Sandell Manufacturing Co., Inc., 26 New Street, Cambridge 38, Mass.

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SPECIAL EQUIPMENT

Merchandise Fixtures

Catalog, 56-pages, introduces modular merchandising gondolas, half-gondolas, and walls. This "800 System" permits retailer to change fixture set-up for packaging, seasonal inventories, or as new merchandise lines occur. Any modular section of fixtures can be treated independently from adjoining section. Sections can be open or closed platforms, open or closed counters, with

or without end-platforms. System is available in 14 colors in a choice of baked-enamel or nongloss matte finishes. Reflector Hardware Corp., 1400 N. 25 Ave., Melrose Park, Ill.

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SURFACING

Tile Comparison Chart

Two-color comparison charts describe asphalt and vinyl-asbestos tile respectively. Each chart contains several lists comparing the colors of the various manufacturers of asphalt and vinyl-asbestos tile. Asphalt and Vinyl Asbestos Tile Institute, 101 Park Ave., New York 17, N.Y.

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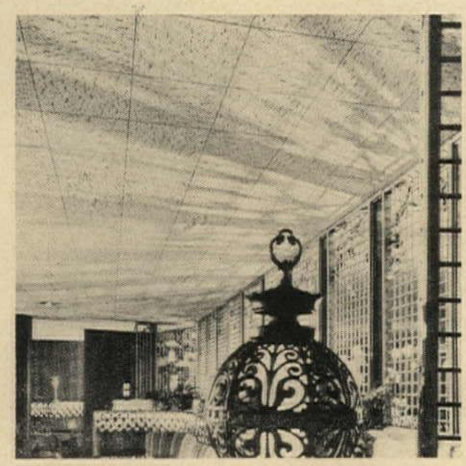
Acoustical Ceilings

Various types of acoustical ceilings are presented in 48-page booklet. They include ventilating; fire-retardant;



membrane-faced; mineral-fiber; and wood, asbestos, and metal. Booklet contains illustrations, size, cost, insulation value, average sound attenuations, flame resistance, flamespread classification, and specifications. Armstrong Cork Co., Liberty and Mary Sts., Lancaster, Pa.

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PROGRESSIVE ARCHITECTURE
NEWS REPORT

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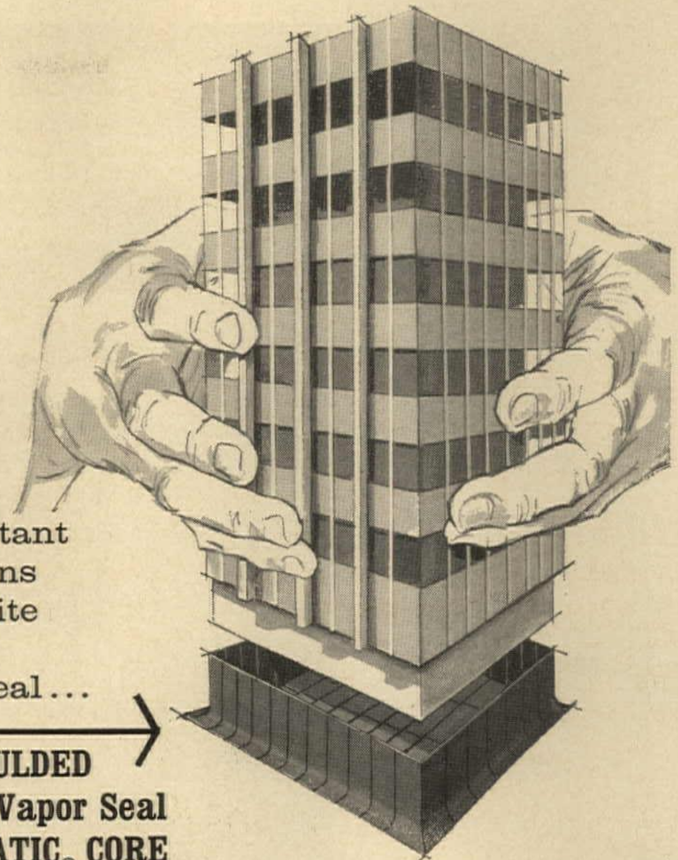

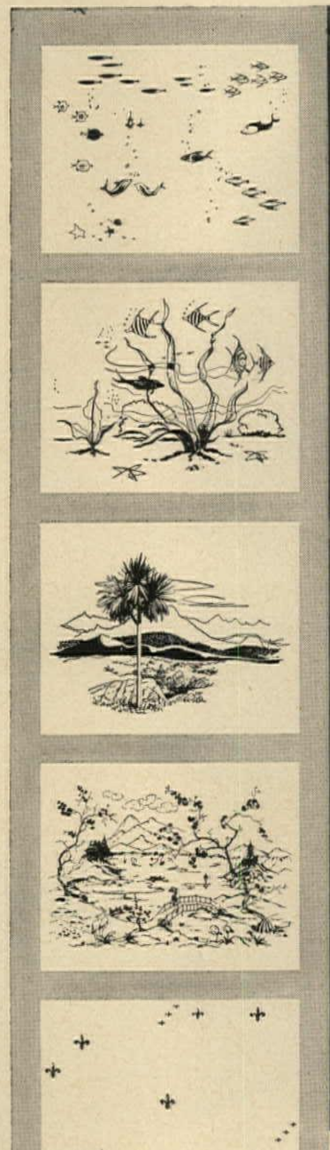

6345

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With beautiful new Marlite Murals, a single panel covers the back wall of a tub recess from corner to corner. These exciting original panel designs, created by fine artists, will add a distinctive decorator touch to any room. Crafted in luxurious gold on a white background, Marlite Murals combine the charm of pictorial scenes and designs with the advantages of Marlite's soilproof baked finish. The result: custom-decorated walls that resist heat, moisture, stains and dents—stay like new for years. Easily installed, Marlite Murals are available in nine designs, all gold on white in a semi-gloss finish. All are 5/32″ thick, in 5′ x 5′, and 6′ x 5′ sizes (first figure indicates height, second width).

For complete information on new Marlite Murals and other Marlite paneling, see your building materials dealer, consult Sweet's Files, or write Marlite Division of Masonite Corporation, Dept. 1014, Dover, Ohio.

Large photo illustrates Marlite Mural #S371 South Pacific.
Small photos in descending order:
#S300 Aquatic, #S302 Seascape, #S325 Desert, #S340 Oriental, #S350 Fleur-De-Lis, #S370 Rangoon, #S372 Catalina, #S837 Snowflake.

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October 1963 **PROGRESSIVE ARCHITECTURE®**

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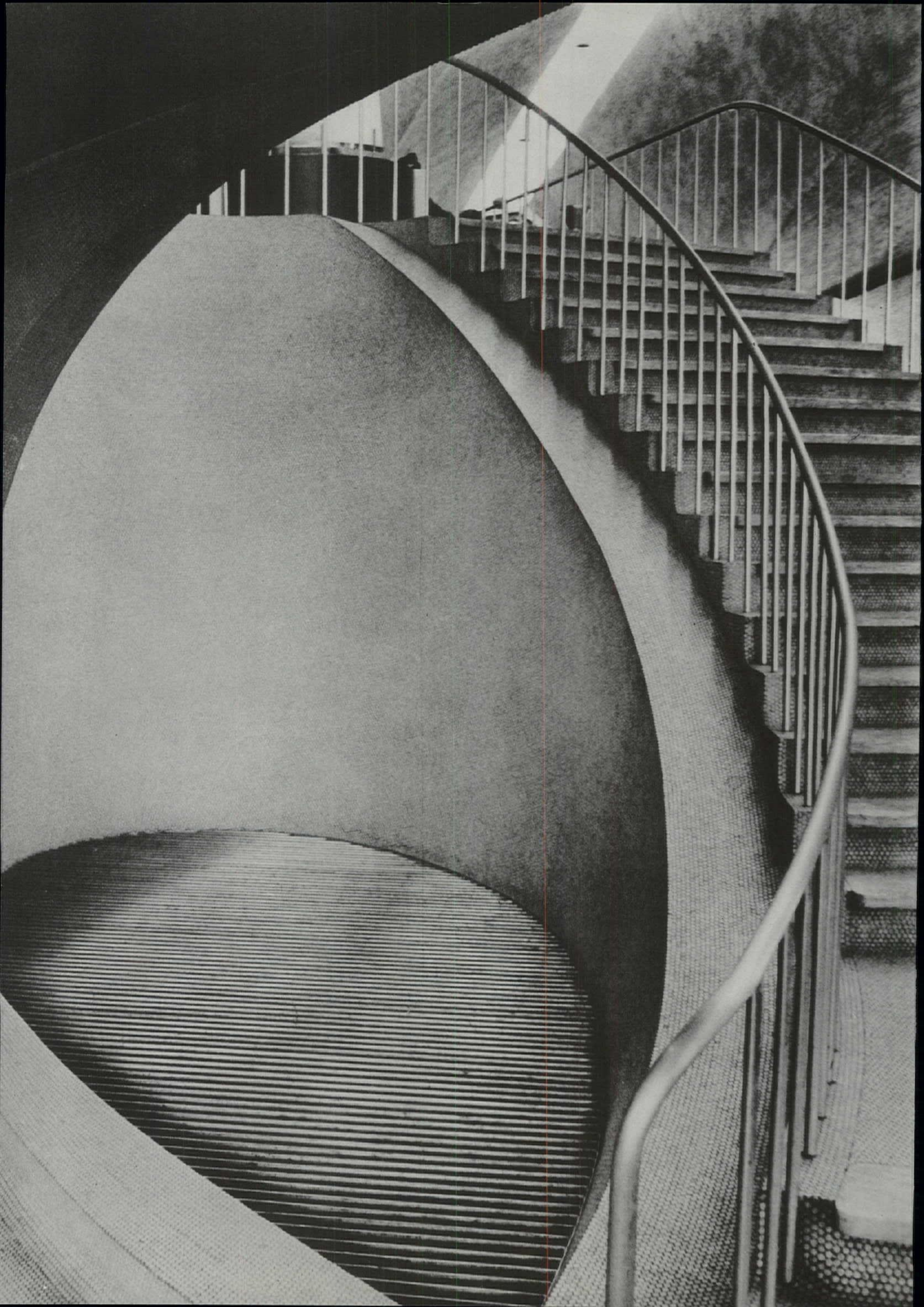


The future of the architectural profession is uncertain. Although nobody quite knows what course it will take in the years ahead, there seems to be a general agreement that the status quo will not be preserved. Recent moves on the part of the Institute well reflect the growing fear of the profession that inroads made by others could widen in scope and eventually diminish the architect's role to the point of insignificance. Of the many influences responsible for this trend, three are probably of greatest importance.

The first is the increase in size of building projects. The rapid growth of population is causing both an obsolescence of existing facilities and a need for new ones. Large scale urban renewal, new university campuses, even whole new urban areas, are not uncommon commissions today. This increased scale and complexity of building programs brought to the foreground planners who, in conjunction with real estate jugglers, exert a control that often excludes architects from the formative stages of a development.

The second influence is the growing importance of technology in building design. One of the biggest technological impacts in architecture—the air conditioning of buildings—is discussed in this issue of P/A. Since the cost of mechanical equipment is already one of the biggest items in today's construction budget, the mechanical engineer becomes a figure of paramount importance. The same is true of structural engineers and electrical engineers. The value of what they design has increased within half a century from an insignificant percentage to more than half of the total construction cost and, in the process, the traditional balance of relative importance of the professionals involved in the design of buildings has been upset. Although in most cases the architect is still the key person, the engineer's responsibilities are constantly growing.

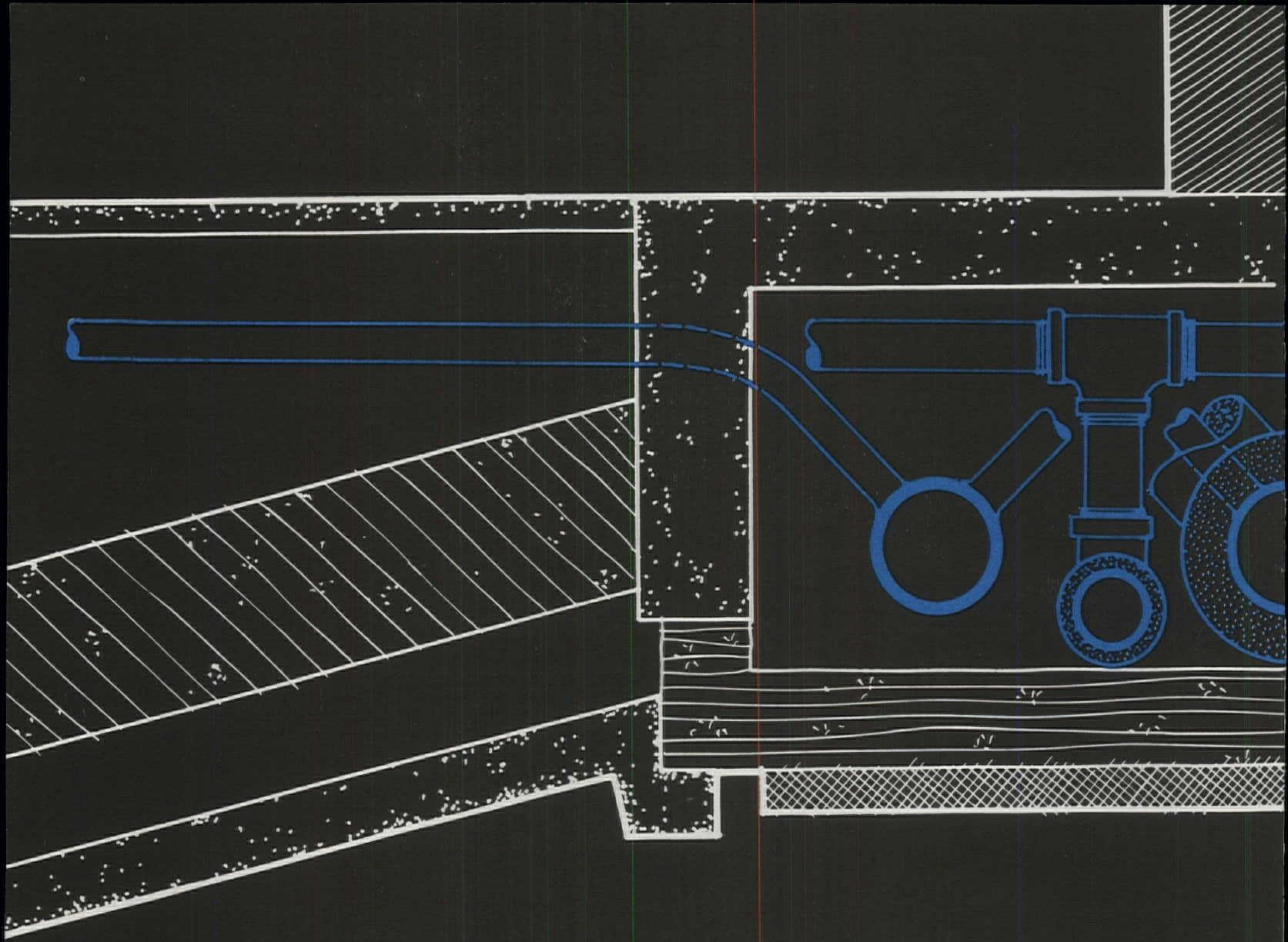
And the third influence is the infiltration of industrial designers into the building industry. It is inevitable that in a society where production of consumer goods is dominated more by merchandizing techniques then by pride in the quality of the product, an attempt will be made to introduce the same concepts into the production of nonconsumer goods. This subject, so far largely ignored, will be discussed at length in future issues of P/A.

When one adds these three influences together, a clear pattern emerges. It is not uncommon today to watch buildings take shape that were conceived by realtors and bankers, made functionally workable with the help provided by various planners, made technically sound through the contribution of engineers, and made saleable because of superficial touches imposed by designers. In such a situation, an architect can either resign himself to becoming a stylist—that last and also least important rung in the ladder—or go out of business altogether.

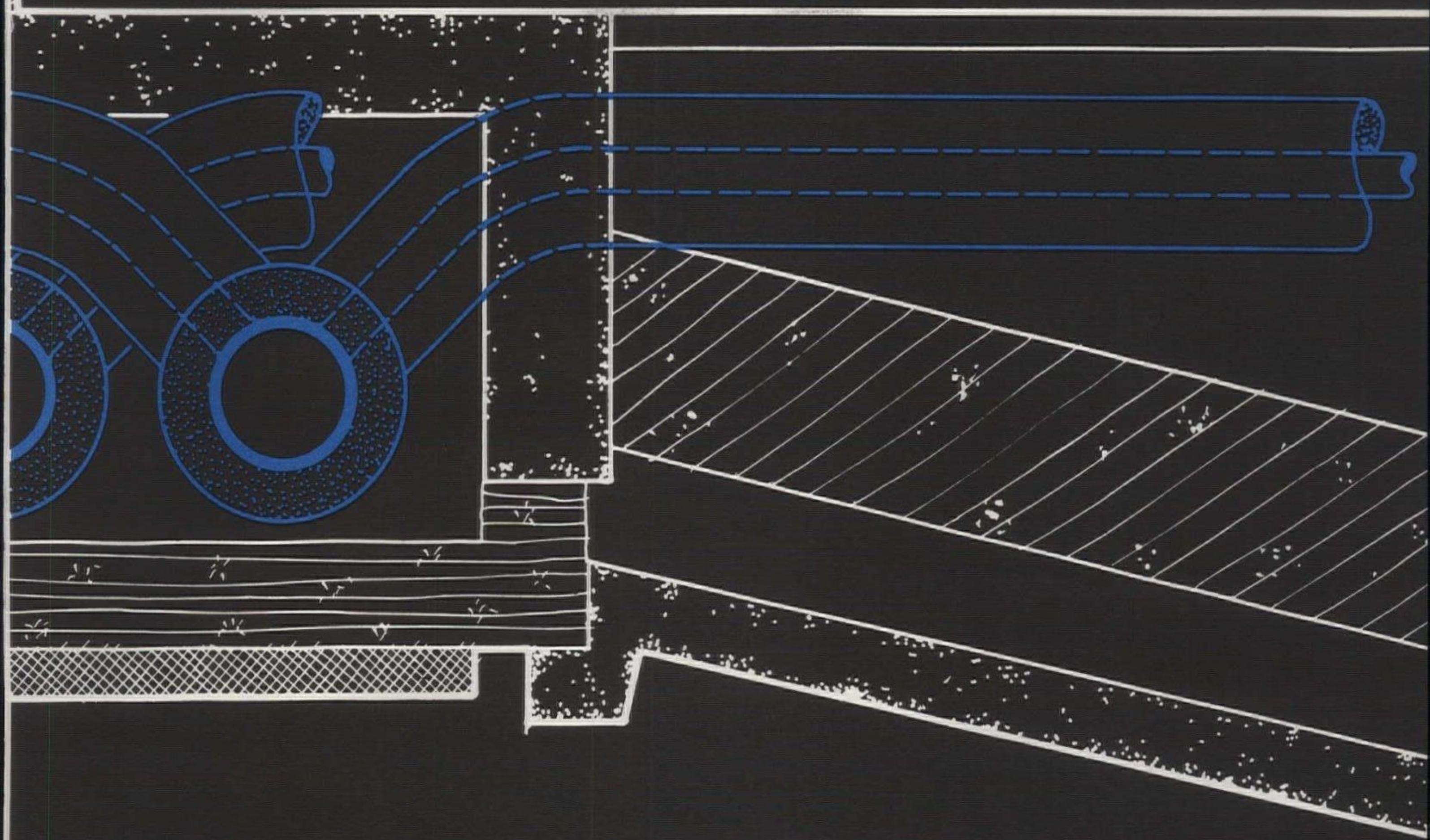
No wonder then that the Institute, gripped by fear of such a disastrous end for the noble profession of architecture, is frantically searching for a substitute solution. The "expanded services" concept and the emphasis on "total environment" are attempts at reversing the malicious trend besetting the profession.

The idea that an architect will in the future lead a team of experts who are responsible for creating man's total physical environment appeals to me. After all, I am an architect. But whether this will ever come to pass depends to a large extent on the answer to an important question: will the public accept the leadership of architects? This I shall discuss next month. ■

Jan C Rowan



AIR CONDITIONING AND ARCHITECTURE



In 1902, when Willis Carrier succeeded in reducing the humidity of air
and holding the moisture content to a specified level
in the plant of the Sackett-Wilhelms Lithographing and Publishing
Company, in Brooklyn, the air conditioning industry was born.
And the four postulates of air conditioning were established:
control of temperature; control of humidity;
control of circulation and ventilation; and the cleaning of air.
Although there have been incredible advances in the development of equipment
to accomplish effective year-round comfort conditioning,
it is still governed by these four laws.
The state of the art of designing air conditioning
was last examined in detail by P/A in March 1958.
In the present issue, the editors have again investigated this sphere of design
and documented some of the principal instances of progress that have occurred since that time.
Presented on the following pages are: design parameters for air conditioning;
mechanical refinements; advances in technology;
integration of components; and future trends.
The editors are especially appreciative of the counsel of Sidney J. Greenleaf,
who has acted as Consulting Editor in the preparation of this review.
Greenleaf, who has an active practice in mechanical engineering in Cambridge, Mass.
(he recently completed the mechanical designs for the new Boston City Hall),
and serves as associate professor in the Harvard School of Design,
is the author of two of the included discussions.

Design Parameters

BY SIDNEY J. GREENLEAF

Air conditioning, in the general sense, is the treatment of air from some natural or unnatural state, by mechanical devices, so that the end product of these processes is acceptable to certain standards to which the human physiology demands conformity. These standards have been fairly well determined by research and may be attained under simply controlled conditions. It is the individuality and summation of these conditions and standards that are of interest to the architect. Fortunately, the combination of factors that determine this conformity are such that a certain latitude may be taken with several, which, when adjusted by others, may result in the same relative comfort level. From the architectural viewpoint, we are interested in three prime factors: the relation of the mechanical systems to people; the relation of the environmental shelter to people; and the relation of the mechanical systems to the building and its structure. The purpose of this text is to investigate the many-faceted relationship between these functions.

The People-Physiology

In the range of temperature concerned with environmental-control systems, the human body is an energy-producing machine that maintains its tissue temperature by the parallel processes of heat loss or gain by convection, and heat loss by evaporation of moisture (perspiration and respiration).

The direction of heat flow in the radiation and convection process depends on the relative temperature of the surrounding surfaces and the surrounding air, respectively. The evaporation process is a heat loss as long as the dew point of the surrounding air is below the body surface temperature. These processes, plus the control of air quality, are the terminal variables which determine mechanical system design and which are having increasing effects on architectural design. How much and how far can we bend these variables in the name of design without affecting the comfort of the occupants? And how much can we rely upon the design of the mechanical systems to make up any shortages caused by aesthetic or structural criteria? Fortunately, there are only a few rules that cannot be adjusted; however, it is imperative that the architect understand the adjustments and have a healthy respect for the inviolates. The achievement of comfort is a combination of air temperature, relative humidity, air velocity, air freshness (quality), and the mean radiant temperature of the enclosing space. The first four are provided by the mechanical systems, and the last, radiant temperature, by the shelter. The temperature of the shelter surface may effect a control on relative humidity because of surface condensation. Air quality is not a variable design factor and definite minimum standards must be used. Temperature, relative humidity, velocity, and radiant temperatures are mutually interchangeable quantities; the lowering of relative humidity requires an increase in air temperature, a reduction of air velocity, or an increase in radiant temperature. A lowering of radiant temperature requires an increase in air temperature, an increase in relative humidity, and a decrease in air velocity. In each case, the human mechanism attempts to adapt its heat-emitting capabilities to the new situation, and, within a narrow range, it can.

Thus, we can appreciate that the body is sensitive not only to the conditions of the air in which it exists, but also to the temperature of the surrounding surfaces. The extreme examples of this sensitivity, and the limits that are too frequently exceeded in contemporary architecture, are the winter situation where an excess of standard glass prevents the sensation of warmth, and the summer situation where the same excess of glass and/or the absence of solar shading prevents a feeling of coolness, regardless of how low or how high the space temperature is held by mechanical systems. The effect of low outdoor temperature on the microspace is to lower the inside surface temperature of materials which have a surface in contact with the low-temperature environment. This low surface temperature then acts as a sink for radiant energy for any object of higher temperature in the space (radiation), and also cools any air in direct contact. If the surface is at a temperature lower than the dew point of the air, dehumidification will occur and visible condensation will appear on the surface. The cooled air, being more dense than the other air in the space, will flow downward from the surface through gravity effects. In this situation, the temperatures and relative humidities will vary considerably from floor to ceiling. In the case of high outdoor temperature, with solar radiation, the amount of radiant energy that penetrates the microspace is a function of the physical properties of the glass and other materials that form the enclosure, solar orientation, and architectural design. The higher ambient outdoor temperature raises the inside surface temperature of the glass and other surfaces, and heat is transferred to room air by convection. As warm air rises, stratification occurs in the space. If solar radiation penetrates directly into the space, its effects are to raise the temperature of any surface that it contacts, and to impart a feeling of warmth to any body. The effects of the radiation are felt directly by the human body, and the air in space is heated by convection from the room surfaces affected. In the uncontrolled or improperly designed space, it is extremely difficult (and sometimes impossible) to overcome the effects of this radiation energy by reducing air temperature and relative humidity, and increasing air velocity, because the range of variations to accomplish physiological equilibrium will exceed the capacity for adjustment of the average human body.

The Site and Climate

Air-conditioning design for any site will be influenced by a number of localized and general factors that are exterior to the building. The most important of these are seasonal temperatures, relative humidity, solar angles (latitude), solar orientation, wind direction and velocity, quality of air (industrial smoke, agricultural pollen, etc.), and relation of the site to its surrounding topography and neighboring buildings. The relation of outdoor temperature to indoor conditions has already been discussed. The effects of external relative humidity are generally felt because of the necessity of supplying ventilation air, and mechanical equipment is necessary to change the condition of this outside air so that the internal comfort level may be attained. Similarly, the removal of smoke, dust, etc., can be accomplished by mechanical means. The airborne factors, other than heat energy, do not generally affect the building space through materials or architectural design, except through infiltration, which is the passage of outdoor air directly into the building through openings such as fenestration cracks, door openings, and poorly calked construction joints. Infiltration is a function of wind velocity, crack and opening size, and negative pressures inside the building caused by improperly designed exhaust and ventilation air systems, or stack effect due to height of building.

Wind direction and velocity may be directly affected by surrounding buildings, trees, or geological obstructions that may tend to block, divert, or intensify normal conditions. In urban locations, tall buildings frequently shade lower structures from the low east or west sun. This shading factor, which will sometimes complicate an otherwise simple design problem, must be accounted for.

Geographical location can cause variations in design for buildings of similar function. For example, a western desert location presents an environment with wide variation in temperature from day to night, small range from season to season, and low relative humidity. A northeast maritime site will have less daily temperature range, great seasonal variations, and high relative humidity. A southeast maritime site will have small daily temperature variation, small seasonal temperature variation, and high relative humidity. An inland site will generally have moderate daily temperature variation, great seasonal temperature variation, and great variation in relative humidity, being generally high in summer and low in winter. On a local level, differences in height will affect temperature conditions. Generally, the lower elevations will be cooler than high points, especially at night, as denser air (cooler) will flow by gravity to the low points. Air passing through or over foliage, grass areas, or bodies of water will be considerably cooler than air passing over pavement, parking lots, buildings, and other heat-absorbing surfaces (usually man-made). The proper placement of a building as to prevailing wind direction and its relation to these factors can have great effect on the comfort conditions within a building. A building, existing in an environment having a given ambient temperature, and under solar radiation, will reflect a certain amount of radiant energy depending on the color and surface texture of its materials.

A portion of the radiation, being unreflected (in dark, rough materials this can be more than 95 per cent), is converted to heat and raises the surface temperature. This surface temperature, being higher than the temperature inside the building, starts a heat flow toward the interior at a rate that is proportional to the temperature differences between the outside and inside surface temperatures. A similar heat flow is set up between the outside surface and the outside air by convection. Since the rate of heat flow in convention is directly proportional to air velocity, wind velocity on the outside surface will greatly increase heat transfer from the surface, effectively cooling it, reducing the rate of heat flow to the interior space by conduction through wall materials and glass. It is especially important to consider this effect when dealing with large amounts of heat-absorbing glass or architectural sun shades. Unfortunately, wind which can be so beneficial in summer, acts in reverse in winter, carrying heat off at an accelerated rate, especially from the glass, which is already too susceptible to heat transfer. In many geographical locations, however, the prevailing wind comes from different directions in winter and summer, a phenomenon that may be important enough for it to be taken into account when the over-all design of a structure is being planned.

The control of solar impingement into the interior space is a function of the latitude of the site and the season. For data on computation of these angles and annual change in sun position, one can refer to *Architectural Graphic Standards*, which presents this data in graphical form. Methods of control are opaque screens arranged at proper angles, deep recesses, and types of glass that either absorb or reflect the sun's rays. The most effective method, of course, is the opaque nonpenetrable screen, which is perfectly efficient but architecturally unwieldy. The recent technological advances in reflecting-type glass warrant the architect's careful consideration of this material. Double glazing and insulating glass are not effective for summer conditions.

The Influence of Function and Form

Air-conditioning design is related to function in three ways: the heat-producing intensity of the function; the character of the human or inanimate participants; and the time rate of change of the internal heat load.

The relation to form may be oriented to several other factors: to external configuration (size, proportion, shape) of the building, which defines the nature of the shell between the internal and external environments, and therefore the susceptibility of interior conditions to external environmental changes; to actual dimension, which is involved because of the dimensional limitations of present technology (see "Systems and Limitations," below); and to the over-all floor plan that determines proportion between interior space, which is independent from external effects, and perimeter space, which is not. The distance to which the effects of external conditions penetrate a building is approximately 20 ft. This dimension coincides with the distance to which an induction unit, a vertical two-duct sill box, or other vertical air discharge method is effective. For air conditioning purposes, this distance has become the standard depth of the perimeter zone. The area beyond this is independent of exterior effects, and is generally considered as a cooling-only zone, usually with a separate mechanical system. A typical office building is an excellent example. The normal floor is usually designed with small offices, conference rooms, and other executive space on the perimeter. The human load in most of these areas is normally small, with the exception of conference rooms, which may have high intermittent loads. Because of the natural light available, the amount of heat due to lighting is small. The major variations in cooling/heating requirements are, therefore, external, and the architectural design of the shelter skin is predominant. The interior spaces (usually secretarial, waiting, and passageways) are not in contact with the external environment and depend entirely on the internal factors. The high illumination level, which is a requirement of function, produces considerable heat, and business machines add to the load. A high human population per unit-area adds more heat and the character of the occupants (female, with odor-generating chemical materials) requires a greater ventilation rate than the lightly occupied perimeter areas. Depending on the climatic location of the building, the perimeter will require a mechanical system capable of rapid adaptability and one which can modify its output to provide a wide range of air temperatures. The range of adaptability is significantly affected by the architectural design of the intervening perimeter skin, a factor that cannot be overlooked in areas of climatic extremes (temperatures less than 25 F or more than 85 F). The interior space will require a system that is generally simpler because of the fewer number of variables. Both areas are affected by flexibility requirements for partitioning changes, as function is modified.

In the perimeter zone (with vertical distribution of air from the sill), no overhead ductwork is necessary, and exposed structure is possible. If the distance from the core to the perimeter band is not more than 20 ft, air may be discharged from sidewall diffusers and no dropped ceiling may be necessary in the interior zone. Beyond 20 ft, however, ceiling distribution is a necessity.

The selection of a system is also affected by the nature of the individual functions in a multifunction building. Tenants whose control requirements vary widely from the average are usually provided with a separate system, so that the extreme requirements will not be imposed on the over-all system. Also, when the individual tenants of an office building operate on different schedules, separate systems may be required so that a central system need not operate for the use of only a small percentage of the building. Most affected by this reasoning are the central air systems, such as the double duct and single duct methods.

Systems and Limitations

The many air-conditioning systems available for architectural design are limited only by the scope of one's imagination and the mathematical laws of combinations and permutations. However, there is a line of logic that can assist the architect in development of reasoning and a methodology for application. All systems can generally be classified as follows:

Systems A. These process air at a central point and distribute it to the point of use without further addition or subtraction of energy:

1. Single-duct systems, low velocity and high velocity (usually variable volume). Used with and without supplementary perimeter radiation.

2. Double-duct systems, low velocity and high velocity (usually constant volume). Used with and without supplementing perimeter radiation.

Systems B. These process air at a central point and distribute it to point of use, where final heat addition or subtraction takes place before the air enters the space.

1. Single-duct reheat/recool systems, low velocity and high velocity.

2. Perimeter induction systems, two-pipe and three-pipe.

3. Fan-coil systems with central fresh-air supply.

Systems C. Distribution of liquid media to points of use, where mechanical devices utilize the liquid to process air locally.

Fan-coil systems with direct fresh air intake through wall.

Systems D. Localized mechanical devices that utilize no central source of air or liquid. Electrical energy normally used for drive.

1. Electrically operated through-the-wall unit air conditioners and heat pumps.

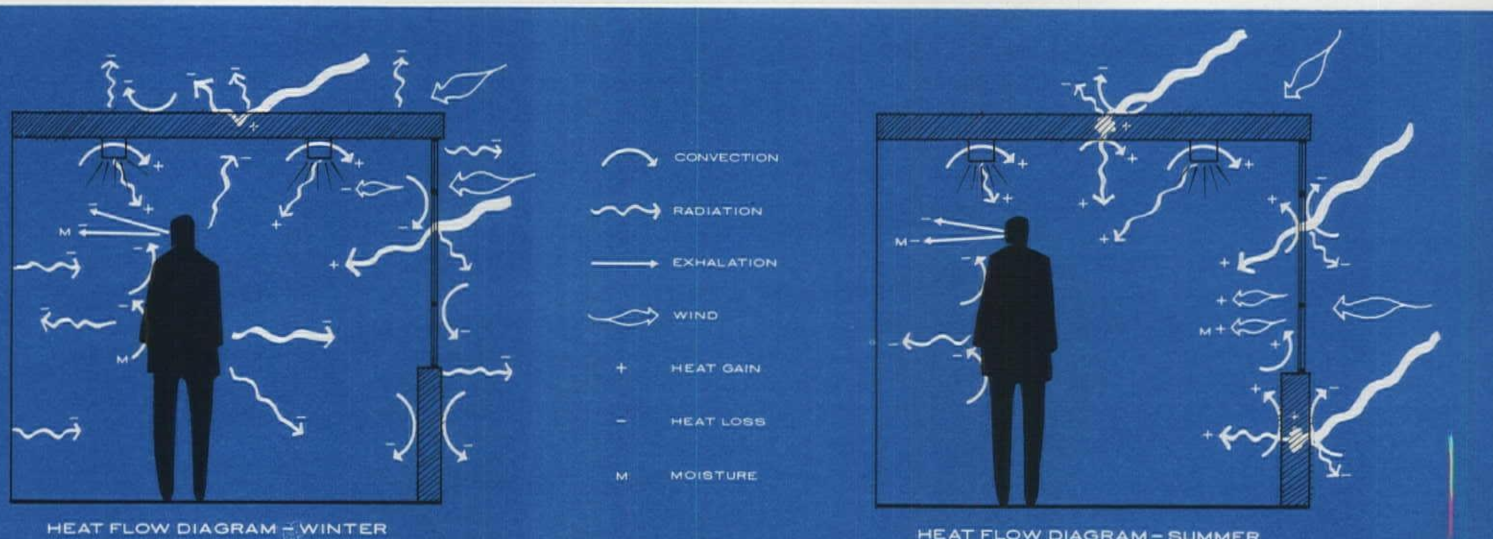
2. Roof-mounted unit conditioners with gas- or oil-burning heater sections.

Systems E. Separate handling of radiation energy from convection energy utilizing radiation panels.

Radiant-panel heating/cooling systems.

The final function of each system is similar. The sum of all energy effects on people and enclosure, entering or leaving, divide into two main units (*see illustrations*): sensible heat (energy that will raise or lower the air or materials temperature) and latent heat (energy of vaporization in water vapor). If air is introduced into the space at a certain flow rate, and at such a temperature and humidity content so as to have a time-rate potential for energy absorption or addition equal to the rate of generation, then the conditions in the space will stabilize at any desired level. Most of the above systems accomplish their effects in this manner, with the exception of the panel heating/cooling systems which make a further differentiation in energy by dividing the sensible heat sources into radiant and convective categories, each of which are handled separately. Generally, the most effective way to control space temperature is to supply a constant volume of air, while varying the air temperature and humidity content in accordance with the demands of changing interior and exterior loads. There are only a few cases where this generalization is not valid.

The limitations of these systems are physical and are related mainly to the fluid or gas media used in each to carry the energy. Air, the most common medium, is very limited in its capacity for long-distance transmission. Because of its low density as compared with water, it is an inefficient carrier of energy, and this inefficiency is compounded by the lack of efficient fans. The result is that large amounts of horsepower are required to generate the high pressures and velocities needed to move the air. Such pressures and velocities are direct sources of noise and these impose a limit to duct velocity. To remain within limits, the ducts are consequently large, presenting a problem in the architectural design process. When designing at the limits of velocity and pressure, there are factors of friction loss, static and velocity pressure interchange, as well as balancing problems, that generally limit the maximum distance from central fan room to the last outlet. This dimension appears to be about 250 ft. The limitations of systems utilizing water are generally concerned with pressure caused by hydrostatic head increases at the rate of approximately ½ lb per sq in. per ft of height. In this situation, materials and equipment must be selected for the proper pressure. Since many of the mechanical devices are not suitable for use at high pressures, provisions must be made in the piping layout to reduce pressure as necessary. Since there is no practical distance limit to the circulation of water, it is an efficient medium. In addition to the limitations of media, each of the systems has other limitations related to architectural and mechanical design. The simpler one-duct air systems, which require a large amount of space, are not capable of servicing a great number of small zones. Because of the low pressures available, and the large duct size, length of duct systems is relatively short and acoustical transmission is propagated. This type of system can supply the total requirements of only a small and simple building. Multiplicity of these systems for a larger, more complex building results in a maze of mechanical devices requiring maintenance and large space requirements. The one-duct systems using higher pressures to increase velocity and reduce duct size, generally with varying volume control, attempt to overcome these disadvantages; they are, however, limited mainly to interior spaces having no heating requirements. The problem with volume control is that in perimeter zones requiring heat, maximum heating effect occurs concurrently with maxi-



HEAT FLOW DIAGRAM – WINTER

HEAT FLOW DIAGRAM – SUMMER

mum ventilation effect; therefore, as heating requirements diminish, so does air volume and ventilation. The reason for less heat requirement is usually increased population or solar penetration, so that reduction in ventilation rate under these conditions is opposite to the effect desired. For cooling-only spaces, however, the varying volume systems have great merit.

The two-duct systems usually originate from a high-pressure fan, and two high-velocity ducts carry cold and hot air to points of use. Final control for an individual zone, which may efficiently be as small as 100 sq ft, is accomplished by mixing air from each main duct to satisfy the requirements of a space thermostat. This system is capable of heating and cooling simultaneously and, if architectural space can be found for the duct systems, is very adaptable to moderate size buildings. As with the one-duct air systems, a complete return-air system is required. The combination of two supply mains plus a return main (usually medium velocity) requires a large amount of space. These systems, which are usually constant in volume, achieve results that are close to ideal—with the exception of close humidity control.

The induction systems are probably the optimum presently available for large buildings. By utilizing the principle of air aspiration at the point of discharge, the amount of air carried by the central system is reduced significantly, usually to ventilation requirement only. Final control is gained by the addition or subtraction of heat by a heating or heating-cooling coil in the induction unit located in the room. It is possible with this system to reduce or eliminate completely the return-air system, so that the total transmission space required is for one small duct, and either two or three pipes. The difference between two- and three-pipe systems is that the former heats or cools, but not simultaneously, while the latter permits any individual unit to select either mode simultaneously. Since there are no mechanical or motor-driven devices in the units, maintenance is usually not problematical and the units are inherently quiet by design.

Systems of the type which distribute water to fan-coil units (two-pipe or three-pipe, for reasons noted above) require even less space than the induction systems, even though they have some disadvantages. The most important of these are mechanical noise directly in the space served; freezing and dirt problems if a fresh air intake is used directly through the wall; and a maintenance problem because of the motors, belts, controls, filters, etc., in each machine.

Unitized through-wall equipment is generally limited to applications requiring only lower grade environmental control, such as apartments, motels, hotels, and small commercial buildings. A secondary limit is that they are suitable only for perimeter applications, with no provision for interior zones. The skin of the building must be penetrated for air intakes and there are architectural problems because of noise, vibration, condensate leakage, and the design of the louvers into the façade. Their real value is in reducing the owner's initial cost, and by putting the units on the individual tenant's meter, the owner avoids the entire operating cost. The units are frequently leased by the tenant from an outside leasing contractor, who provides all service. Owner's only provision is wiring.

Architectural-Structural Implications

The trend in architecture today is to integrate the air-and-water-distribution systems into the over-all planning and structural design. There are many structural floor systems presently available that provide for the passage of supply and return air through steel, precast concrete, or preformed members. Such distribution can effectively reduce mechanical space requirements, especially floor-to-floor height. Most of these systems have a limitation in the amount of flexibility that is available for partitioning changes because of the inert nature of the structure.

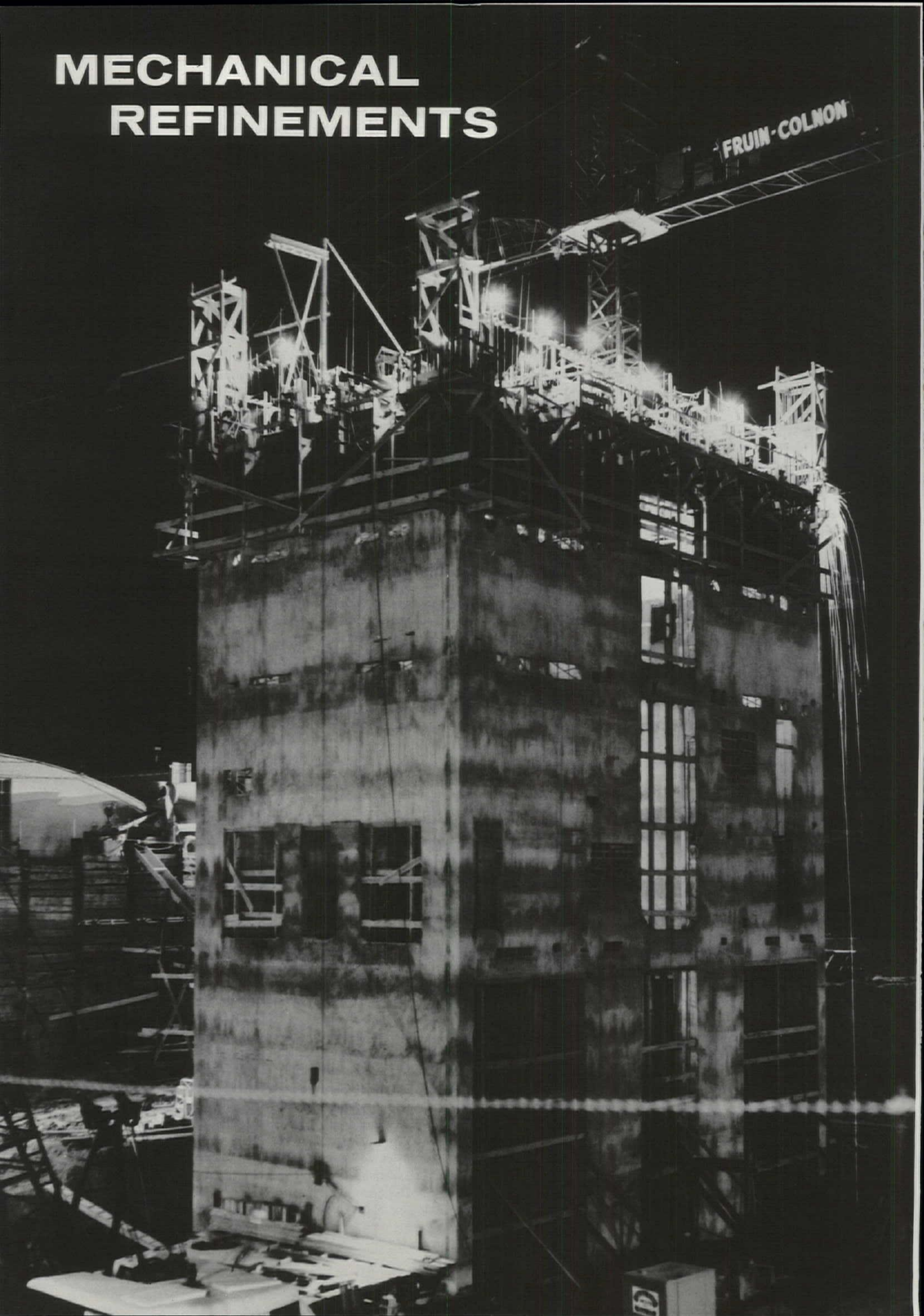
The use of high-level lighting has resulted in large heat loads that can add severely to the air-conditioning problem. The problem may be significantly reduced by designing the ceiling system so as to allow the heat to be removed by ventilation air (exhaust or return) before it enters the space. Through proper mechanical design, the heat collected in interior spaces may be utilized elsewhere in the building for heating. The main disadvantage of the several heat collection methods now in use is that the ceiling plenum requires space and adds to floor-to-floor height. The radiant-cooling ceiling systems pick up heat directly into chilled-water piping in the plenum, and this is probably where most of their efficiency is derived.

There are several ways that the air-distribution systems may be integrated into a structure. In the floor concept, a central distribution system may rise vertically in a central core, and a group of horizontal duct trunks will run centrally under the structural floor system as main feeders. The air then penetrates upward into the floor structure and is carried to the perimeter of the building through the structural void system. At the perimeter, some form of reheat coil is used to give final control. The main distribution system may be high or low velocity, but the floor core velocity is usually low. It is quite difficult to terminate this distribution in an induction unit because of the pressures required, so that a full return-air system is usually needed. In this case, the supply system equipment and duct work is proportionately larger. In the skin concept, induction air is carried vertically in or on the skin (usually in conjunction with columns) and take-offs are made directly to induction units at each floor. This system, capable of finer control, can save significant volume in the building. The two-duct system can also be used in this manner, with a two-duct mixing box replacing the induction unit.

In buildings requiring flexibility for partitioning change, the air-diffusing ceilings have real merit. The most flexible surface in a building is the ceiling, and recent research in systems and materials has developed the calculations to design an effective distribution pattern. The ceiling system can be designed on a module to correspond with the partitioning module, so that there are grounds to attach partitions and separators to provide acoustical integrity. The placement of separators above these ceilings is critical, both for temperature control and sound transmission.

As for total integration of duct systems into structure, this is possible as long as control devices are accessible and pipes carrying liquids are not permanently enclosed. For a building with permanent function, integration is more likely; if flexibility is involved, it is infinitely more difficult. For example, if a floor system originates at a building core and travels 60 ft to the perimeter, it is difficult to achieve three 20-ft interior zones in the future from the same structural void without adding ducts and mixing boxes under an exposed-concrete deck. For reasons of structural economy, the individual voids which are available as air channels in precast concrete planks are not large enough to service a complete zone, and combinations must be used. The systems which utilize a raised floor system, creating a plenum chamber, have more free area, but are not much easier to utilize when flexibility is required. When a structural system is designed for air-conditioning purposes, its cost increases rapidly to the point where no advantage is gained over nonintegrated methods. Again, the choice of method probably boils down to dimension. If only one zone occurs between core and perimeter zone, total integration is simple. If two zones occur, integration is harder. If a multitude of zones are required, preformed systems are almost impossible, and the hung ceiling is the logical choice.

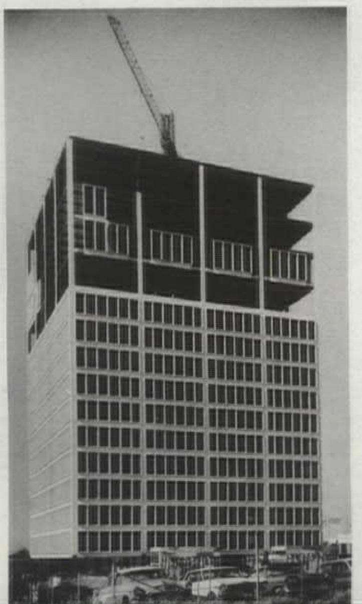
MECHANICAL REFINEMENTS

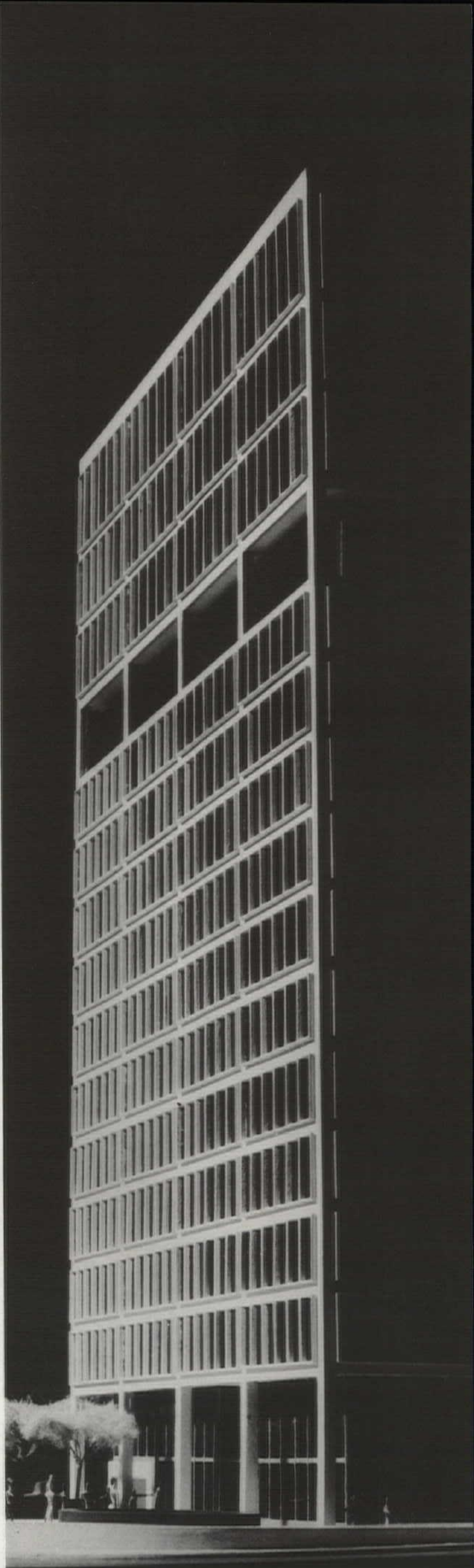


Slip-Form Core Speeds Mechanical Installation

Unusually close teamwork among the architects, engineers, and contractors accomplished a saving of three months of construction time in the erection of the Pierre Laclede building in St. Louis, Missouri. With this accelerated schedule, the early occupancy requirement set by the client was met, and in turn meant considerable savings in construction dollars and earlier investment return for the client. To a large degree, it was the application of the slip-form mechanical core (*construction photo, facing page*) which made these savings in cost and time possible. This core, for instance, permitted the installation of 95 per cent of all rough plumbing, 100 per cent of all elevator work, 25 per cent of roughing-in of electrical lines, and all mechanical risers, while the structural steel bays were growing unimpeded around the core and curtain wall panels were being affixed to the perimeter (*construction photo below*).

The building is 16 stories high and contains approximately 246,000 gross sq ft of space. Exterior skin and fenestration (*model photo right*) express clearly the various functions within the building. The first two floors, which house various commercial tenants, are sheathed in aluminum and clear plate glass recessed 5 ft from the exterior face of the building. The next ten floors are designed for office use and have a cladding of precast, exposed-aggregate concrete panels with fixed solar gray glass set in neoprene gaskets. Similar but taller panels, reflecting more generous ceiling heights, are used on the upper three floors, where a private club is located. The thirteenth floor, recessed between club and office floors, is devoted to the mechanical equipment. Here, the central chillers, boilers, pumps, hot water heaters, electrical distribution centers and control panels are located. Chief reason for this placement was the specific requirement that an independent mechanical and electrical system be installed for the private club on the top floors, as well as the commercial establishments on the first floor. "Should the mechanical floor have been placed at the penthouse or at the basement level," explain the consulting engineers, "it would have meant a duplication of risers through the other floors, which would have demanded a much larger core space at each floor, and this would have meant a reduction of the available rental space." Furthermore, placement of the mechanical equipment in the basement would





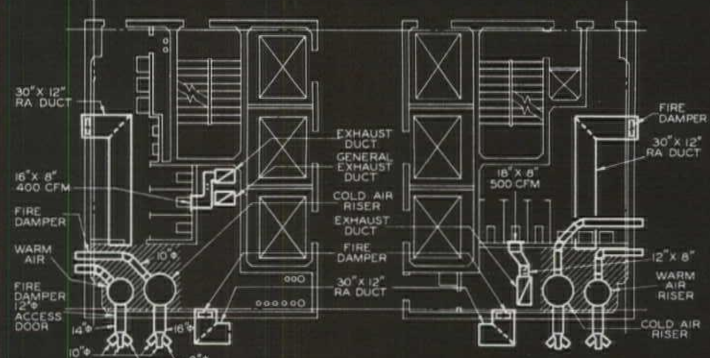
have interfered with the efficiency of the garage layout. "It is estimated," suggest the engineers, "that a saving of at least $50,000 was achieved due to the elimination of an expensive high-rise flue stack, condensing, chilled and hot-water piping, and duct work, even considering the added cost for better acoustic and vibration isolation treatment at the thirteenth and fourteenth floors." As finally resolved, using down-feed and up-feed from the thirteenth floor, the complete mechanical space represents only 4.75 per cent of the total building area.

The mechanical core occupies two of the sixteen structural bays, and, for reasons of office plan flexibility, was placed off-center. The 32′ x 62′ x 266′ core was poured continuously in 16 days, and the working platform from which the core was slipped also supported the crane, which was lifted as the core grew in height. Particular co-ordination was required among the building trades and professions to properly place and size all of the 2370 openings in the concrete core for ducts, pipes, conduits and boxes.

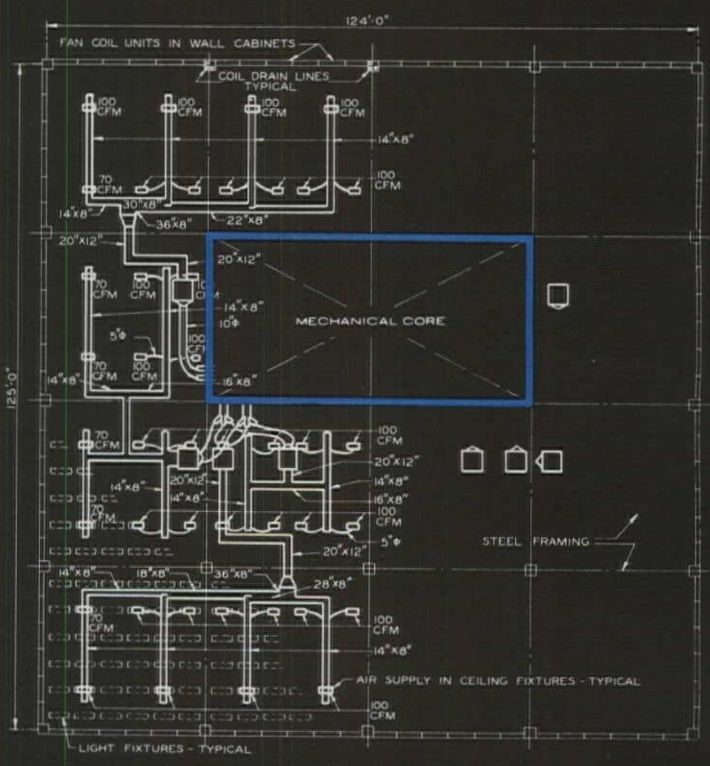
Air conditioning of the office areas is accomplished by two central high-velocity dual-duct systems for the interior bays (*plan right*), and fan-coil units for the exterior bays (*details facing page*). An overlap of cooling capacity is provided in both exterior and interior systems so that the boundary zone between exterior and interior bays may be covered by either system. Combination air distribution and lighting troffers on 5-ft centers were specified for the interior zone. The ceiling space is used as a plenum for the return and baffled hoods over the return-air troffers serve to eliminate sound transmission between the different office suites (*detail below right*). The supplementary fan-coil system is not unusual in any sense, but has, however, been carefully integrated with the assembly of precast-concrete window and spandrel elements (*photo facing page*).

A specially designed outdoor temperature sensing box is being installed to measure the effective outdoor temperature due to solar heat gain through heat absorbing glass. This will permit the building management to determine the change-over requirements among the four building exposures.

The success of this structure reflects the close collaboration among the following firms: Smith & Entzeroth, Architects; William Tao & Associates, Consulting Mechanical & Electrical Engineers; Fruco & Associates, Structural Engineers; Fruin-Colnon Contracting Company, the General Contractor.

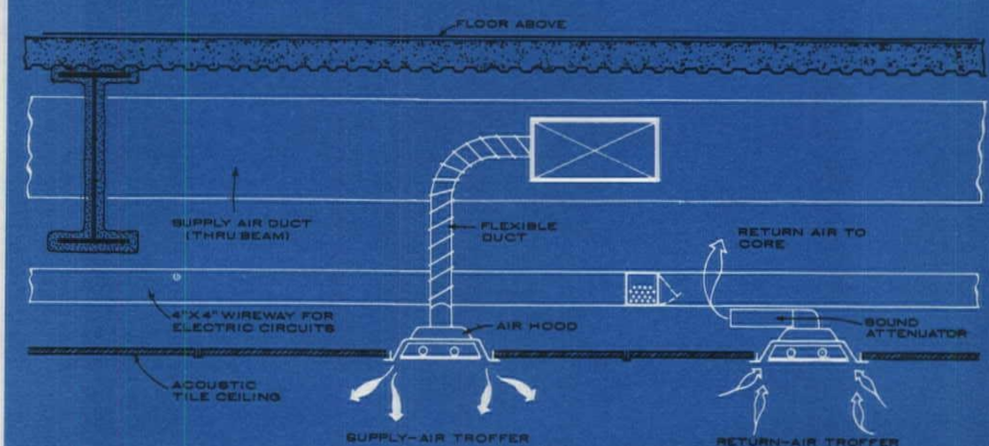


DETAIL OF MECHANICAL CORE

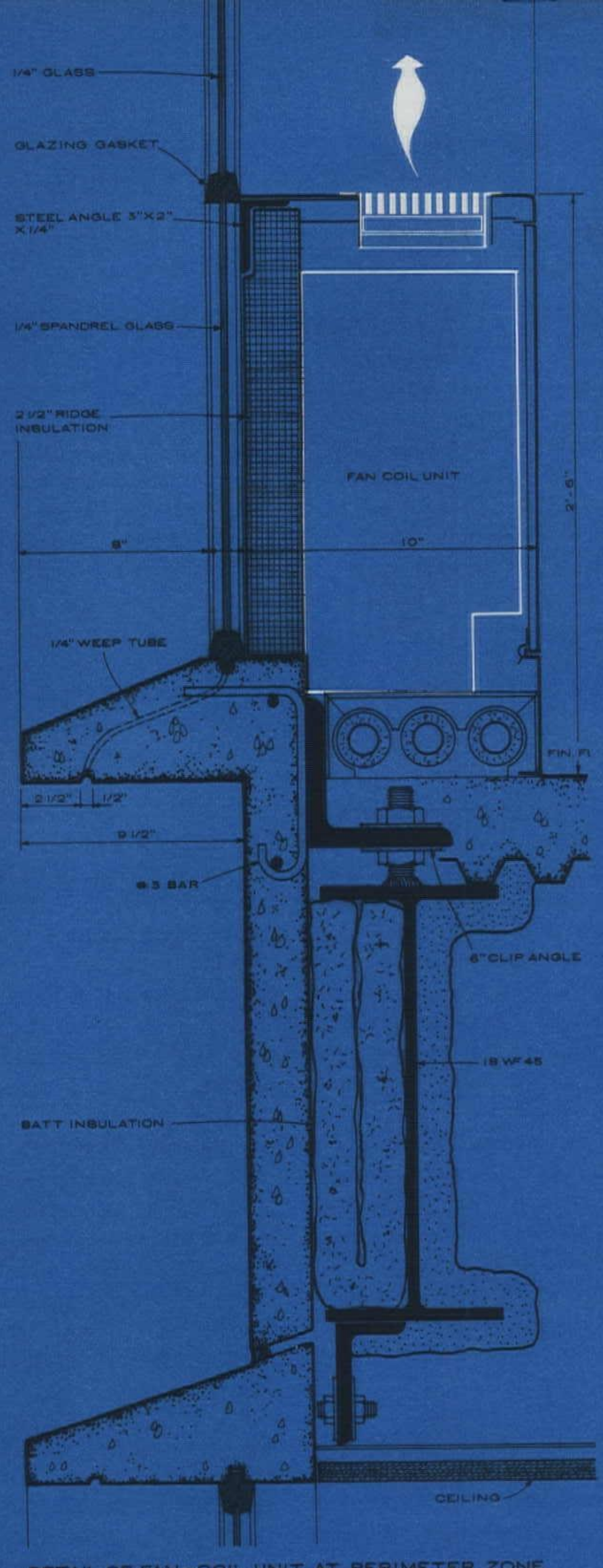


TYPICAL OFFICE FLOOR WITH AIR DISTRIBUTION

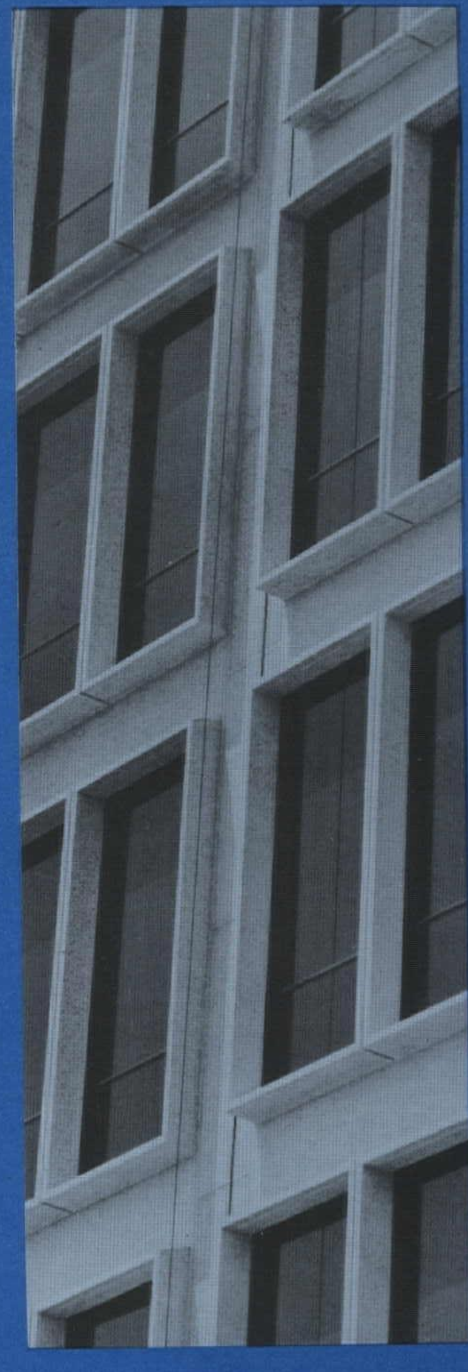
ADAPTED FROM "BUILDING CONSTRUCTION," FEBRUARY, 1963.

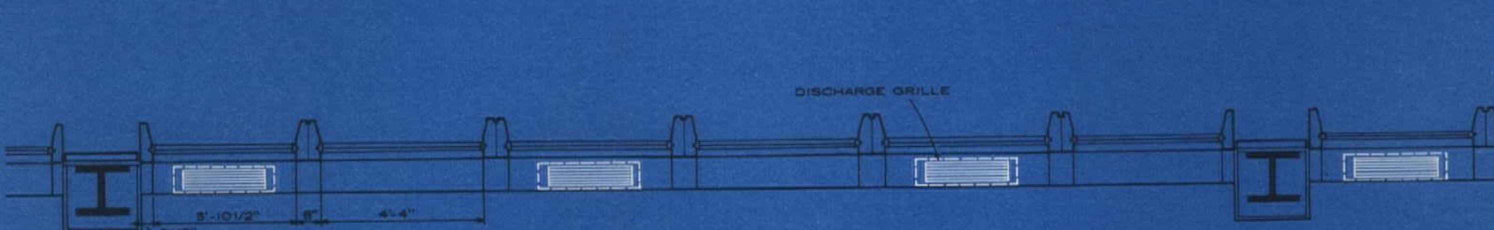


DETAIL OF PLENUM SPACE AT INTERIOR ZONE



DETAIL OF FAN-COIL UNIT AT PERIMETER ZONE





PLAN
LOCATION OF FAN-COIL UNITS AT PERIMETER ZONE

ELEVATION

85 Classrooms for Year-Round Use

As one of its 2600 students might say about the new high school in Mount Vernon, N. Y., "Man, this place is *cool!*" And indeed it is. Fully air conditioned except for the gymnasium wing, the 319,000-sq-ft school may rank as the largest air-conditioned public school in the country. It didn't begin that way—original plans were for heating and ventilating only. This was first amended to provide for future air conditioning, then later changed to include all equipment, for a total increase of only $1.25/sq ft.

Even at reasonable costs, school air conditioning is still sometimes controversial. It helps to call it "year-round environmental control," says Manfred Moses, partner in the firm of Abrams & Moses, mechanical engineers for the Mount Vernon school. Moses maintains that new schools without "at least the provision for air conditioning will soon be as obsolete as any new commercial or office building that is not so equipped." To add air conditioning later may be prohibitive in cost, unsightly, or even impossible. Overheating is not just a summer problem, although it becomes critical with the increased summertime use of the schools for special classes, and with the possibility of a 12-month curriculum. The unique problem of schools—large heat gain from dense occupancy and from build-up of lights and sunlight—can be severe from March to mid-November, even in relatively cool weather and in Northern states.

In Mount Vernon, it was the superintendent of schools who initiated the idea of air conditioning for the new school, which combines academic-vocational education and is now the city's only high school. The board of education (and later the voters) supported him in his belief that true economy would consist in having the school plant and its personnel at peak efficiency at all times.

The architects — Sherwood, Mills & Smith — find that "most air-conditioned schools of today are designed especially for their air conditioning... the tail wags the dog." Lester W. Smith, partner in charge at Mount Vernon, believes that "a school should be air conditioned without having the plan and amenities of the spaces sacrificed." They rejected a closed-in environment, and gave each classroom natural light and operable sash. Various provisions were made, however, to lower the cooling load—reducing the window heights; reducing the exposed perimeter of classrooms by increasing their depth; using reflective and insulated roofs, and providing sun screens.

Unit ventilators and a hot-water heating system were already recommended for the classrooms. As a first step toward ultimate air conditioning, it was decided to investigate unit ventilators that would provide cooling as well as heating and ventilating. To increase their capacity from 1000 to 1500 cfm, and make other accommodations, cost was estimated at $100,000. Considered a wise investment, this was included in the base bid. A complete installation, with chiller and cooling tower, was bid as an alternate.

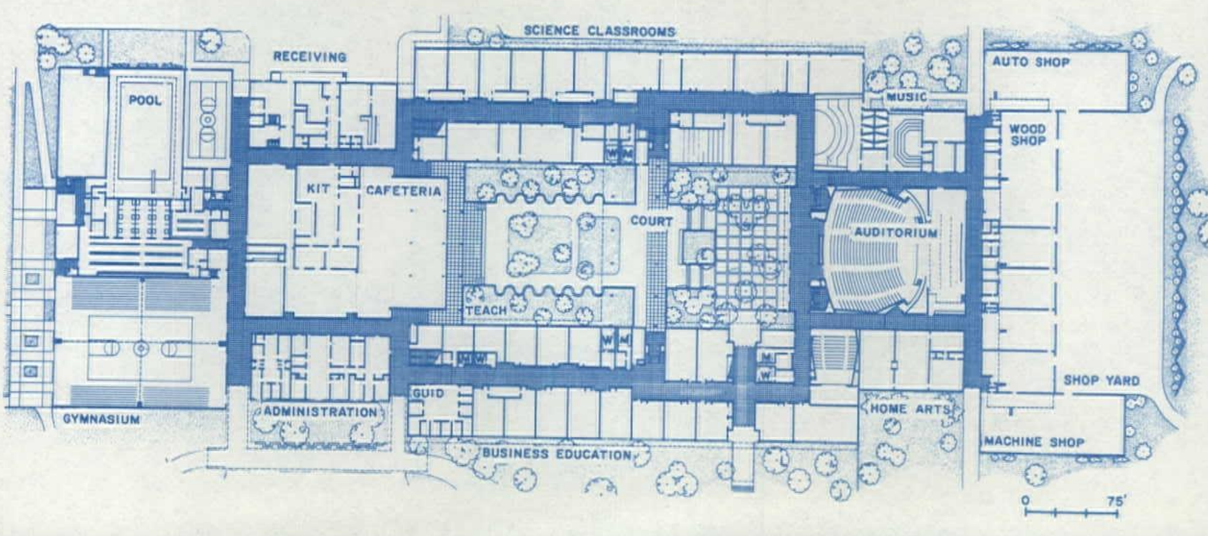
Adding up all loads, total demand was 1000 tons of refrigeration. But since not all areas of a school are occupied simultaneously, requirements can be dovetailed and thus served by a 600-ton chiller. A system of pneumatic switching from the central control panel permits the custodian to shift chilled water to the various zones as needed.

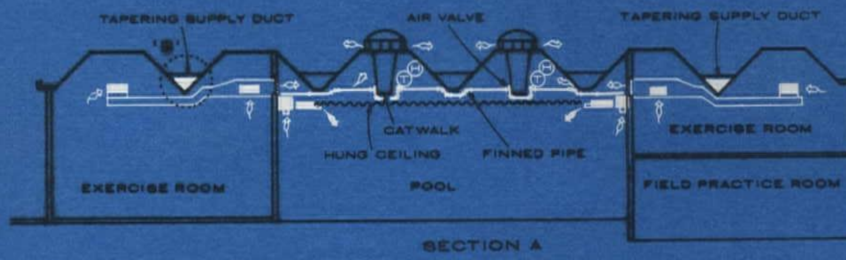
Layout of the building lent itself to a giant loop reverse-return distribution system (above hung ceilings along the main corridor), with the same piping used for hot-water heating and chilled-water cooling. Submains along the perimeter feed the Herman Nelson unit ventilators. According to the engineers, this system has several advantages for this job—flexibility of operation (each unit ventilator can be operated independently) and savings in space (ductwork for a central air system would have been much larger). Instead of unit ventilators, there are fan-coil units for various offices, and air-handling units for larger spaces.

Several unusual techniques are of interest. The large quantities of air for the physical-education wing and the auditorium would have caused large loss of floor space if ductwork had been furred into walls. (Gym situation was complicated by the fact that it has no basement.) Underground distribution for both supply and return air is of Johns-Manville's asbestos-cement air duct, which comes in 13-ft lengths and is made watertight with new coupling devices.

Condensation on the swimming-pool roof was another potential problem. A hung ceiling of translucent plastic acts as a vapor barrier; above it, finned-pipe radiation maintains warmth and dryness. Air is exhausted from the exercise rooms into this pressurized space, and vented to the outside of the building by relief shutters.

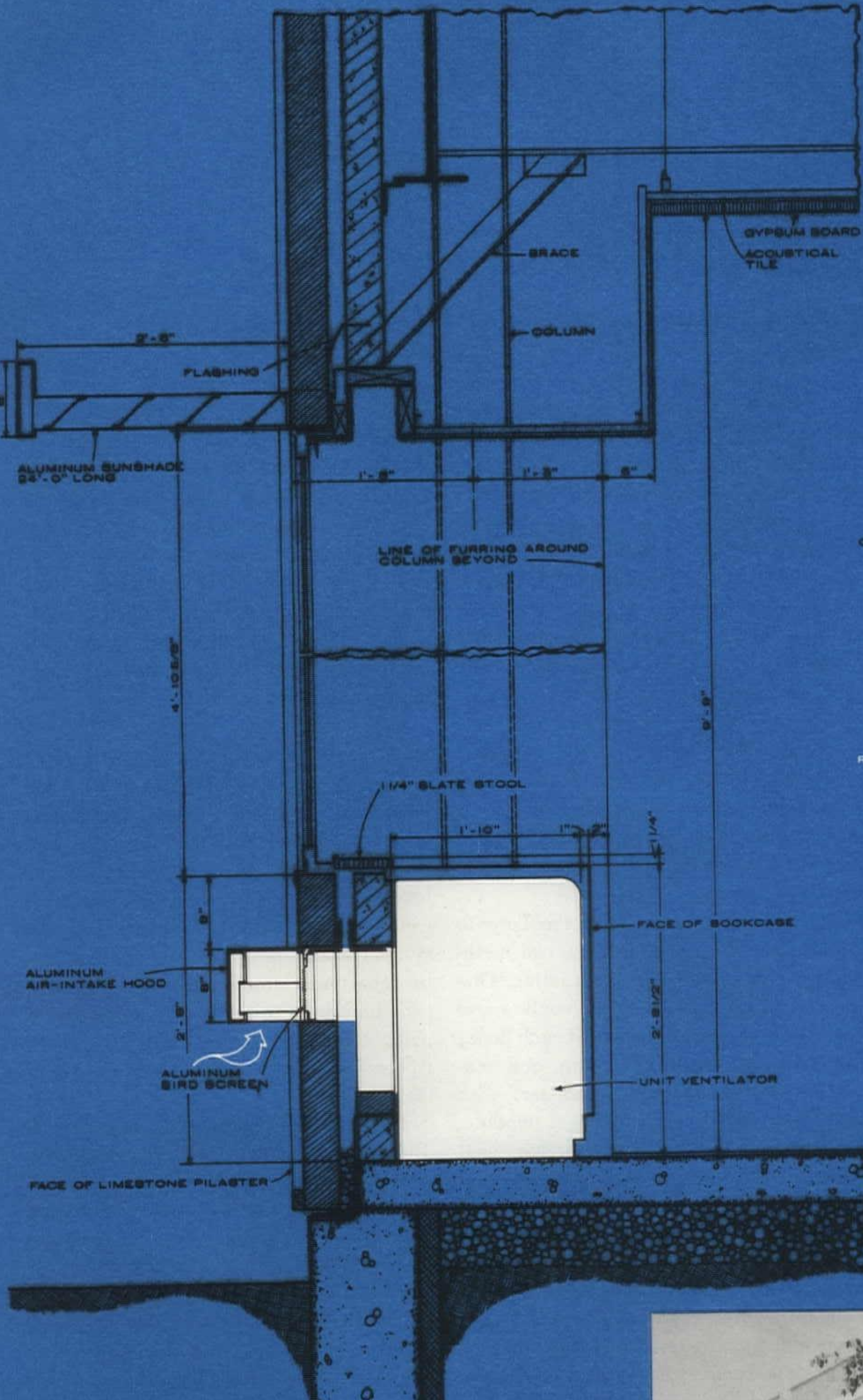
The mechanical design throughout was not aimed at sophistication but at the simplest system consistent with adequate capacity, proper controls, flexible operation, and easy maintenance. Total cost of the system was $1,278,000; total cost of the building (excluding site work and equipment) was $6,596,330, or $20.05/sq ft—considered pretty cool for the high cost of schools in this area.



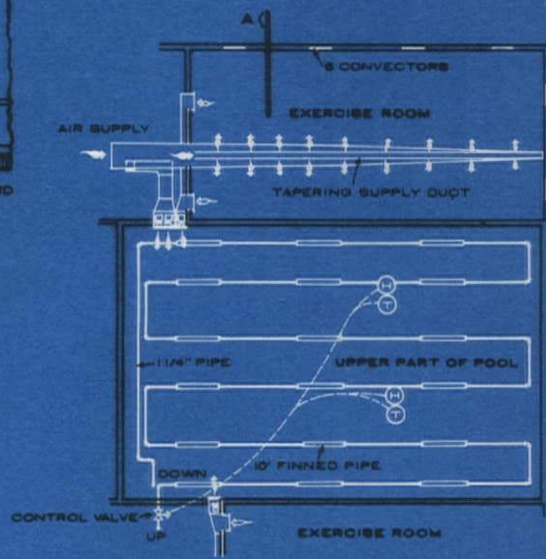


SECTION A

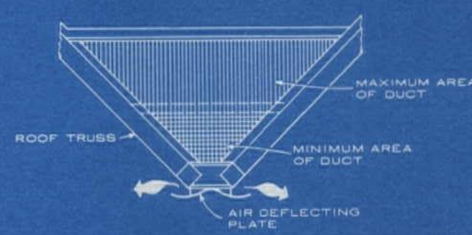
DIAGRAMS: ADAPTED FROM "HEATING, PIPING & AIR CONDITIONING," DECEMBER 1962



PARTIAL EXTERIOR WALL SECTION



PLAN



DUCT SECTION AT 'B'

In the classroom wings, a similar detail for sun shades and air-intake hoods makes this practicality into a design element (left, below). *In the gymnasium wing, V-shaped ducts conform to the shape of the folded-plate roof. Ducts are tapered at the top to allow for rain run-off* (above, right).

PHOTOS: E. PERRY

Waste Heat Salvaged by Bootstrap

Bootstrap heating may be defined as a system whereby enough heat is salvaged from various sources within a building to heat that building fully: i.e., where the building's internal heat gain is sufficient to match its heat loss. The Toronto Professional Building, now under construction, illustrates both the advantages and limitations of the technique.

Initiated and owned by a group of doctors and dentists in Toronto, Canada, the 16-story building provides space for professional suites and such ancillary facilities as laboratories, operating rooms for minor surgery, and offices for medical supply firms (*see typical floor plan, overpage*). At ground floor and basement levels are a restaurant, bank, drug store, and other services. Architects are Gilleland & Janiss, with Dr. Eugene Janiss the partner in charge of design. Structural engineers are M. S. Yolles Associates Ltd.; mechanical engineers, R. T. Tamblyn & Partners, Ltd.

The possibility of bootstrap heating was investigated early in the design stage. A heat-loss calculation—based on single glass, a standard curtain wall, and a ventilation rate of 0.04 cfm/sq ft of rentable space—totaled 9,671,000 Btu/hr. A second calculation—based on double glass, 2 in. of foamed polystyrene in the wall, and 0.08 cfm/sq ft of gross area—reduced the heat loss to 3,210,000 Btu/hr. Turning then to heat gain, every available source was evaluated: occupants, lighting, fans, pumps, cooling of elevator equipment rooms, lavatory exhaust. A total heat gain of 3,653,000 Btu/hr indicated that the insulated building would be self-heating.

Studying initial costs for a bootstrap system, it was shown that the savings on boilers and chimney (and their floor space) would pay for the extra insulation, double condenser for the water chiller, and special electronic filters. (Because the minimum fresh-air ratio is used, filtration is necessary to purify air.) As for operating expenses, a unit cost of 86¢/million Btu for bunker oil would be equalled by the bootstrap system. Cost of the latter includes a unit cost of 63¢/million Btu for the water chiller to transfer heat from the core of the building to the perimeter heating circuits by day, and a cost of $1/million Btu to provide the same heat from a direct resistance off-peak electric water heater during nights and weekends. (Savings with bootstrap result from its load of 3210 MBH, compared to 9671 MBH for a conventional system.)

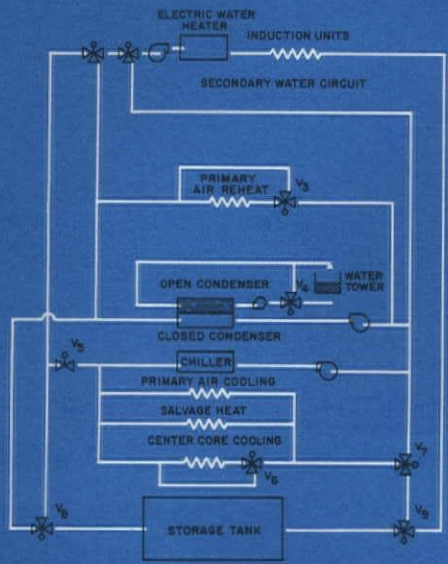
The mechanical system for the Toronto Professional Building involves two methods for central heating and cooling. One is an air-handling system for cooling and ventilating the central areas of each floor; the other is a heating, cooling, and ventilating system for the perimeter, with induction units in each 10 ft module. Equipment is arranged to salvage heat from the central areas of the building and supply this free heat to the perimeter. Electric resistance heating is used in the perimeter water circuits when lights are turned off.

In providing heat when the building is unoccupied, two alternate systems may be used (*diagrams, facing page*). System No. 1, used in Toronto, has an electric boiler with sufficient storage capacity to cover the time lag before lighting gives off its full heat. System No. 2 has a large storage tank to store surplus waste heat, plus an electric water heater if this amount is not enough.

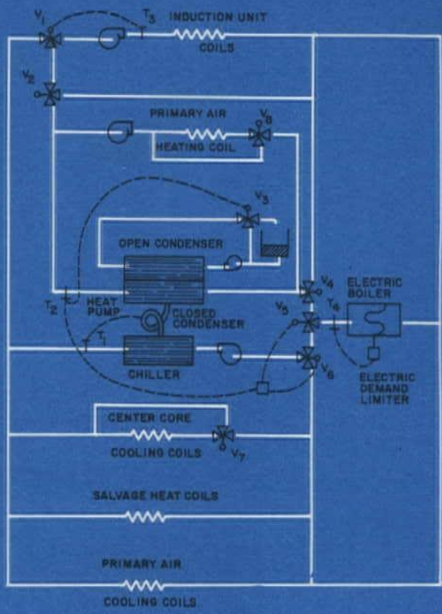
Major advantages of the bootstrap method have been summarized by R. T. Tamblyn (*ASHRAE Journal*, April 1963) as follows: (1) it reduces first cost of mechanical plant in most cases; (2) it reduces architectural cost where insulation does not have to be added; (3) it reduces cost of heating in many localities; (4) it releases rentable space through savings in shaft and equipment space; (5) it reduces maintenance of equipment since entire plant is easily automated.

In general, writes Tamblyn, "when the building tends toward rectangular floor area with the long side not more than twice the short side; when the typical floor is 10,000 sq ft, or more, in area; and when the ratio of glass to total wall is below 40 per cent, the office may become a candidate for bootstrap heating." The system would be especially well suited to department stores and other commercial buildings with high internal heat gain. A building of less than 100,000 sq ft, however, is considered too small to bear the cost of design.

The future of the method, according to Tamblyn, depends upon the cost of electric power and fossil fuels in any given locality. The use of the bootstrap system should be investigated where the terminal rate cost of power is less than 0.5¢/kw and the average cost of operating a motor for 300 hrs/month is less than 1.5¢/kw-hr (shown on map). But even this is not definitive. "Savings in operating cost may not be the best reason for using this type of heating. Savings in first cost may be more important than savings in operating cost and may substantiate an increase in operating cost." For its various advantages, then, the system may be profitably explored, and new installations will be watched with interest.

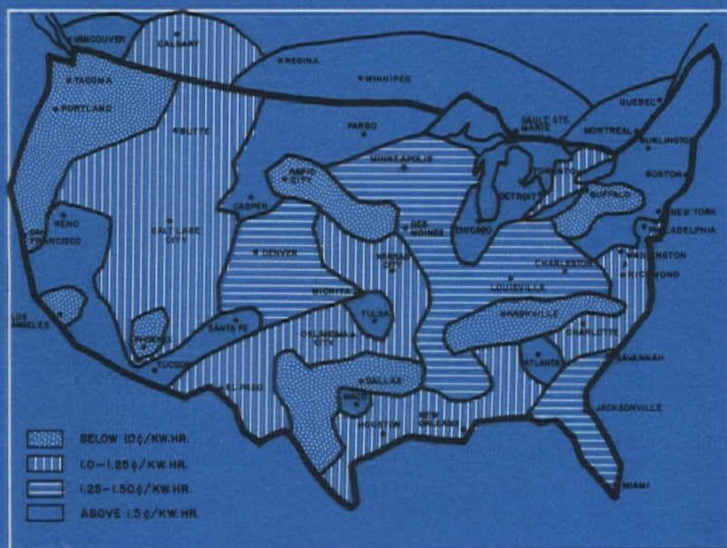


SYSTEM NO. 2



SYSTEM NO. 1

DIAGRAMS ADAPTED FROM "ASHRAE JOURNAL," APRIL 1963.



HEAT GAIN AND HEAT LOSS: TORONTO PROFESSIONAL BUILDING

HEAT LOSS TABLE

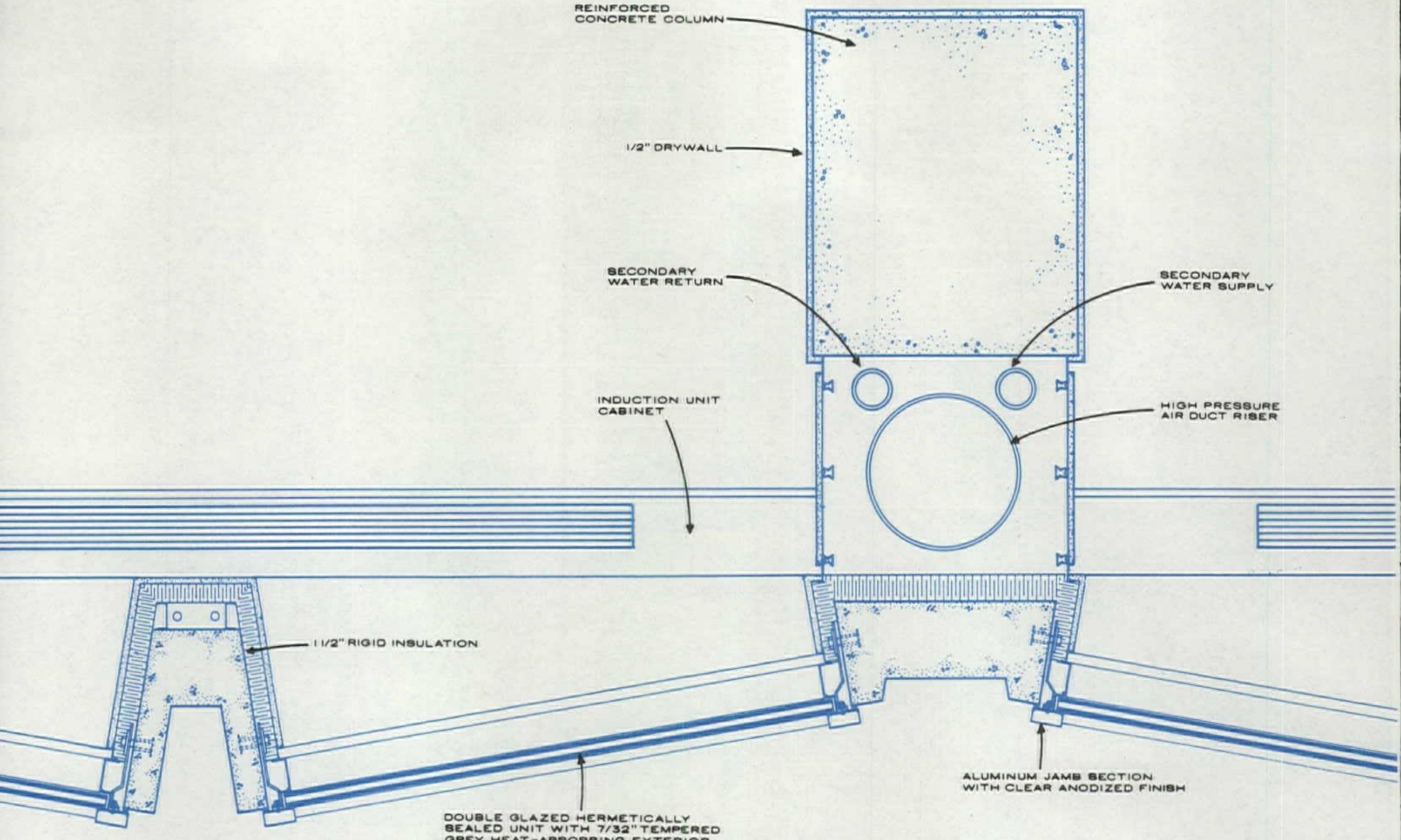
	Conventional Building			Insulated Building		
Item	**Factor**	**MBH**	**Btu/sq ft**	**Factor**	**MBH**	**Btu/sq ft**
Glass	1.13	2645	14.70	0.65	1520	8.43
Wall	0.25	1120	6.22	0.10	448	2.49
Roof	0.18	144	.80	0.10	80	.44
Other		12	.07		12	.07
Infiltration	0.4 cfm/sq ft	5750	31.95	.08 cfm/sq ft	1150	6.38
Total		9671	53.74		3210	17.81
Equivalent kw		2840			940	

HEAT GAIN TABLE

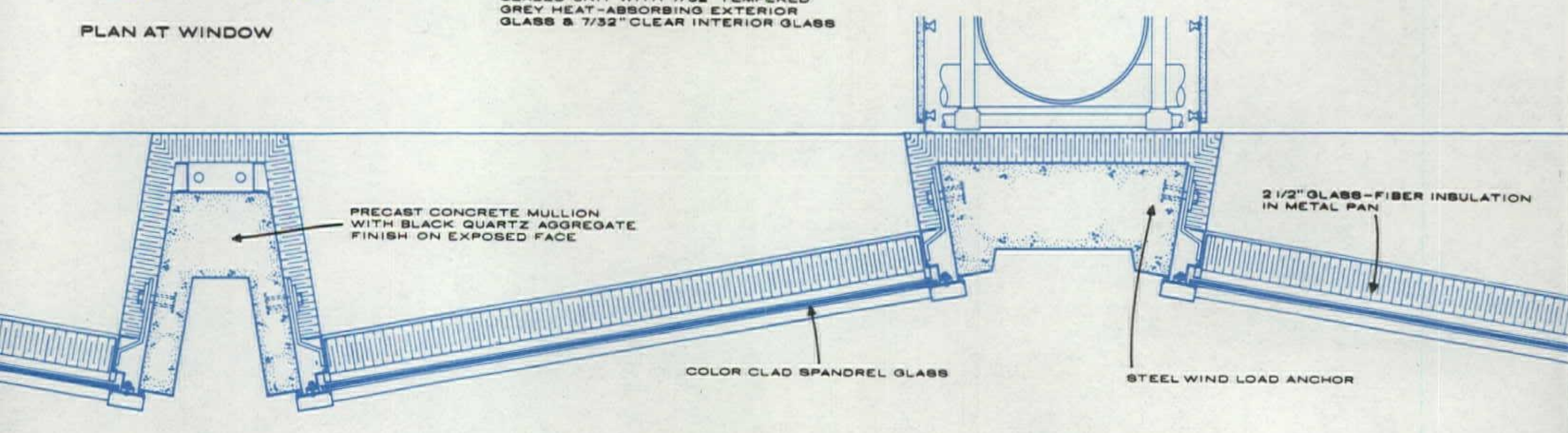
Item	Value	MBH	Btu/sq ft
People	900	180	1.0
Fans & Pumps	109 kw	373	2.07
Miscellaneous	45 kw	153	0.85
Lavatory Exhaust	5000 cfm	108	0.60
Elevator Room	20% of 200 kw	136	0.76
Transformer Room	3% of 1000 kw	102	0.57
Heat Pump	100 kw	341	1.89
Lights	85% of 783 kw	2260	12.55
Total		3653	20.29

COST OF BOOTSTRAP HEATING COMPARED WITH OTHER FUELS

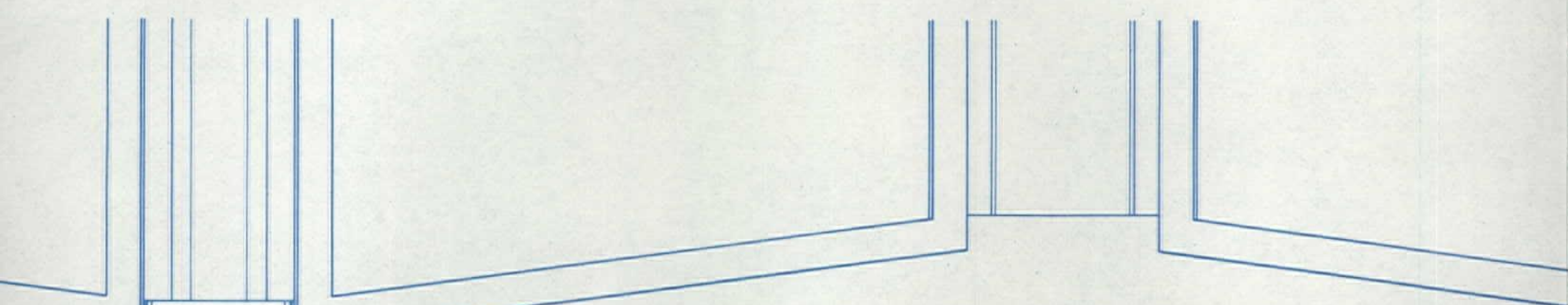
Location	Fuel	Cost/million Btu
Toronto	Electricity	$3.95
	Natural gas	1.28
	No. 2 Oil	1.25
	No. 5 Oil	0.93
	No. 6 Oil	0.86
	Bituminous coal	0.86
	Electricity (Bootstrap System #1)	0.86
	Electricity (Bootstrap System #2)	0.47
Chicago	No. 5 Oil	0.94
	No. 6 Oil	0.85
	Electricity (Bootstrap System #1)	1.44
	Electricity (Bootstrap System #2)	0.69
New York	No. 5 Oil	0.86
	No. 6 Oil	0.66
	Electricity (Bootstrap System #1)	2.14
	Electricity (Bootstrap System #2)	1.04



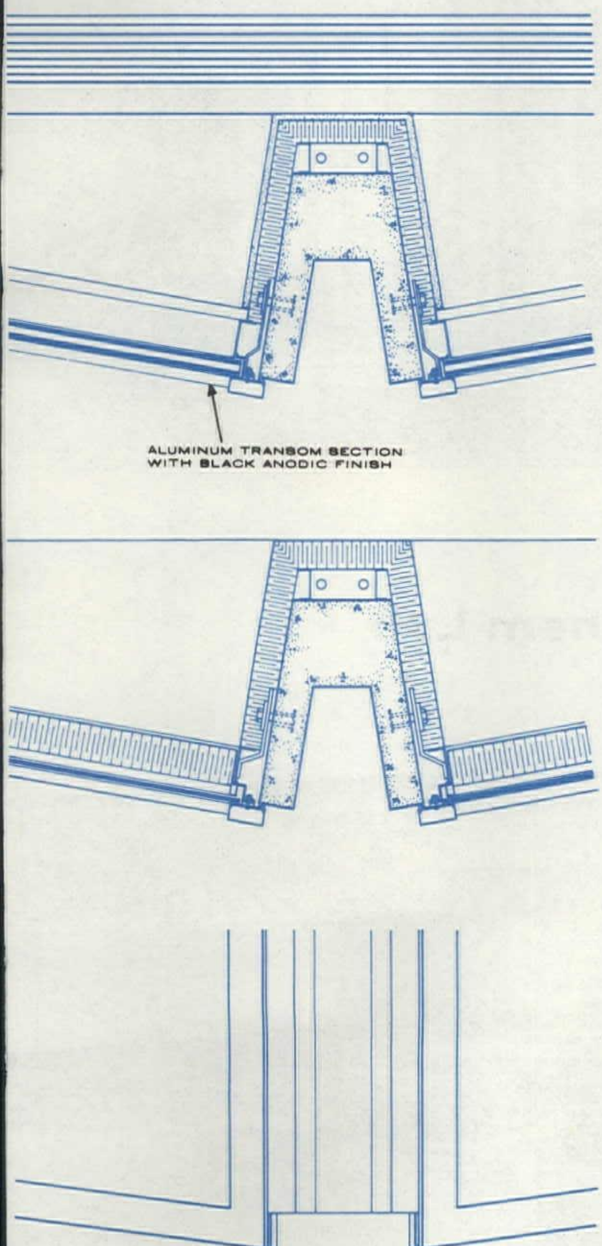
PLAN AT WINDOW

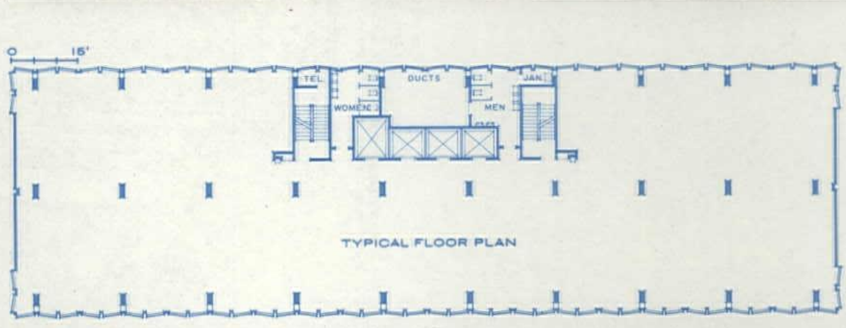


PLAN AT SPANDREL



ELEVATION AT SOFFIT LEVEL

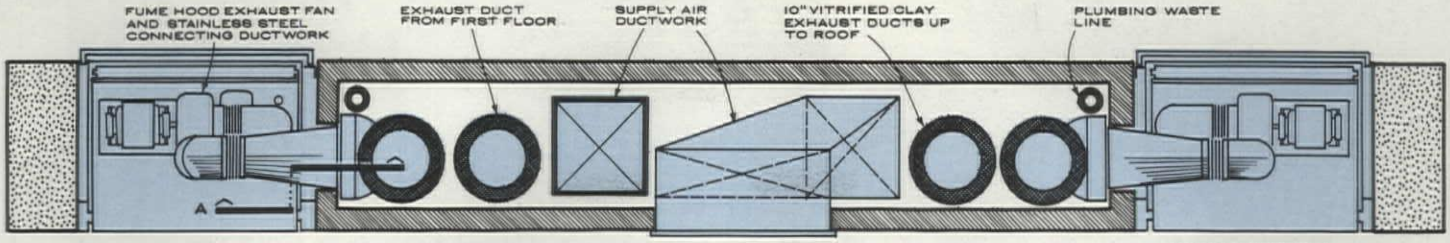




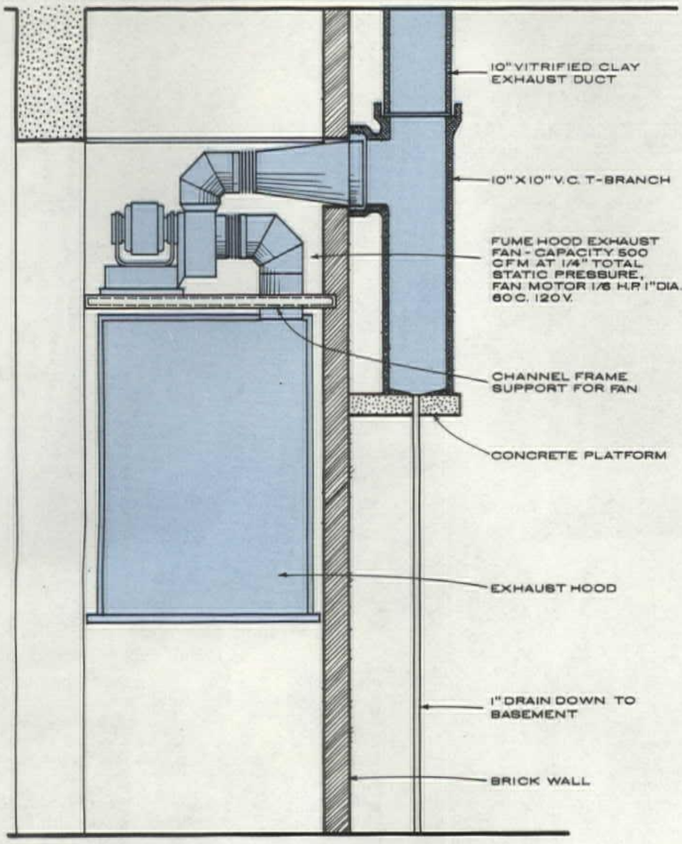
The narrowness of the building permits each suite to have natural light. The façade is distinguished by angular planes of grey glass which "reflect a giant montage of the townscape." The exterior wall is well insulated to achieve the low heat-loss rate required by the bootstrap system: windows are hermetically sealed, and glazed spandrel panels also have an air space of ½" between components.

Conditioning the Chem Lab

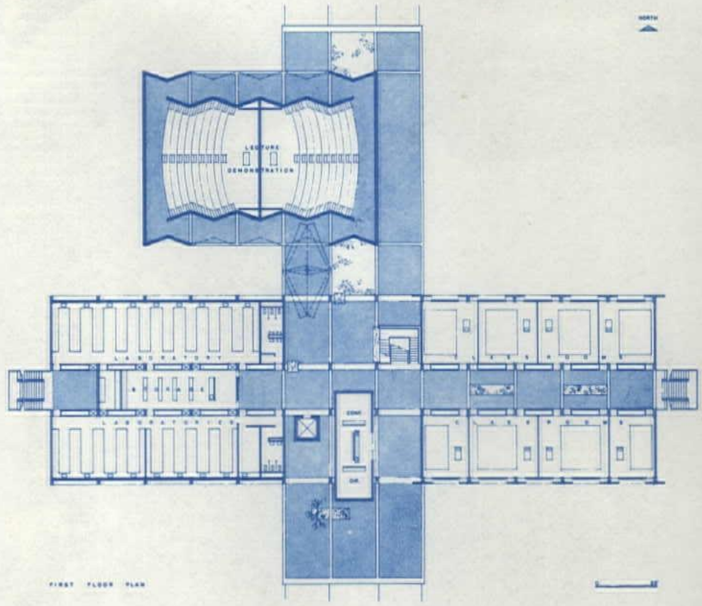
PHOTOS: ALEXANDRE GEORGES

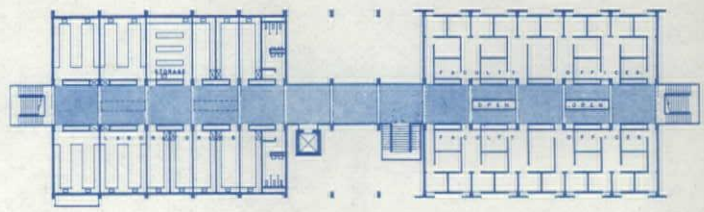


PLAN SECTION
(MECHANICAL CHASE AT 2ND FLOOR)



VERTICAL SECTION AT 'A'





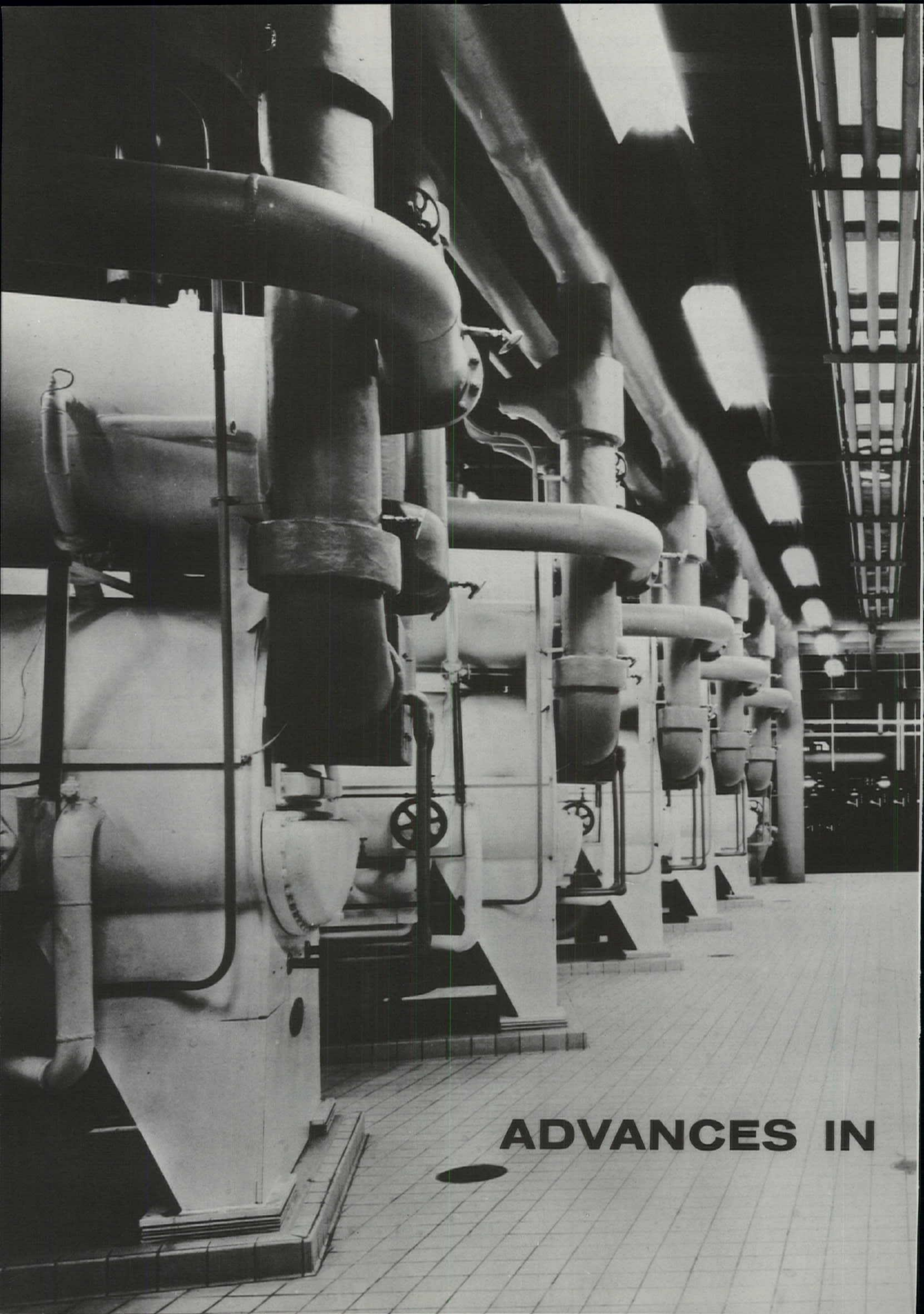
In this building for the University of South Florida at Tampa, the special air-conditioning needs of college chemistry labs have been met in a way that is notable for its simplicity. Such simplicity was attainable only because the architect, Mark Hampton, considered mechanical needs in establishing his design concept.

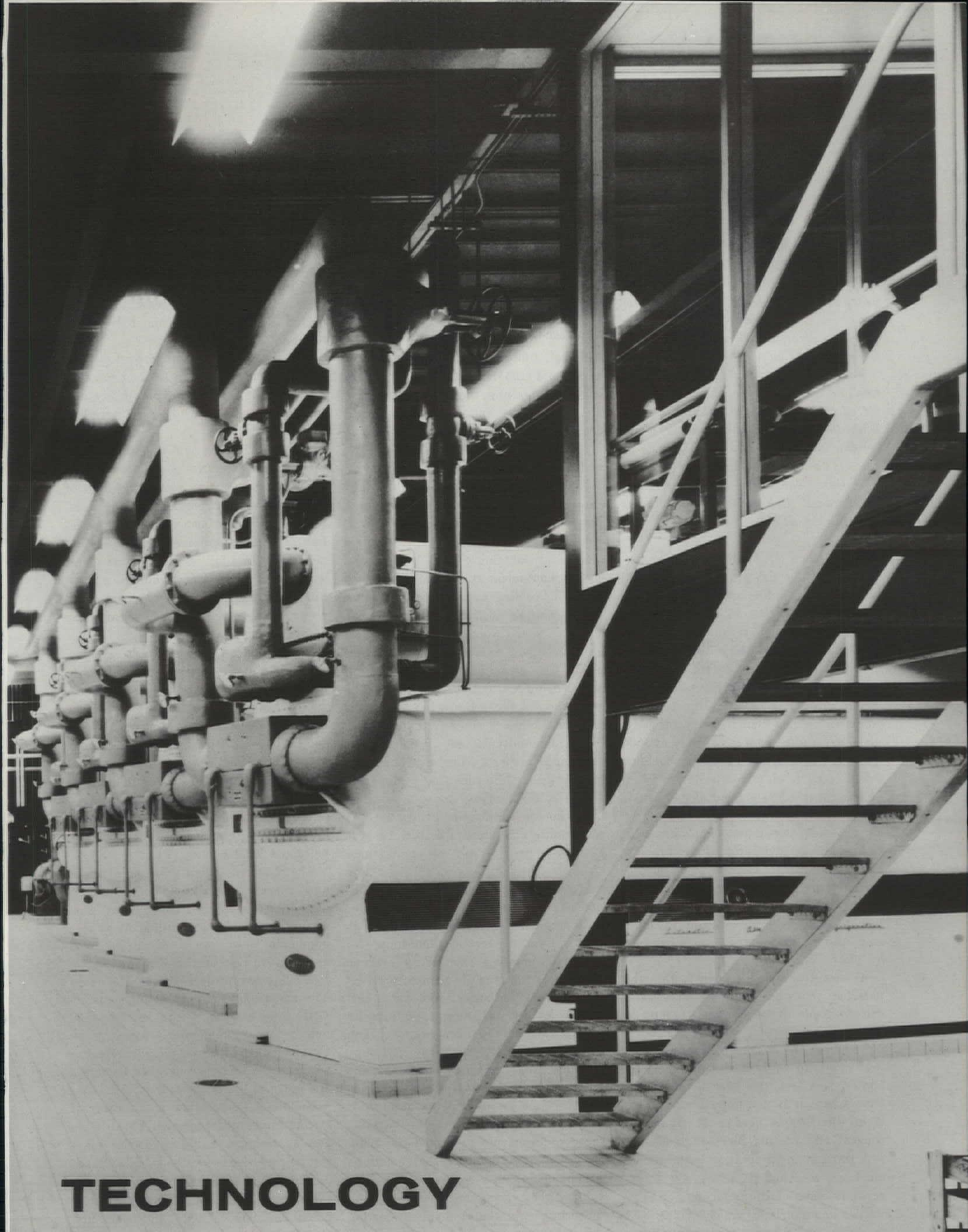
As part of the first group of buildings for a new campus, this structure was subject to an over-all design policy that recognized the problem of air conditioning in a subtropical climate (see p. 133, SEPTEMBER 1962 P/A). All buildings on the campus have a minimum of windows, protected where they occur by deep overhangs or concrete grilles.

The functions of this building are segregated into three separate but connected elements. The lecture halls, with their special requirements for clear spans and acoustical control, are located in a one-story wing. The two three-story blocks, one housing classrooms and offices and the other housing the laboratories, are identical structurally but differ in their air-conditioning requirements. The classroom block has narrow windows, whereas the laboratory block is windowless.

The mechanical engineers, Ebaugh & Goethe, have located all air-conditioning ducts for both blocks in chases between the interior columns. Air-conditioning supply ducts lead up from the basement mechanical room (which is provided with hot and chilled water from a central university plant). In the classroom wings, the chases also house return-air ducts. In the laboratory block, where there is no recirculation of air, they house exhaust ducts leading to the roof from the fume hoods (*drawings above*).

Other mechanical services, such as water, compressed air, steam, and gas, reach the U-shaped laboratory counters through chases in the windowless exterior walls. The ceilings are completely free of ducts or pipes.


ADVANCES IN



TECHNOLOGY

Central Plant Progress

BY WILLIAM L. McGRATH

Three of the most rapidly expanding innovations in central air conditioning within the last five years—district chilled-water plant, heat pumps, and refrigeration drives—are reviewed by the Executive Vice President, Engineering, Carrier Air Conditioning Company.

For years, the term "central refrigeration" or "central air conditioning" has referred mainly to single-building systems. With the advent of chilled-water plants serving whole campuses and big building clusters, a new term is needed to avoid confusion. The term "district chilled-water plant" is suggested and is being used in this article.

In 1940, when Dr. Willis H. Carrier predicted that one day chilled water would be sold as a public utility, one of the world's first district chilled-water plants was being installed to air condition the library of Southern Methodist University in Dallas. This 90-ton system, using ammonia compressors, piped chilled water 500 ft through a 6 in. line installed in an existing steam tunnel. Today, the SMU plant has a total cooling capacity of 3600 tons and will soon add a 2000-ton machine.

The growth of this installation is indicative of the development of the district chilled-water plant concept—one of the most rapidly expanding innovations in central air conditioning within the last five years. Plants with up to 12,000-ton capacity are now in operation or being built, sending chilled water thousands of feet through pipes up to 30 in. in diameter. And chilled water is now being sold by public utilities.

A second new development within the past five years has been the electrically driven inside-air-source heat pump, or heat recovery system, wherein heat is removed from the interior of a large building and used to heat the periphery in winter. In effect, this system takes heat from where it is not wanted and moves it to where it is needed. It eliminates conventional heating plants.

A third major innovation is the refinement of mechanical drives for large-capacity water-chilling machines. Gas as well as steam turbines are now being used to drive centrifugal refrigeration machines, and the waste heat from these turbines is used again to operate absorption-cooling machines for additional capacity at low cost. Natural-gas engines are driving centrifugals, and the heat removed from these engines by water jackets is also being used in absorption machines.

District Cooling Plants

Although the central plant providing year-round climate control from a remote location is not new, the concept is spreading. Universities and colleges across the country are using these plants in increasing numbers to serve existing facilities and to provide for future expansion.

Purdue University is an example. With enrollment expected to double within 10 years, the university has abandoned its old central steam plant and has built a new plant containing both heating and cooling equipment at one end of the campus. The cooling capacity is 5800 tons, with provision for 7300 tons by 1970. Valuable space where the old plant was located is now available for other purposes. Classes in nearby buildings will not be disturbed by the sound of machinery. And its flexibility will permit the addition of new buildings of any type.

This flexibility is one of the reasons why large airports, such as New York International (Idlewild), have found that a district plant offers complete freedom from concern about independent heating and cooling facilities. Idlewild has the world's largest airport air-conditioning system, with 9300 tons in 13 absorption refrigeration machines (*see previous page*). Nearly 25,000 gallons of water per minute are pumped to air-conditioning units in the many terminal buildings.

John P. Veerling, chief of the aviation plant and structures division of The Port of New York Authority, said that a centralized facility was selected for Idlewild because it offered space economy and efficiency as well as flexibility. Although Terminal City comprises 655 acres, the individual unit terminal sites were confined by such essential needs as aircraft parking, roadways, and auto parking. These requirements prompted the planners to remove facilities that could be accommodated in a separate area. This included the heating and cooling.

Veerling said that individual heating and cooling plants in each terminal would have restricted and constricted freedom of transfer of people between ground vehicles and aircraft—which is the function of a terminal. He added that it was not practical to place this equipment below grade, because of the high water table, or on the roof, because of the required sight clearance from the control tower to peripheral taxiways.

He also said that the growth of air transportation has been so dynamic that flexibility in terms of expansibility and function is essential to sound terminal design.

Finally, Veerling said that the district plant afforded relative economies both in capital and operating costs. Had each of the terminals incorporated its own plant, there would have been extensive duplication of capital equipment and operating personnel. In addition, the central plant, with space feeder lines, afforded a flexibility and assurance of service that could not have been practically afforded by separate centers.

The district plant concept is now branching out to other areas. The National Aeronautics and Space Administration's Manned Spacecraft Center, now under construction near Houston, will be served by a district plant with an ultimate cooling capacity of 12,000 tons, and a heating capacity of 180,000 pounds of steam. Chilled and hot water will be supplied through 30-in. lines, insulated with aluminum jackets, in a walk-through tunnel about 9000 ft long **(1)**.

The Hartford (Conn.) Gas Company is now operating the world's first utility-owned district chilled-water plant, supplying both steam and chilled water to a number of downtown Hartford buildings as well as to Constitution Plaza, an urban redevelopment project **(2A)**. The plant now has 11,000 tons of cooling capacity **(2B)**, and expects to add another 4500 tons in one machine within a few years. Customers are billed on the flow rate and temperature difference between incoming and outgoing water.

Uni Plant Corporation, a subsidiary of Pacific Lighting Corporation, recently began operating a 2417-ton district plant for the exclusive use of the Douglas Space Systems Center at Huntington Beach, California **(3)**. This plant will ultimately reach 7500 tons capacity, and is the first to be owned and operated by a public utility for a single customer. Pacific Lighting has another subsidiary, Central

Plants, Incorporated, which will build similar installations to serve a number of customers in one general area.

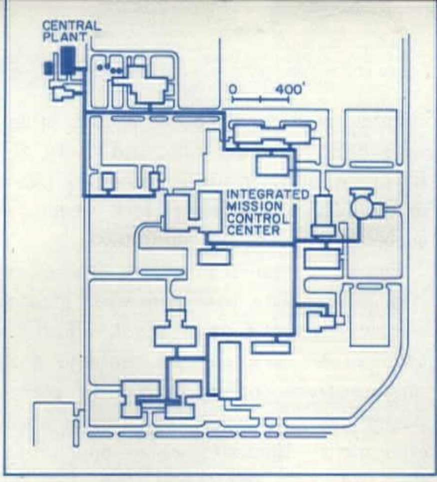
The latest market for district heating and cooling is the residential field. River Park Cooperative Homes, a development combining a high-rise apartment with 134 townhouses in Washington, D.C., was the first to use this approach (4). Hot and chilled water from a single plant under the high-rise building is piped to fan-coil units in each home. Capitol Park, a similar development in Washington, has taken a different approach, using a single 640-ton refrigeration machine for its 317 townhouses. Chilled water is piped to coils in gas-fired furnaces located in each home.

Charles Goodman, architect for River Park, discovered that the district plant provided greater freedom of design by eliminating chimneys and the individual condensing units of conventional heating and cooling systems. It permitted the use of an unusual barrel-vaulted roof without complications.

Charles DuBose, architect for Hartford's Constitution Plaza, said that the removal of boilers, stacks, and rotating machinery from the building lowers first costs, gains space, provides flexibility in planning, and permits larger fuel storage to take advantage of seasonal costs and guard against interruptions in fuel supply. Removing the cooling tower from the roof does away with the weight problem. With the district plant approach, housekeeping is simplified, controls can be more refined, and one can justify a more highly skilled operating staff.

Trained operating personnel are required for large boilers and some types of refrigeration machines. This is often governed by state law or local ordinances. With a district plant, less personnel is needed and labor costs are lower. However, care must be taken to hire capable operating personnel for the buildings being served, since inefficient operation of the air-handling equipment (and even such a simple thing as open windows) can waste capacity.

The placing of mechanical equipment in penthouses often requires heavier structural support. Putting this equipment in basements often requires additional excavation and high headroom areas. Space saved by eliminating me-



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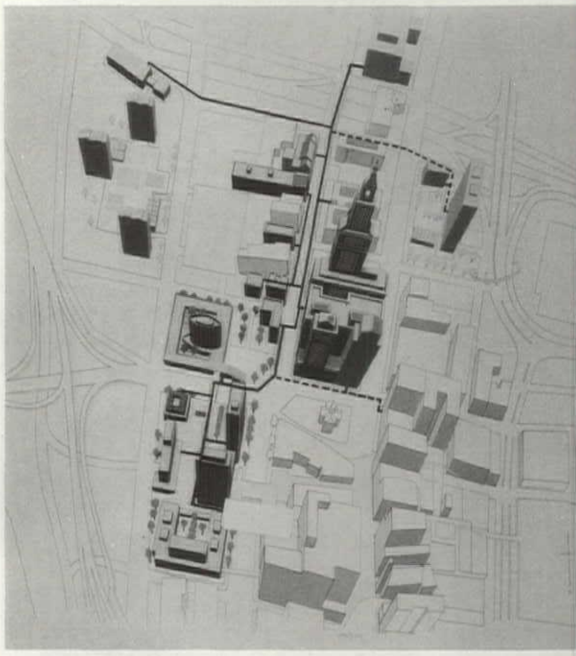
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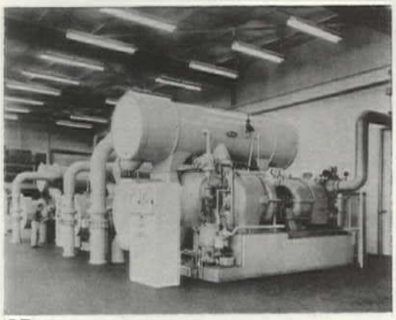
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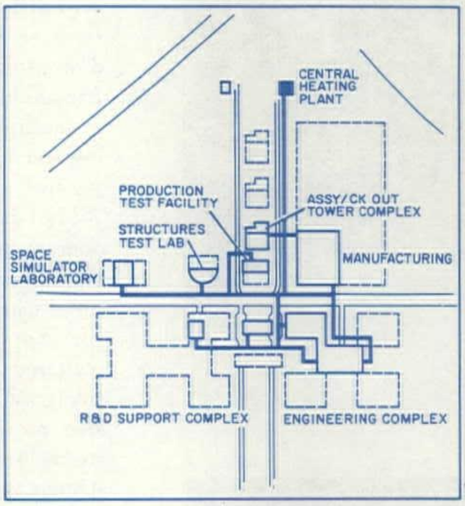

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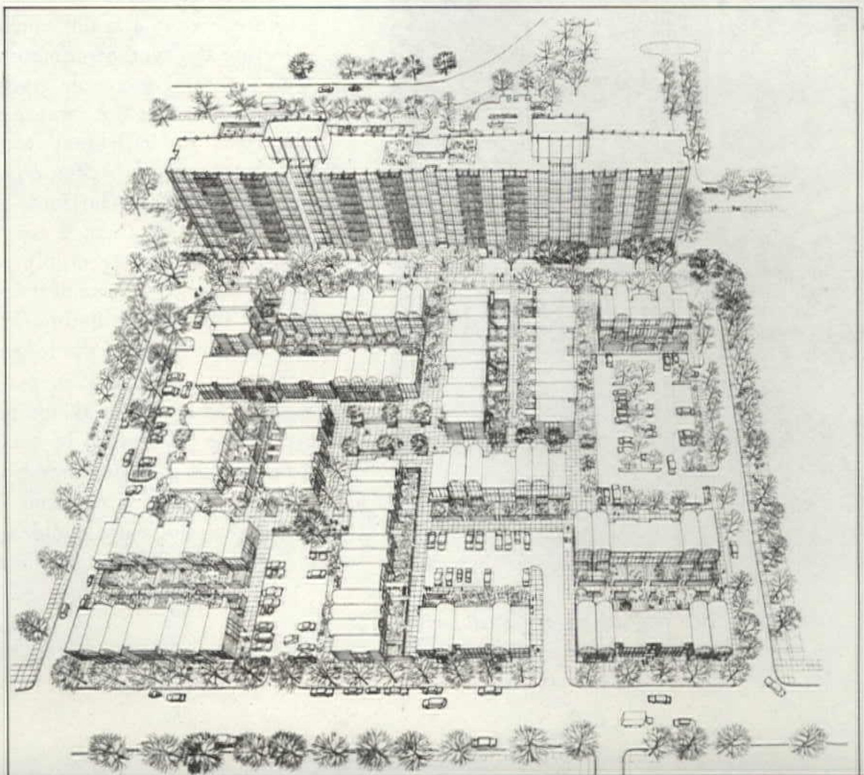

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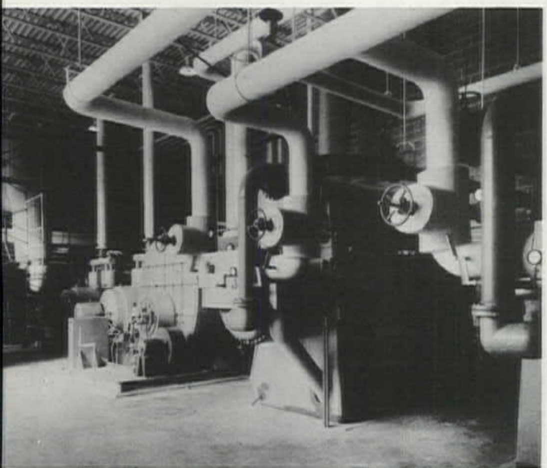

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chanical equipment can be rented, otherwise used, or not built. And there are fewer problems in air conditioning existing buildings, which may lack structural strength or room for equipment.

Smoke abatement programs can be carried out at less cost and with greater efficiency in a district plant. There is usually less soot and no problem with misting from cooling towers to bother passers-by. Removal of refrigeration equipment eliminates noise and vibration sources, and saves the cost of special sound-absorbing or attenuating techniques.

Centralized operation and maintenance require less time from responsible executives who may have other duties. Responsibility for cooling-tower water treatment and periodic cleaning of heat exchangers in boilers and refrigeration machines is centralized under one authority. Also, emergency breakdown service is usually more swift and expert.

Stand-by heating and cooling are provided at greatly reduced cost. Good engineering practice demands that boilers be provided in any building on a stand-by basis so that if the largest unit breaks down, full service can be maintained. Refrigeration machines are usually installed in multiples rather than with nonoperating stand-by equipment. It is far less expensive for a district plant to do this.

Most importantly, a district plant can operate more efficiently at partial loads, which occur most of the time. One of three machines in a central plant might run at optimum output, instead of several scattered machines operating less efficiently at partial capacity. A large plant also provides for more efficient use of steam. Already available for heating, this steam can be used to drive refrigeration machines in a number of ways. These will be discussed later.

Since cost is a major consideration in selecting the type of climate control system, a careful economic study should be made comparing the owning and operating costs of individual versus district systems. Costs of distribution are primary. For example, in Hartford, a minimum load density of about 2 tons per linear foot of chilled-water supply pipe was required to justify a remotely located plant and the cost of distributing services under city streets. Costs of the four-pipe system were about \$200 to \$250 per linear foot (compared for an 11,000-ton plant). However, these costs could be slashed in half for a college campus where trenching and piping is less of a problem.

Pumping horsepower adds to both owning and operating costs, and increases with distance. Heat loss and gain through pipelines must be considered, plus the costs of insulation and the type of burial —whether trench or tunnel.

There are several considerations in locating a district plant, once feasibility has been established. Pipeline routes must be carefully selected to avoid rock substrata or streets heavily undercut with utility lines. Rivers and streams to carry away heat of refrigeration may cut costs drastically by eliminating cooling towers. The cost of pumping water from a distance can be balanced against cooling tower owning and operating costs.

Future expansion must be considered in laying out a district plant. The plant itself may be flexible in that additional machines can be installed, but the distribution system is not. Pipe size must be determined by the ultimate size of the project to be served, in order to avoid the installation of additional main lines. Over-sizing the mains may be costly, and insulation requirements are increased because of the slower water velocity.

The distribution system must provide heating and cooling simultaneously all year, using steam or hot water in summer for the reheat necessary to good air-conditioning systems. The two-pipe system can be used in place of the conventional four-pipe approach, however, in those cases where an existing individual heating system is available.

Heat Pumps

Outdoor air, water, and even the earth have been the traditional sources of heat for this type of system, but only recently have engineers turned to a reliable and inexpensive heat source—the building itself.

Most modern buildings require some cooling all year, and generate enough internal heat from high-intensity lighting and heat-producing business machinery to provide all or nearly all of the heat needed to maintain normal winter temperatures. It is rarely economical to operate a boiler to heat one portion of a building while a refrigeration machine is supplying cooling to another. But the problem would be solved if this internal heat were available when and where it is needed.

Through the heat pump, or heat recovery cycle, the heat given off by lights, machines, and people is absorbed by heat-transfer equipment and is then "pumped" to other heat-transfer equipment to offset transmission losses, raise the temperature of incoming air, and heat water for humidification.

The system uses centrifugal refrigeration and standard air-handling equipment. Of course, the boilers and stacks of the conventional heating-cooling system are eliminated.

The first system of this type was installed in 1958 in a six-story addition to the home office of the Oklahoma Gas & Electric Company, Oklahoma City. A 220-ton centrifugal is the heart of the system, which has adequately heated the building through winters as low as −7 F. Neil Hill, partner in the architectural and engineering firm of Sorey, Hill & Sorey, designed the system on the premise that the interior zone would generally have only heat gain, being protected by a well-controlled perimeter zone.

To provide for periods when the building is shut down and heat sources are not available, the system circulates hot water in the perimeter zone only, creating a buffer zone to reduce heat loss from the interior. This enables the building to be held at 60 F to decrease transmission losses. Excess heat from the preceding day is stored in water tanks, with electric heating elements providing supplementary heat in extreme weather.

Water storage is also used at the Allen-Bradley Company plant in Milwaukee. This 1400-ton system, recently placed in operation, provides all the heating and cooling for the company's eight-story headquarters and research building. The system, designed by consulting engineer George H. Volk, includes two 75,000 gal tanks for storage of warm water to provide storage capacity for about 70,000,000 Btu. Excess heat is used to temper domestic water, melt snow on sidewalks and ramps, and raise the temperature of outside air. During summer cooling, or when all heating requirements are satisfied, the excess heat is discharged into the atmosphere through cooling towers.

Heat for this system is picked up from toilet exhausts, electrical equipment rooms, elevator penthouses, air-conditioning equipment rooms, but mainly from interior zone lighting. The average lighting is 3.6 w per sq ft, and the entire cooling capacity is 16,700,000 Btuh.

The General Post Office in Houston does not need to store water because it is a 24-hr operation (5). The mechanized facility requires cooling all year to remove heat from machinery-filled work areas, and uses this heat in winter for the adjacent, glass-wrapped office tower. In summer, three centrifugal machines supply 1500 tons of cooling capacity. Only two of these machines are used on the heating cycle, and one of these is a stand-by unit.

The Houston system, designed by consulting engineer Dale S. Cooper, does not take occupancy or office lighting into account as a heat source. This is used as a safety factor. Under extreme winter conditions, city water is tapped for its heat and released. Cooper estimated that this supplemental heat will be needed for an average of 32 hours per year, so that the cost is negligible.

In first cost alone, this system saved $70,000 over conventional heating and cooling equipment.

Many buildings, regardless of local climate, can use this system to advantage. To qualify, a building should have some of the following characteristics: large mass, small amounts of glass on exposed walls, high-intensity lighting, large interior space with no exterior exposure, interior heat sources such as machinery and kitchens, reasonable roof and wall insulation to reduce heat transfer, high occupancy loads, or enclosed first floor spaces (such as buildings with stores on the ground level).

A careful study of outside air requirements should be made to obtain maximum benefits without wasting heating or cooling capacity. Uncontrolled ventilation is a major contributor to system inefficiency. Waste heat sources should be carefully investigated for type, size, and economics of utilization.

Refrigeration Drives

Three of the four basic types of refrigeration machines are limited to one type of drive. Reciprocating and hermetic centrifugal machines are powered by electricity. Absorption machines operate on heat from steam or high-temperature hot water. Only the open centrifugal offers a choice of drives, and this choice widens with each new development.

Drives for open machines, in their approximate order of use, are: (1) electric motors; (2) steam turbines where a boiler or district steam is available and for industrial applications where exhaust steam can be used in process requirements; (3) gas engines; (4) diesel engines; and (5) gas turbines.

The latest development is the combination system, usually teaming centrifiguals with absorption, to produce a lower steam rate or operating cost than if operated independently.

Such a system is in use at International Harvester's new technical center at Hinsdale, Illinois. Having a total capacity of 2100 tons, it consists of two interconnected combinations of absorption and centrifugal units. High-pressure steam is supplied to the turbine-driven centrifugal. Instead of using a relatively expensive condensing turbine and steam condenser, a less costly noncondensing turbine is used. Exhausted low-pressure steam energizes the absorption machine, which serves as both a steam condenser and water chiller.

Selection of the turbine is important in a combination system, for its steam rate determines the refrigeration split between the centrifugal and absorption machines.

A variation of this system can be found at the Park Plaza Shopping Center in Little Rock, Arkansas (6). Gas turbines are used to generate electricity, and these gases are directed through a heat recovery boiler to produce steam for heating, cooking, and domestic hot water. This steam is also used to power two 252-ton absorption machines for cooling. When fully loaded, the over-all thermal efficiency of the turbine-driven generator and heat recovery system reaches 61.75 per cent.

Ten minutes away is University Shopping Center, which uses an "ebullition" cooling system. A 250-ton centrifugal is powered by a natural-gas engine. Heat is recovered from the water jackets and exhausts of this and two other engines, and is used to provide steam for heating water to heat the center or to supply steam for the 200-ton absorption machine. The absorption unit supplies the base cooling requirements, and the centrifugal handles the overload.

At the research laboratories of Parke, Davis & Company, Ann Arbor, Michigan, a walk-through tunnel carries chilled water and steam from a district plant which serves three buildings (7).

One or another of the foregoing developments in refrigerating plants may save building or project planners substantial money and building space. The money savings can come through transferring a portion of the capital investment to another organization, as in the utility approach, or through lower owning and operating costs. They offer architects a wider choice of alternatives affecting building design itself.

The variety available, and a host of related factors, point to a broad engineering analysis to determine accurately which type of system or combination of machines will be most suitable. The systems described are large, complex, and relatively new. Therefore, they also call for extra-careful specifying and selection of contractors and manufacturers to assure proper matching of components, clear responsibility for satisfactory operation of these components, and availability of skilled service where and when needed.

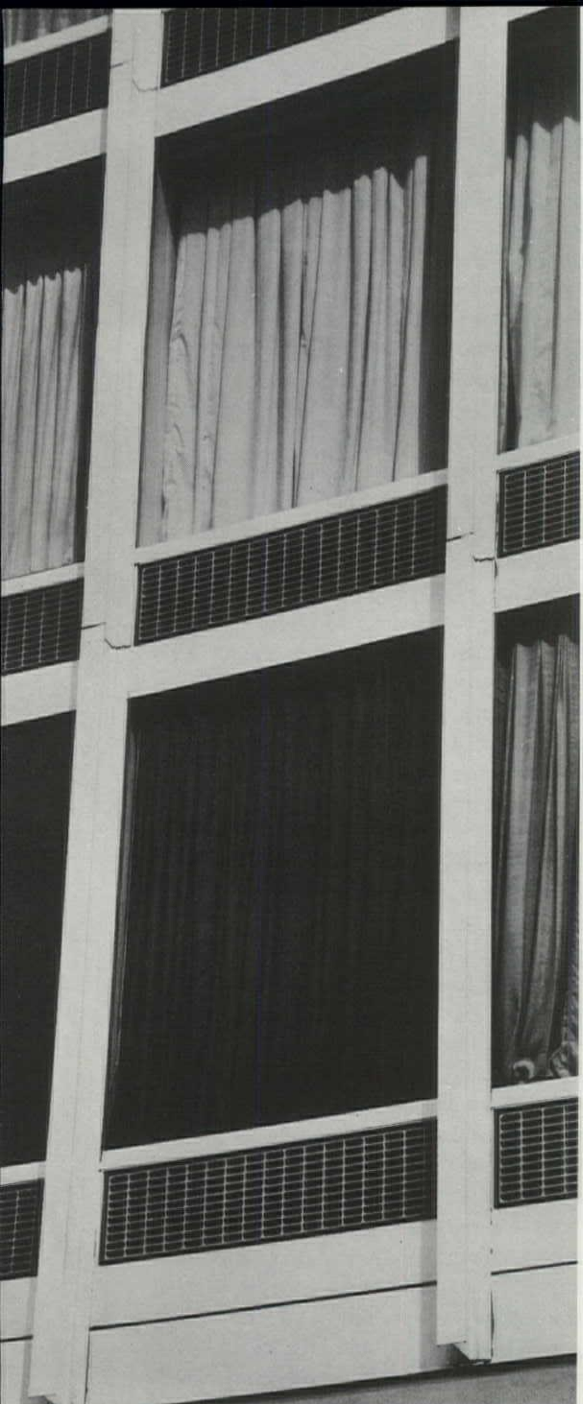


PHOTO: COURTESY AMANA REFRIGERATION, INC.

Through-Wall Performance

BY GABRIEL F. MOE, JR.

Improved performance has been an important factor in the acceptance of through-the-wall air conditioners in many of today's apartment and commercial buildings. Principal arguments for the installation of units of this kind are reported here. The author is Chairman, Technical Subcommittee of the Room Air Conditioner Certification Committee, National Electrical Manufacturers Association; and Chief Engineer, Air Conditioning Engineering, Consumer Products Division, Philco Corporation.

Ten years ago, the increasing installation of "individual packaged" air conditioners in apartment and commercial buildings resulted in scores of letters being received from architects, engineers, and leaders in the building-management field, all asking for more information about individual units as compared with central systems. In a report prepared to answer the inquiries, one manufacturer commented: "What is taking place now in the apartment air-conditioning field is the same kind of situation that took place years ago in regard to household refrigerators in apartment houses. Once central refrigerating systems for apartment buildings were the rule rather than the exception. But owners now realize the many advantages of an individual refrigerator in each apartment. . . . And the same trend is taking place in regard to air conditioning for buildings of varying types and sizes."

This comment on the "trend" to room air conditioning was prepared in 1954—not a long time ago. Yet in terms of the development of through-the-wall conditioners, particularly during the past few years, 1954 was back in the industry's "Model T" era.

Although through-the-wall models did not come on the market in volume until 1958, annual sales since that time have shown sharp increases. According to figures reported to the National Electrical Manufacturers Association, through-the-wall units in 1960 accounted for approximately 7½ per cent of total room air-conditioner sales. In 1962, through-the-wall unit sales rose to 15 per cent of total volume.

Early Models

Room air conditioners installed a decade ago were generally described as 'window" or "console" models. The window units were the predecessors of current window models. The consoles were neither window nor through-the-wall units. They were "floor" models, which were backed up against a window so that a part of the assembly could extend onto the sill.

The early models and the modern through-the-wall conditioners have many advantages in common; however, there are notable differences in design, performance, styling, and method of installation.

In general, the older models were larger. Both window and console units had to be installed in, or in front of, a window, and the consoles were floor-mounted. The modern through-the-wall equipment, of course, can be placed in the exterior wall and effectively detailed into the fenestrations and structural module.

Contemporary Characteristics

As a result of engineering advances—higher velocity air delivery and new compressors, for example—the modern units are more compact. Usually installed flush with the exterior of the building, their projection is a function of the wall thickness (see "Voltages and Dimensions," below).

Cooling capacities of the early models were expressed in horsepower. This was not a precise measurement, since it referred only to the motor which operated the compressor. Today, cooling capacities of room air conditioners are more accurately stated in Btu's per hour.

As a result of extensive research in the laboratories of all major manufacturers during the past few years, there has been a significant reduction in noise levels. This has been accomplished by changes in the shape of fan blades, refinements in design of fan housings, more insulation around the case, and improved operating efficiencies of the refrigerating system.

Another significant difference is that a decade ago, room air conditioning was limited, in most cases, to existing structures, while today it is often specified for new construction. This indicates that the choice of equipment is no longer based solely on ease of installation. Through-the-wall conditioners are now judged on over-all performance, with economy and adaptability being decisive factors in their selection.

Equipment and Operational Savings

Since a room air-conditioning system has no central cooling plant, it eliminates water towers and air-distribution ducts for the perimeter zones. In a multistory building, this can amount to an enviable conservation of space that would otherwise be required for equipment and ducts. Usually, there is likewise a saving in the initial cost of through-the-wall units, when compared with a central plant. Operating expenses will depend upon the specific installation, but it should be noted that room air conditioning can be operated with special economies. There is a minimum of waste, or "over-cooling," since each tenant will set the room or zone thermostat to individual requirements and will not call for more than that amount. In many cases, particularly in apartment buildings, tenants are separately metered, and therefore pay for their own air-conditioning power cost.

Other reductions in equipment and operating costs are made possible by individual room control of the units. In any multi-unit installation, there will always be a need for varied capacities because of differences in the size of rooms, sun exposures, and heat loads. Room units are available in many cooling capacities, and consequently each one can be specified to meet the needs of the particular room without being oversized or undersized. In addition, models provide individual thermostatic control, some means of ventilation, air deflectors to direct the currents of cool air, and a degree of air filtration.

Maintenance and Installation

Amount of maintenance required and ease of making repairs are items of particular interest to the building agent and owner. Room air conditioners, which have a hermetically sealed refrigeration system, are designed for many years of service-free operation. Seasonal inspections, including cleaning or replacement of filters, can be done quickly.

In many instances, it is possible to service a unit on the spot without disrupting the activities of the area or room. If major repairs are necessary, the unit can be removed and temporarily replaced by a "spare."

Some through-the-wall units are installed "as is," with the original case fitted and secured in an opening in the wall. Others have a matching sleeve which is first installed in the wall, and the conditioner is then guided into place. The sleeve assembly is particularly adaptable to buildings designed for air conditioning at some future time, or at the option of the tenant. The sleeve is purchased separately and installed during construction. Closure panels are fitted over both exterior and interior openings of the sleeve. When air conditioning is requested by the tenant, the panels are removed and the air conditioner installed.

There are no particular mechanical problems or difficulties in the actual installation of a through-the-wall unit in any type of exterior wall. Directions for installing the air conditioner, or its sleeve, are provided by the manufacturer. These include recommendations for sealants, calking, or flashing that may be necessary to make the installation weatherproof. Installation details are shown in accompanying illustrations. Any of the many manufacturers of through-the-wall room air conditioners provide technical assistance on specifications and installations.

Adaptability of room air conditioning is especially apparent when through-the-wall units are specified for a building designed for electric heating. This gives the tenant year-round room or zone temperature control. No duct work is required for either heating or cooling, and little space is taken up by equipment.

Voltages and Over-All Dimensions

Through-the-wall room air conditioners operate on 115-, 230-, or 208-volt alternating current. Amperage may range from 6 to 12 or more. Cooling capacities range from approximately 6000 to 30,000 Btu/hr.

Dimensional range of through-the-wall units normally is: height, 15 to 20 in.; width, 24 to 27 in.; depth, 15 to 20 in., with considerable variation. Large capacity units can be expected to exceed this average size range. The units can be installed in any type of wall construction —frame, masonry, brick, cement block, etc. Exterior grilles are provided in rustproof designs. Exterior grilles or panels to meet the architect's specifications may be available on special order.

Possible Locations

Inside the room, the unit can be located where it will be most convenient: under a window, alongside it, or high in the wall. Room-side styling is generally in a neutral vein and will vary according to the manufacturer; however, the front can usually be refinished to suit the décor of the room.

In placing through-the-wall conditioners, the architect must consider the necessity of exhausting heat to the outside. A unit installed in an exterior wall transmits heat directly into the atmosphere. Water vapor picked up from the room by the unit's coil is also exhausted to the outside air. The unit may be placed in an interior wall, if heat and water vapor can be transmitted into a shaftway or other area that gives access to the outside air.

One question arises: How are corridors and elevator lobbies of apartment buildings cooled, if it is impossible to locate conditioners directly in these spaces? The solution to this situation depends on the design of the building. The problem is partially solved on the basis of "perimeter cooling." Since the units located in the exterior walls are nearest the major source of heat, some of the conditioned air circulating through the rooms is diffused into the corridors. Corridors and lobbies will not be as cool as the air-conditioned spaces in the building, but they will probably be cooler than the outside temperature. This, in itself, is of some benefit, since it provides a gradual change from the extreme heat outdoors to the cooled rooms of the conditioned building.

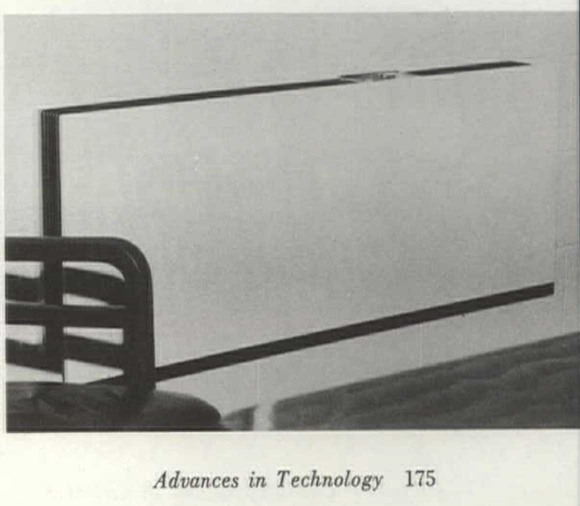
Capacities

Calculation of heat loads in the various rooms or zones, so that cooling capacities of the conditioners can be specified, depends upon many variables. These include an area's size and exposure, its relationship to other conditioned areas, insulation, the number of persons who will regularly use the area, and the wattage of lights and other electrical equipment. Once the required cooling capacity of each unit is determined, it is essential to have assurances that the conditioner will deliver at its rated capacity. The capacities of some models may be guaranteed by their manufacturers; others are certified to be accurate under a program sponsored by NEMA. This association also provides a free cooling-load estimate form for calculating the amount of cooling capacity in Btu/hr required for a given area.

Companies that market more than 92 per cent of all room air conditioners sold in the United States participate in the NEMA certification program, which is open to both members and nonmembers of the association. Now in its second year, the program provides for verification of cooling capacity, amps, and watts ratings by an independent testing agency. The ratings are not only certified by NEMA, but also a special seal is permanently attached to each qualifying unit.

Certified models are listed in two directories published by NEMA: a general directory, and a builders' directory that has been edited especially for architects, contractors, builders, and consulting engineers. The builders' directory contains listings principally of through-the-wall models, and gives their certified cooling capacity, amps, and watts ratings. (It is available, free of charge, from John Page, Executive Secretary, Room Air Conditioner Certification Program, National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N. Y.)

PHOTO: COURTESY GENERAL ELECTRIC CO.



Gas-Powered Equipment

BY RALBERN H. MURRAY
AND CHARLES D. BROWER

The many types of air-conditioning equipment using natural gas as the primary source of energy—by direct and indirect applications—are reviewed by two members of the American Gas Association. Their respective positions are: Manager, Industrial and Commercial Section; Manager, Industrial and Commercial Features.

In 1962, more than 169,000 tons of gas-powered air conditioning were installed in the U.S., and continuing increases are predicted. In most areas, energy costs for natural gas are such that it can and does compete vigorously with other forms of energy. There is a wide variety of types of gas-powered air-conditioning equipment, ranging from gas engine-driven reciprocating and centrifugal compressors to steam and gas turbine-driven centrifugal compressors, including systems employing various refrigeration and dehumidifying cycles.

Air-conditioning equipment using natural gas as the primary source of energy can be divided into two categories. In the first, gas is burned directly in the equipment and the energy released operates the unit; examples are direct-fired absorption and gas-engine or gas-turbine-driven units. In the second, or indirect application, gas is used in boilers to generate steam or hot water, which in turn operates the air-conditioning equipment.

Types of Gas-Powered Systems

The principal refrigeration cycles applied by manufacturers in their gas-powered air-conditioning units are:

Absorption Cycle

1. Direct-fired
2. Steam-operated
3. Hot liquid-operated

Compression Cycle

1. Gas engine-driven reciprocating compression systems
2. Gas engine-driven centrifugal compression systems
3. Gas engine heat pump systems
4. Steam turbine-driven centrifugal compression systems
5. Gas turbine-driven centrifugal compression systems

Combinations of these cycles are also possible, such as the steam turbine-driven centrifugal compression and the steam-operated absorption combination systems.

Gas-powered systems are currently available in capacity ranges from 3 to 3000 tons. Absorption systems can be obtained in sizes from 3 to 1000 tons; natural-gas engine-driven reciprocating systems, from 3 to 375 tons; steam turbine-driven centrifugal compressors, from 200 to 3000 tons and up; and gas engine-driven centrifugal compressors, from 90 to 1000 tons. Gas turbine-driven centrifugal compressors are available from 200 to 3000 tons and up.

Characteristics and Applications. In general, the gas air-conditioning systems listed are applied with standard application engineering methods. The major variations in engineering approach, as compared with electrically-operated equipment, are details involving service connections and foundation requirements. Dehumidification units are usually used in combination with all types of refrigeration equipment, the latter a necessity for sensible cooling.

Absorption System

Although the absorption system is not new, its tremendous acceptance in recent years has led to more manufacturers to enter the field with a great range of equipment sizes.

In the absorption system, an absorbent, usually lithium bromide, absorbs vapors given off by water. The continual evaporation of the water, which acts as the refrigerant, provides the cooling. Heat from steam or hot water or from a gas flame in the direct-fired absorption unit is used to regenerate the absorbent by boiling off the excess water vapor.

Direct-fired absorption units are available in capacities up to 25 tons. Direct-fired units up to 25 tons are designed to provide both heating and cooling. Steam or hot-water units are manufactured in capacities ranging from 25 to 1000 tons. Steam pressures of 10 to 12 lbs may be used. Super-heated hot water at temperatures ranging from 240 F to 380 F may also be used to operate absorption machines.

The principal features of large absorption units are:

1. No major moving parts, thus minimizing noise and maintenance costs and assuring long life expectancy. The only moving parts in the absorption system are the solution pumps in larger units. Vibration is also eliminated, permitting installation on any floor without added investment in foundations.
2. Safety with the use of water as the refrigerant, a nontoxic salt solution as the absorbent, and the operation of the system at subatmospheric pressures.
3. Fear of overloading is eliminated, since any overload can be presented to the machine without fear of damage.
4. Operating flexibility is at a maximum, since the absorption machine will modulate from zero to full load.
5. Less floor area is required than in other machines of similar capacity, thus reducing investment charged to air conditioning.

Wiring and electric-service requirements for the absorption unit are small.

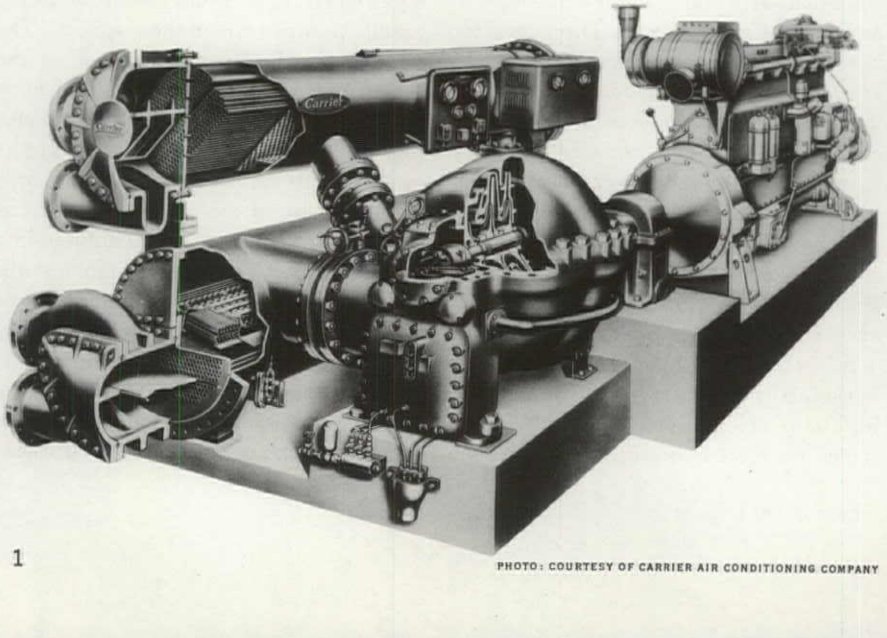


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PHOTO: COURTESY OF CARRIER AIR CONDITIONING COMPANY

For example, the maximum horsepower requirement for solution pumps on a 700-ton absorption unit is 14½ horsepower.

The initial cost of large-tonnage absorption equipment is comparable to the initial cost of large centrifugal-compression equipment, when the two types are considered on an installed basis. Operating costs of the absorption system will vary according to fuel rates in various locations throughout the country.

Absorptions systems are particularly suitable whenever: (1) low-pressure steam is economically available; (2) high-temperature hot water is used for heating; (3) widely fluctuating loads are encountered, such as intermittent process cooling in bottling plants as well as certain industrial and comfort air-conditioning applications; (4) local codes require licensed operators for other types of systems; and (5) long runs of wiring would be required for electrically-driven equipment for rooftop installations and where steam is available.

Natural Gas Engine-Driven Reciprocating Compressors

Natural-gas engine refrigeration machines consist of a heavy duty industrial-type gas engine coupled to a compressor. The major characteristics of these units include low operating cost and a high degree of flexibility in some models by combining speed variation with cylinder unloading.

Natural-gas engine-driven reciprocating compressor units, condensing units, and complete water-chiller packages are available as factory assembled and tested systems in sizes from 3 to 375 tons. They can be used with remote direct expansion coils located in air handlers or ductwork and are adaptable to air-cooled condensing, evaporative condensing, or water-tower applications.

Advantages. Among the benefits of natural-gas engine driven machines is that of economy. They require from 8 to 13 cu ft of 1000 Btu natural gas per ton-hour; no demand charges apply on natural gas in most areas. The cooling-tower pump can be driven by the engine, reducing electrical demand and operating costs. In addition, engine-jacket water and exhaust heat can be recovered and used for domestic-water heating, to provide boiler-water preheat, or as reheat on a dehumidification cycle at no additional cost for energy.

Other advantages claimed for the gas engine are that compressors last longer when driven by variable-speed engines, since they operate for a large portion of the time at 1000 to 1200 rpm instead of cycling on and off at a fixed speed. Compressor life is further extended by the virtual elimination of refrigerant liquid floodback, which tends to dilute the compressor lubricating oil, damages plates and bearings.

Gas-engine units give close humidity control. The typical engine-compressor unit varies both speed and cylinder loading and therefore cycles on and off infrequently. This means that speed and pumping rate change rather than suction pressure when the load varies, and the cooling-coil temperature is therefore held constant. The result is close humidity control through the full operating range of the unit.

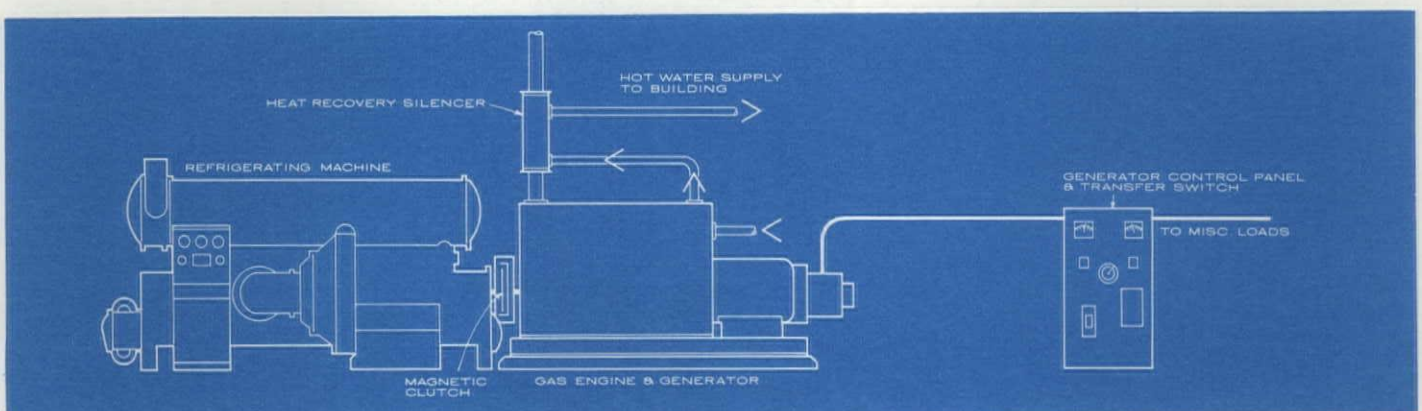
Coupling Gas Engines With Centrifugal Units

A sizable interest has developed in the use of gas engines to drive centrifugal refrigeration compressors in the 90 to 1000-ton range (1). Virtually all manufacturers of adaptable centrifugal compressors now offer their units for this type of drive.

In part, the increased use of this type of system stems from a growing awareness of the potential long-term benefits in operating economy. While the system perhaps demands a somewhat higher initial cash outlay, it can often return the differential to the owner many times over in reduced power costs throughout the useful life of the equipment. The natural-gas engine-driven centrifugal systems with engine speed controls provide extremely economical operation. Over a range of 100 per cent to 30 per cent output load, the specific fuel consumption can vary from 8000 to 9200 Btu per ton-hour. Also contributing to the growing popularity of gas-engine drive for centrifugal units is the progress made by engine manufacturers in refining their designs by employing higher speeds, high compression ratios, and super-charging. These advances now give the user maximum power output per unit of equipment weight and space. The coupling of this type of drive with the already compact centrifugal compression system results in a unit very little larger than those with more conventional drives.

By far the largest application of this type of system lies in the field of comfort air conditioning in office buildings, manufacturing plants, textile mills, and hospitals, just to mention a few. Further potential usage is found in industrial process refrigeration systems, employing either brines or chilled water.

Adding to the over-all economy of the gas engine-driven centrifugal in any installation is the value of the heat rejected through the engine exhaust gases and jacket water system. Properly reclaimed as steam or hot water, it can be used for reheat purposes in air-conditioning systems, for domestic hot-water, or for laundry heating loads. Further, the engine may



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be used as an emergency electric power source and is ideal for hospital applications because of this feature **(2)**.

Gas Engine-Driven Heat Pumps

It has been apparent for many years that if a building is going to be heated with a heat pump, there are several excellent reasons why an internal-combustion engine should be used to drive the compressor. These benefits stem from the fact that an internal-combustion engine, in addition to its power output, has a lot of surplus heat. This heat can be recovered easily by the utilization of engine jacket cooling water and the addition of a heat exchanger in the exhaust line. Added to the heat "pumped" by the compressor, this surplus heat becomes a definite plus value with more than one advantage.

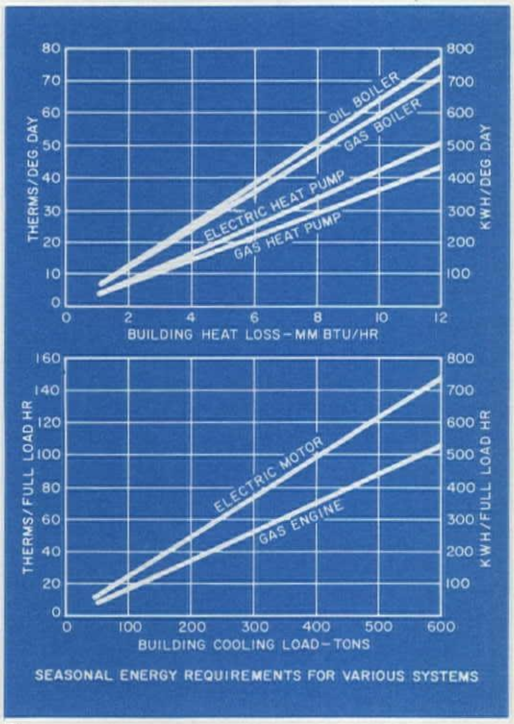
Comparative Operating Costs. Energy requirements for heating and cooling with other systems can be compared to that required by the gas heat pump **(3)**. Curves, based on data obtained by test, are arranged to permit estimation of energy requirements for any building in any locality once the building heat loss, seasonal degree days, building cooling load, and seasonal full-load cooling hours are known. The curve for oil-fired boilers is based on an assumed efficiency 5 per cent less than that of the gas boiler tested.

By applying chart **(3)** and energy costs prevailing in Washington, D.C., to a test building, comparative operating costs for a 50-ton package heat pump developed by the Worthington Corporation using a continental natural-gas engine **(4)** can be derived (*Table I*).

A larger building, one that would use several of these heat-pump packages, would fall in the range of heavy oil application and also have a gas interruption rate. Comparative costs for a 250-ton installation are shown (*Table II*).

Operating costs are not the full story, of course. Estimates of maintenance costs and fixed charges, however, indicate that the above savings in fuel costs will be more than enough to make the gas heat pump the most economical system to own and operate, particularly for the larger jobs.

As is true with boilers in medium to large commercial buildings, heat pumps should be installed in multiple or with other stand-by equipment to permit shutdown for maintenance during the heating season. In the remodeling market, where office buildings and apartments must be brought up to date by air conditioning, heating stand-by can be provided by the existing boiler. An especially attractive application can come about where the boiler is fired by fuel other than gas and the gas utility has an interruptible rate. Here the gas heat pump need carry the load only above the interrupting temperature and gains in efficiency. In some areas



SEASONAL ENERGY REQUIREMENTS FOR VARIOUS SYSTEMS

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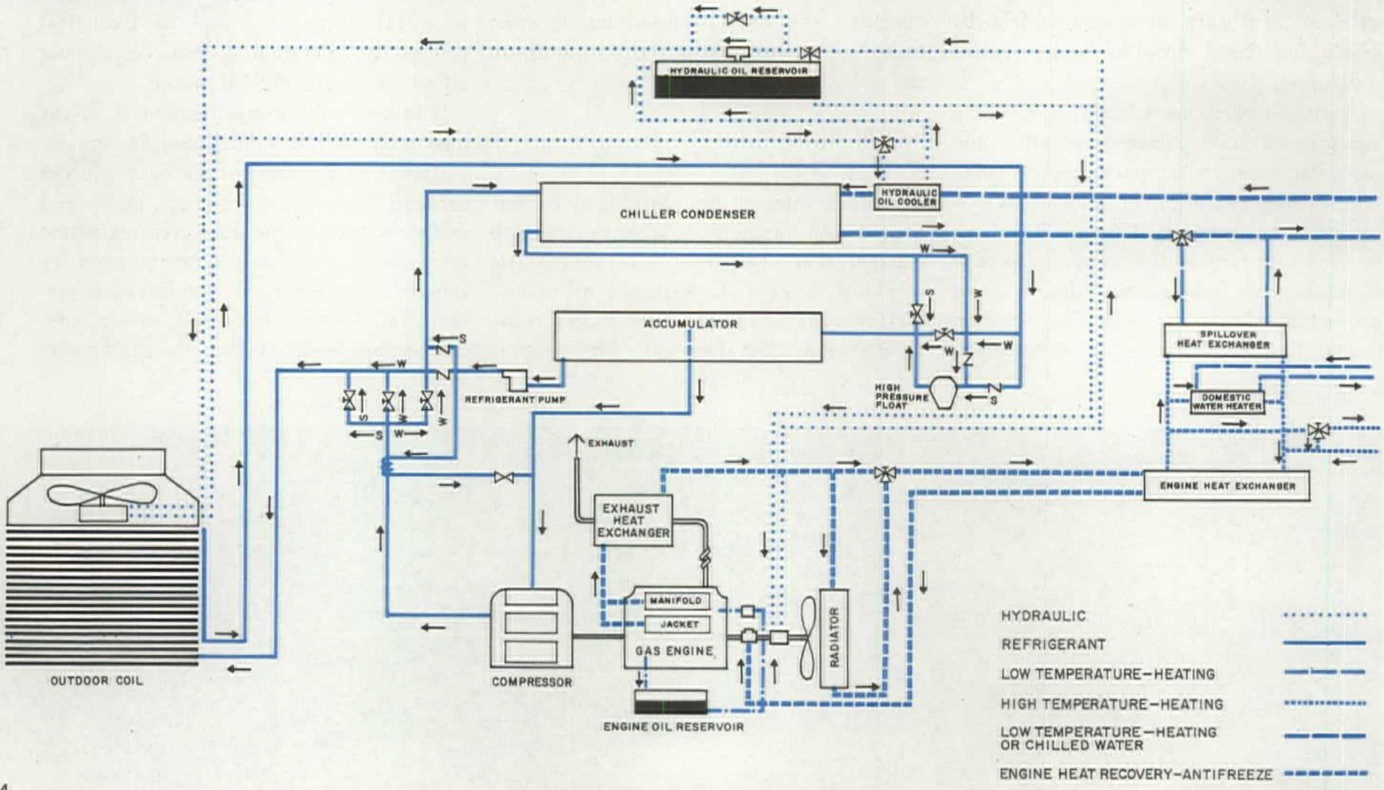

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50 TON GAS ENGINE HEAT PUMP PACKAGE

of the country, this could also mean savings in first cost, because the heat pump need not be sized to carry the load below the cut-off point.

Steam Turbine-Driven Centrifugal Compressors

Steam turbine-driven centrifugal compressor water chilling systems are particularly well adapted to large capacities. The units are usually applied in single unit installations ranging from 200 to 3000 tons.

One of the basic reasons for the particular compatibility of the centrifugal compressor and steam turbine driver is operating speed. Centrifugal compressor speeds will vary from approximately 3000 rpm in the larger size machines to about 10,000 to 12,000 rpm in smaller sizes. The steam turbine is also a high-speed machine, generally attaining better efficiencies and therefore lower steam-consumption rates as speeds increase. This makes it an ideal companion for the centrifugal compressor, the two being directly connected without any intervening speed-compensating devices. As a result, important reductions in both space requirements and noise levels are made possible. A minor advantage also lies in elimination of the approximately 2 per cent horsepower penalty found in the use of gear-speed increasers.

Steam turbines as used for driving centrifugal compressors can be grouped into three types: (a) condensing; (b) non-condensing; and (c) variable-pressure bleeder type.

Condensing Type Turbine: This is the most commonly used steam turbine and operates with steam at almost any pressure. It is relatively simple in operation and easy to lay out and install. It is readily available in a wide range of speeds and horsepowers. At about one horsepower per ton, the steam requirement would be about 15 lbs of steam per ton-hour at full load. Thus, over the above ranges of steam pressures, the steam consumption of a condensing turbine can be expected to range from as low as 12 to as high as 25 lbs of steam per ton-hour, with gas consumption at 80 per cent boiler efficiency averaging 20 cu ft per ton-hour of 1000 Btu gas.

Non-Condensing Type Turbine: This turbine acts as a reducing valve for high pressure (say, 125 psi) steam. It is a popular selection where the low-pressure exhaust steam (say, 12 psi) has other applications, such as process work or where used to operate absorption machines for additional water chilling—for example, turbine-absorption combination systems.

Variable Pressure, Bleeder-Type Turbine: This is, in effect, a combination of the previous types and is used where the steam source may be variable. Higher initial costs are normally offset by the flexibility of this turbine to fit into the varying steam supply situations which frequently exist in industry, hotels, hospitals, and other types of projects.

Centrifugal-Absorption System Combinations

Combination centrifugal-absorption systems (steam turbine topping absorption) can provide lower operating costs in many installations than can either type of machine operating alone. The realization of this potential, however, demands ingenuity on the part of the engineer in the design and control of steam and chilled-water circuits.

In these cases, the turbine fits into the heat-balance system of the industrial plant or commercial building with little cost for its motive energy.

A typical rate for a turbine topping absorption job would be 40 lbs of steam per hp-hr. If it were connected to a centrifugal compressor water-chilling system, the rate would then be 40 lbs of steam per hp-hr or per ton-hr with this first stage. The 40 lbs of steam is then discharged from the turbine to the absorption system, which, however, requires only 20 lbs of steam per ton-hour. Hence, with each 40 lbs per hour of steam used, one ton-hour is produced at the centrifugal and two ton-hours by the absorption machine, or three ton-hours total, giving an over-all rate of 13.3 lbs of steam per

TABLE I

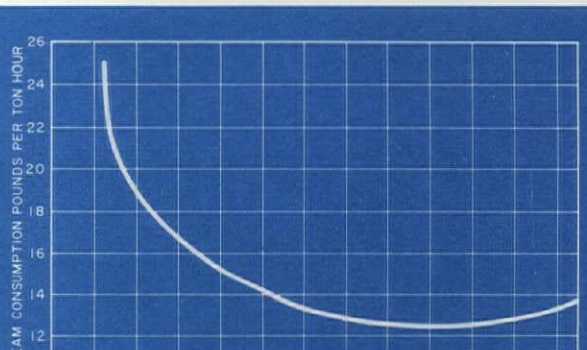
	Seasonal Heating Cost	Savings With Gas Heat Pump	
Gas Heat Pump[1]	$1,300	$ —	—
Gas-Fired Boiler[1]	2,070	770	37%
Oil-Fired Boiler[2]	2,540	1,240	49%
Electric Heat Pump[3,4]	3,470	2,170	63%

[1] Air-conditioning gas rate avg. 10.0¢/therm
[2] No. 2 oil, 15.6¢/gal
[3] Average electric rate, including demand, 2.3¢/kwh
[4] Includes $60 for service hot water by gas water heater

TABLE II

	Seasonal Heating Cost	Savings With Gas Heat Pump	
Gas Heat Pump[1]	$ 3,750	$ —	—
Gas-Fired Boiler[1]	5,810	2,060	35%
Oil-Fired Boiler[2]	5,250	1,500	29%
Electric Heat Pump[3,4]	13,820	10,000	73%

[1] Interruptible gas rate, 5.5¢/therm with heavy oil stand-by
[2] Heavy oil, 7¢/gal
[3] Average electric rate, including demand, 1.8¢/kwh
[4] Includes $300 for service hot water by gas water heater



ESTIMATED PERFORMANCE CURVE FOR A TURBINE TOPPING-ABSORPTION COMBINATION CONSISTING OF A 440 TON CENTRIFUGAL COMPRESSOR AND AN 800 TON ABSORPTION MACHINE

5

ton-hour as a typical rate.

First cost economics are also good, primarily due to the low cost of the turbine, which, operating at a low steam head or pressure difference, may be an economical single-stage machine.

Turbine topping systems are most applicable in tonnage ranging from about 600 to 1500 tons for single systems. A typical performance curve of a combination of such a system is illustrated **(5)**.

Gas Turbine-Driven Centrifugal Compressors

The gas turbine is another gas-powered prime mover that has good possibilities in the air-conditioning field for the production of chilled water over wide ranges of capacity. It has considerable flexibility in adapting to the requirements of a variety of applications.

About 16,000 Btu per hour, or 16 cu ft per hour of 1000 Btu gas, is required to generate one horsepower at the turbine drive shaft; the thermal efficiency is 2545 ÷ 16,000, or 16 per cent. This is low efficiency, considerably less than that of a gas engine which shows about half the fuel rate of the turbine.

However, no utilization has been made so far of the heat of the 850 F exhaust gas leaving the turbine. It is the use of this heat, in a waste heat boiler to generate steam for supplying further useful prime energy, that brings about a much improved over-all efficiency. For example, in a typical design application, such a boiler, in making steam, will cool the exhaust gas from 850 F down to about 350 F. This means the recovery of another 9000 Btu per hour per horsepower for useful work, at a great improvement in over-all thermal efficiency, which now becomes $(2545 + 9000) \div 16{,}000 = 72$ per cent.

The waste heat boiler can be selected for high steam pressure (125 psig) or low pressure (15 psig). It can be used, at the latter pressure, for making chilled water for air-conditioning duty in a lithium bromide absorption system.

Such a system, requiring about 20 lbs of steam per hour to develop one ton of cooling and having 9000 Btu or 9 lbs of steam, available per turbine shaft horsepower from the waste heat boiler, would therefore develop cooling at the rate of $9/20 = 0.45$ ton per shaft horsepower.

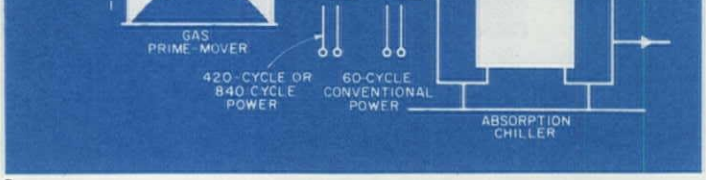
If a centrifugal compressor water-chilling system requires about one bhp per ton, the foregoing can then be summarized to an over-all heat balance concept that 16 cu ft of gas per hour burned in the gas turbine develops 1.0 ton at the compressor, and 0.45 ton at the absorption systems. The over-all fuel rate then becomes 16 cu ft per hour of gas $\div$ 1.45 tons $=$ 11 cu ft of gas per hour per ton.

In place of the absorption system, a steam turbine-driven centrifugal water-chilling system may be selected for a higher steam pressure, for example, 125 psig. The resulting steam rate, usually about 15 lbs per ton-hour, is lower than the 20 lb rate required for the absorption machine. First cost of the steam turbine centrifugal system combination will probably be higher than the absorption system cost.

Application of the gas turbine to air conditioning seems at present more feasible for larger systems. The turbine itself is relatively expensive per installed horsepower. The waste-heat boiler, absorption system, and various needed accessories and auxiliaries are sizable investments. So for justifiable initial costs, large capacities, tending to lower cost per unit of capacity, are indicated. As an example, a 1050-hp gas turbine centrifugal with waste heat boiler and 450-ton absorption systems capable of developing 1500 tons in the total application, should have possibilities of winning out in an economic feasibility study comparison with other methods.

The Total-Energy System

The most advanced development in the comfort air-conditioning field today is the "total-energy system" in which natural-gas energy is utilized to produce electrical power as well as cooling and heating requirements. The following discusses the methods whereby natural gas is employed to provide all three—using a natural-gas



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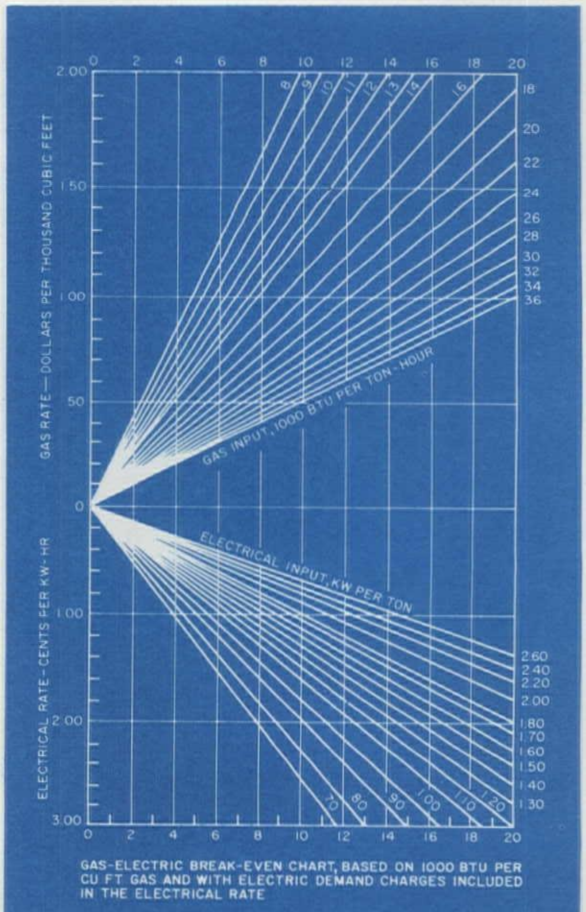


GAS-ELECTRIC BREAK-EVEN CHART, BASED ON 1000 BTU PER CU FT GAS AND WITH ELECTRIC DEMAND CHARGES INCLUDED IN THE ELECTRICAL RATE

7

fueled gas turbine or reciprocating engine as the prime mover in generating both conventional and high-frequency electrical power—and recovering exhaust heat from the prime mover to provide absorption cooling and heating. By generating power on the premises at reasonable cost and recovering enough heat for auxiliary heating or total refrigeration requirements, substantial savings in operations will result and more than pay for the additional equipment required for power generation.

All power cycles are for the conversion of fuel energy to more usable forms. The gas-turbine cycle produces both shaft power and economically recoverable heat energy. When this "total energy" conversion is considered, the gas turbine cycle with auxiliaries is the most efficient cycle commercially available today. Thermal efficiency of units so utilized may be as high as 75 per cent.

The Gas "Total-Energy Package" operates in the following way **(6)**:

A. The prime mover (1), fueled by natural gas, provides shaft power to turn the generators (2) and heat recoverable energy through its exhaust (4).

B. High-frequency power produced by the generator (2) is used for lighting; a part of this power (3) is generated as 60-cycle power for convenience outlets.

C. Exhaust heat is recovered in the exhaust heat boiler (5) to produce low-pressure steam for absorption refrigeration (7) and other uses, such as wintertime space heating, water heating, etc.

D. In the event additional steam generating capacity is required, the exhaust heat steam can be supplementally fired with natural gas (6); the exhaust heat contains 80 to 85 per cent of the oxygen normally found in the air, and no premix supplementary air is required.

E. Thermal efficiency of the "total energy package" may be as high as 75 per cent or higher for certain industrial processes where exhaust heat can be used in the process itself. This cycle is the most efficient that is commercially available today.

Economic Considerations

Operating costs of a proposed air-conditioning system can only be determined accurately when all of the variable factors which affect the operation of the system are known or can reasonably be estimated.

The basic data or assumptions usually required to estimate the owning and the operating costs of similar gas and electric systems include: (1) applicable gas and electric rates; (2) heating value of gas in Btu per cu ft; (3) energy consumption of gas equipment in Btu per ton-hour or pounds of steam per ton-hour; (4) energy consumption and demand charges of electric demand loads (demand charges are usually not present with gas rates; gas equipment may be operated in off-season without involving demand charges and allowing comfort conditions to be maintained); (6) boiler efficiency; (7) total operating hours, both full and partial loading for the application; (8) water consumption and rates; (9) man-hour and labor cost of operating conditions; (10) maintenance requirements; (11) amortization schedule; (12) taxes; (13) interest; and (14) number of machines to be specified.

In many cases, the main factor influencing an economic comparison of gas and electric units is the operating cost of the prime mover. Therefore, in order to provide a convenient method of estimating the comparative costs excluding auxiliaries of gas and electric energy, a gas vs. electric break-even chart **(7)** has been prepared. This shows what an electric rate must be to break even with a given rate for the system being compared.

Energy requirements of a variety of gas- and electric-cooling machines are compared (*Table III*).

Source Material

"Building Heating and Cooling with a Gas Engine," L. Bert Nye, Jr., A.G.A. Research & Utilization Conference, April 1963.

"Natural Gas Engine Drive for Centrifugal Compressors," J. C. Conrad, Worthington Corporation and *Heating, Piping and Air Conditioning*, December 1962.

"Gas Powered Air Conditioning Reference Section," *Air Conditioning, Heating and Ventilating*, March 1962.

TABLE III

Gas Equipment	Input, 1000 Btu per Ton-Hr
Arkla lithium bromide absorption units	23
Bryant ammonia-water absorption units	40
Large steam-turbine centrifugal units	17.5
Turbine topping-absorption combination	16.5
Small (3-15 ton) engine-driven units	18-25
Large (20 ton and up) engine units	8-13

Electrical Equipment	Input, Kw per Ton
Window-type units	2.0-2.6
Central residential systems	1.2-1.6
Commercial-type units	1.0-1.3
Large industrial units	0.8-1.0

PHOTO: BALTHAZAR

The mall at Randhurst Center, Chicago, by Victor Gruen Associates.

Shopping-Center Systems

BY HOWARD WOLFBERG

The recent advances in air-conditioning technology have been utilized in shopping centers, where many different systems are applicable. The author, head of the Mechanical Engineering Department of Victor Gruen Associates, summarizes current usage in this new building type.

Air-conditioning systems used in shopping centers vary considerably owing to different policies and objectives of landlords and developers toward financing, capital recovery, profit, leasing, and assumption of operating costs. Architectural layout also plays an important role in determining the kind of system to be used. It is not our aim to indicate which system is best for a given situation; rather, we will attempt to classify the various systems that are given serious consideration and substantial usage in shopping centers today.

Noncentral Plants

The most commonly used systems fall under the category of the "noncentral plant." By this, we mean that the prime energy sources—electricity and fuel gas—are individually supplied and metered to each tenant. Individual tenant systems which utilize fuel oil stored in underground tanks are also included in this category.

A noncentral plant can be used in virtually all types and sizes of shopping centers, ranging from a small cluster of individual buildings to a large regional center with an air-conditioned central mall.

The nature of a noncentral plant is such that, depending on conditions, the landlord may benefit in the following ways: (1) The tenant pays directly for utilities and for the operation of his air-conditioning system. (2) The tenant pays directly for a greater portion of the installation of air-conditioning in his space. (3) The tenant assumes complete responsibility for operation and maintenance of his equipment. (4) In certain locations, the landlord can purchase electrical power and/or fuel gas at bulk rates and then distribute and meter it to tenant spaces individually. Tenants then pay for the energy at prevailing rates, which are higher than bulk rates. The landlord thereby makes a profit on the energy consumed, although the tenant pays no more than normal.

The type of equipment utilized in noncentral plants generally depends on the size of tenant spaces and on the quality or price of equipment desired. The variety of equipment used includes all that is commercially available. For smaller spaces, the trend is toward direct expansion, reciprocating refrigeration compressors with air-cooled condensers, evaporative condensers or cooling towers mounted on the roof or at another exterior location. In such installations, air-handling units and cooling coils can be located within the tenant's space. Heating generally is by gas furnaces or by gas-fired steam or hot-water circulation boilers located within tenant spaces.

In larger tenant spaces and department stores, chilled-water recirculating systems are used more extensively. Electric motor-driven reciprocating compressor and centrifugal compressor units are used, as well as steam-supplied absorption units. Boilers are used for heating and for furnishing steam to absorption units. Air-handling units, pumps, boilers, and water chillers generally are located within the spaces or within enclosed penthouses, and cooling towers generally are located on the roof.

A popular trend is toward the use of roof units. These units include fans for circulating air to the spaces below, as well as the refrigeration compressors, coils, and condensers necessary for cooling. Also included in some types of roof units are gas-fired furnaces for heating. In the western and southern portions of the United States, where mild winters prevail, roof-mounted all-electric heat pumps are popular. Units of this type permit economical installations, since penthouses are not required.

Modified Noncentral Plants

Large, compact shopping centers with enclosed, air-conditioned malls are becoming increasingly popular. The use of noncentral plants in these centers can create problems. For instance, indiscriminate location of roof units and roof-mounted condensers, cooling towers, stacks and vents serving the various tenant spaces result in unsightly appearances and can make expensive roof structures necessary.

Two-level shopping centers with tenant spaces one above the other create greater problems. Roof units make it necessary for the large supply and return ducts that serve lower level tenant spaces to be routed through upper level spaces. The alternative of using a split system—in which condensers or cooling towers are located on the roof, and compressors, coils, furnaces or boilers are located on the lower level—requires the routing of power and control wiring, piping, and vents through the upper level tenant spaces. (*See drawings, page 185.*)

A central cooling water-circulation system can be used to eliminate tenant condensers or cooling towers from roofs and other exterior areas. In this case, the landlord normally furnishes the cooling water-circulation system piping to the boundaries of a tenant's leased space. The tenant extends this piping to water-cooled condensers serving refrigeration air-conditioning equipment in his space.

The landlord's cooling water-circulation system usually includes one or more strategically located cooling towers, cooling water pumps, and the piping distribution. Water is constantly circulated to the tenants' condensers, whether or not they are in operation. Condenser water regulating valves are not used, and the cooling water temperature is maintained at a fairly constant level by cycling the cooling tower fans and using cooling tower by-pass valves.

In regions subject to freezing temperatures, the cooling tower located outdoors can drain continuously into a steel tank or sump located in a heated interior area. Such an arrangement permits the cooling water systems to be started, stopped, and operated automatically with little danger of freezing.

A modified noncentral plant system may include central cooling water distribution with or without a central heating system. A central heating system eliminates the service of fuel gas or fuel oil to each tenant; furthermore, the stacks or vents and provisions for adequate combustion air for each tenant are also eliminated. The alternative, all-electric heating, is most often not practical because of operating costs.

Central heating systems in shopping centers generally are of the hot water-circulation type. The landlord provides the boiler or boilers and the primary circulating pumps, in one or more strategic locations, and installs hot water-distribution piping to within the boundaries of each leased tenant space. The tenant extends this piping to his heating coils.

Several types of hot water-circulation systems are used. In small-to-medium sized shopping centers, a multicircuit, single-pipe circulation system with secondary pumps furnished by the tenant is economical for the landlord to install and operate. In large shopping centers, two-pipe, reverse return systems with or without secondary pumping are used advantageously.

Steam distribution systems are also used. However, the installation and operating problems of sloping and dripping steam mains, and the usual requirement for a condensate pump in each tenant's space, normally make a steam system less attractive than a hot water system.

Serious consideration is being given to the use of water-source heat pumps in shopping centers. These units can be used advantageously in compact centers where refrigeration compressors for air-conditioning and air handling units are desired in each tenant's space; otherwise, a central cooling water and a central heating system are required. Packaged water-source heat pumps are available in sizes ranging from 2 tons to over 30 tons; units larger than this can be field-fabricated.

In an installation of this type, a two-pipe, uninsulated, central water circulation distribution system is provided by the landlord to within the boundaries of a tenant's leased space, and the tenant extends the piping from this point to his unit. The central distribution system includes one or more cooling towers, boilers, heat exchangers, and pumps. By operating the cooling towers and boilers in sequence, the circulating supply-water temperature is prevented from dropping below 70 F and from rising above 85 F.

During cooling operation, heat is rejected into the central water-distribution system by a tenant's unit. On the other hand, heat is extracted from the central water-distribution system by a tenant's unit during the heating operation. When some units are on cooling and others on heating, there is a transfer of heat between the units, and the cooling towers or boilers operate only to make up the difference between heat rejected and heat extracted. Such a system would be economical to the landlord both in installation cost and in operating cost.

Central Plants

Normally, a central plant is used only in large, regional shopping centers. Within this range of application, its advantages are greatest with the large, but compact centers that have enclosed air-conditioned malls.

The usual central plant provides chilled-water distribution for cooling and hot-water or steam distribution for heating to within the boundaries of a tenant's leased space. From this point, chilled-water and hot-water or steam piping is extended to coils in air-handling units located within each space. (*See drawing, page 185.*) A large air-handling unit that circulates conditioned air to several tenant spaces is seldom used, except for specific areas with relatively small tenant spaces or isolated areas where units in individual tenant spaces would be impractical.

Centrifugal compressor refrigeration machines, either electric motor or turbine driven, or steam absorption refrigeration machines normally are used to chill the water. This equipment can be located in a large machine room within the shopping center or in a separate structure nearby. Centrifugal pumps in the same area circulate chilled water to tenant spaces and condenser water to exterior cooling towers, which may or may not be in close proximity.

In shopping centers that are subject to below-freezing climatic conditions, the chilled-water plant and its distribution are shut down when the outdoor temperature is below 50 F. Tenant units then use outside air for cooling interior spaces. This method of operation is particularly appropriate to single-level shopping centers where supply air ducts and relief ducts can reach the outside directly from a tenant's space.

Two-pipe chilled-water distribution systems are used and, where practical, a reverse-return piping arrangement is preferred. Secondary pumps within tenant spaces are optional. Two-way modulating valves for control at individual coils are preferred over three-way modulating valves, since the use of two-way valves permits the chilled water-distribution system to be designed for the block cooling load of the shopping center instead of the summation of maximum cooling coil loads.

Cost of operating the central chilled-water system may be pro-rated among the tenants through rent or stand-by charges. The installation of Btu meters in tenant spaces permits each tenant to be charged on the basis of actual central-plant cooling used. However, since this arrangement is costly and at times troublesome, it has lost the popularity it may have had.

Hot-water supply temperatures generally are below 210 F. Higher temperature —medium and high-temperature, hot-water—systems usually cannot be justified, particularly for compact shopping centers. Boilers frequently are of the packaged scotch-marine type. Pumps and boiler room normally are located in the same general area as the chilled-water plant. Where practical, two-pipe, reverse-return systems are preferred. Secondary pumps within tenant spaces are optional. Two-way modulating control valves are preferred over three-way modulating control valves for the reasons discussed above. Cost of operating the hot-water distribution system may be pro-rated, or Btu meters may be used.

Central plants with hot water-distribution sometimes have relatively small, central, high-pressure steam plants. In this system, steam is generated at approximately 100 psi by boilers located in the main boiler room. The steam is distributed at suitably reduced pressures to main restaurant kitchens, alteration rooms, and hot-water generators.

A central steam-distribution system also can be used to heat the shopping center in lieu of a central hot-water distribution system as previously described. However, this presents problems of sloping and dripping steam mains and of providing condensate pumps within individual tenant spaces. These problems can become severe in compact shopping centers, where heating mains often follow tortuous paths above tenant ceilings. On the other hand, a steam-distribution system has the advantage of permitting relatively inexpensive metering. Condensate meters can be installed within tenants' spaces at a fraction of the cost of Btu meters.

Large, compact shopping centers with enclosed, air-conditioned malls and with two or even more levels of tenant spaces create special problems in the movement of air. The routing of outside supply air and relief ducts from lower-level tenant spaces to the roof causes a loss in upper-level tenant space and decreases the flexibility of renting and of changing upper-level partitions at later dates.

Where codes permit, this problem can be solved in an economical manner by supplying the mall with 100 per cent outside air which is tempered or cooled as required for human comfort. This air is then drawn into the tenant spaces through openings bordering on the mall. The tenant spaces have their own recirculating air-handling units, and the amount of air drawn from the mall is sufficient for ventilation make-up. Next, the air can be discharged into storeroom and work areas and then into a truck tunnel or garage area before being discharged to the outside. This is the system Victor Gruen Associates employed at the Southdale Shopping Center in Minneapolis (*facing page, bottom*).

Generally, in this kind of system, the recirculating air units within tenant spaces provide cooling throughout the year. In fact, many of them do not even possess heating coils. The central-plant refrigeration system operates to extract heat from interior spaces. During the winter, this heat can be rejected from the refrigeration system condensers to a hot water or brine recirculation system which tempers the 100 per cent outside air introduced into the mall and which warms the outside walls and glass of the building.

The system described above is a heat pump. Cooling towers and boilers or well water, where available, can be used to supply the difference between heat rejected and heat extracted.

Total Energy Concept

Years ago it was common practice for large, metropolitan office buildings and industrial plants to have their own local, on-site, power-generating plants. Under certain conditions, on-site power generation can be practical and can be economically justified in today's modern, compact shopping center. One of the conditions is that a central air-conditioning plant be combined with the power-generating plant and be made a part of its operation.

Surprisingly enough, this total energy concept has been carried to fulfillment in small and medium-sized shopping centers. Reasons for this are: (1) standard, packaged, natural gas engine-driven generator sets can be used. This equipment is high in efficiency, low in first cost, and easy to install. (2) The alternating current voltage produced by the generators is the utilization voltage required by the shopping center. No large transformers or transformer vaults are required for power transmission over the relatively small shopping center area. (3) A temporary disruption of power normally would not be catastrophic to the small center.

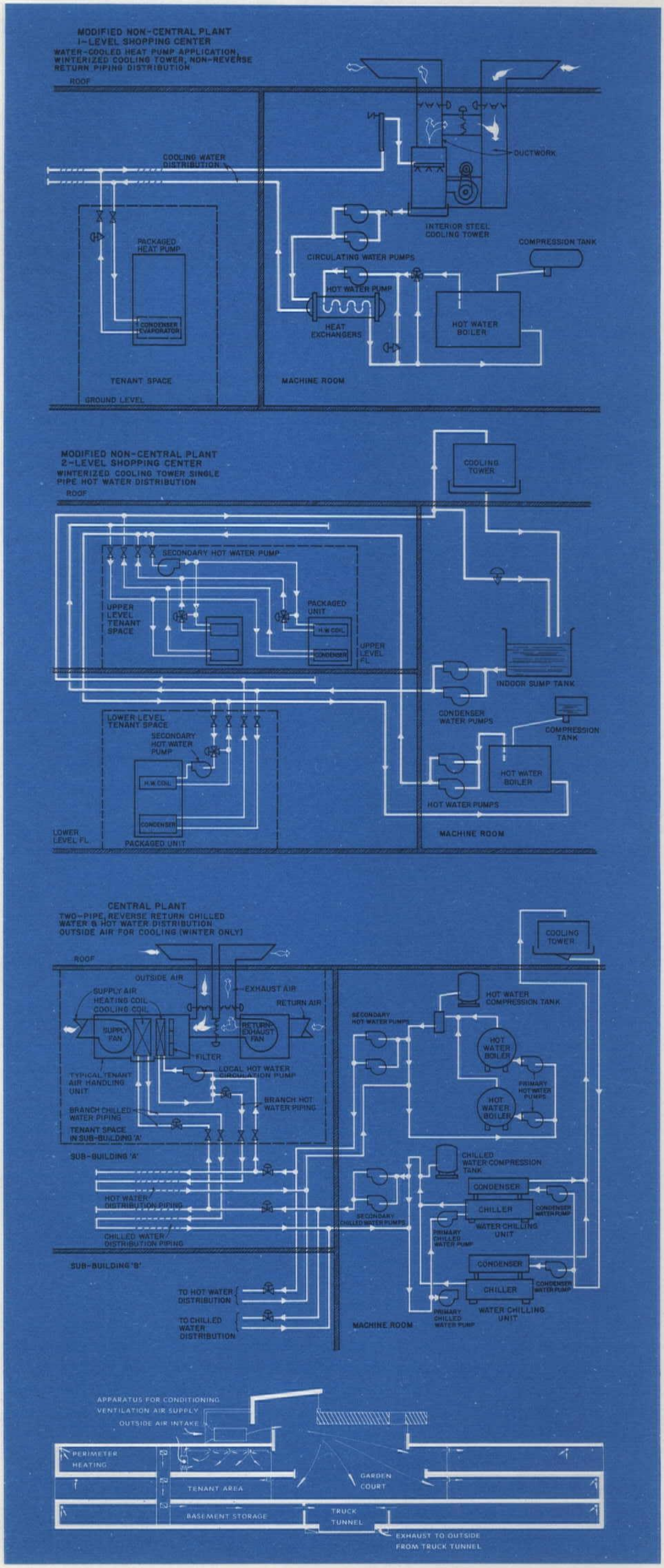
In this system, the waste heat of the gas engines is used to provide air conditioning. While the gas engines are being used to generate power, the heat that normally would be dissipated by the engine radiators is used to generate steam in the engine jackets. Additional steam is obtained from heat-exchanger mufflers, which extract heat from the engine exhaust gases. This steam is used by absorption units to provide chilled water for air cooling and hot water for heating and can even be used to heat domestic water. The cooling tower for the absorption unit can be used to dissipate any excess heat developed by the gas engines.

Generally, except for peak cooling periods and the coldest winter evenings when the shopping center is shut down, the waste heat obtained from the engines, as they produce electricity for general lighting and power, is sufficient to satisfy the total cooling and heating demands of the center. For, during operating hours, the compact shopping center usually has constant and relatively high lighting intensities, and its cooling and heating loads are not greatly susceptible to the influence of outdoor weather conditions. With this system then, not only is the energy cost of electricity at a minimum, but the energy for cooling and heating is obtained virtually free of cost.

An electric steam boiler that is powered by the gas engine generators can be used to provide additional steam at peak cooling periods and steam for heating when the shopping center is closed. The overall thermal efficiency of the electric boiler arrangement is approximately equal to that of a conventional boiler, since the waste heat of the engines is added to the heat obtained from the electric boiler. If desired, peak cooling periods can be handled by supplemental gas engine-driven refrigeration units, and off-hours heating or morning heating pick-up can be handled by a separate, conventional gas-fired boiler.

Summary

The types and variations of shopping center air-conditioning systems are numerous, as the preceding information has attempted to make clear. Many factors enter into the selection of the system to be used and its application to variations in shopping-center types.



INTEGRATION


OF COMPONENTS

Air Distribution and Interior Design

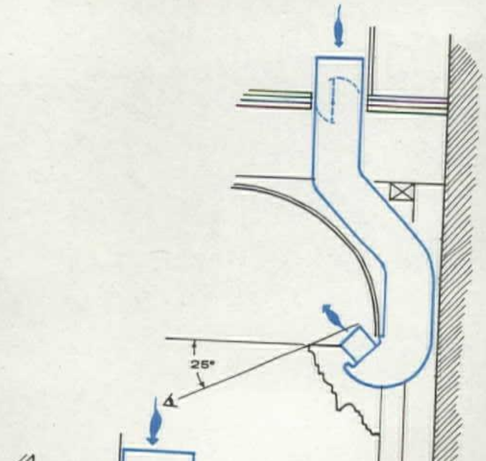
Integrating air-conditioning equipment into the visual design of interior spaces is generally approached in one of three ways: the devices are concealed; they are exposed and expressed as part of the design; or the problem is ignored altogether. This last approach—by far the most prevalent—is to be discouraged. When the problem is well handled—as the examples on the following pages illustrate—air conditioning devices do not intrude on the over-all interior design; indeed, sometimes they contribute to it. As the Knoll Planning Unit says, "We feel that a diffuser as such should not become a dominant element in an interior." Preventing this, however, is not often easy.

Probably the most difficult and expensive of the successful ways of handling diffusers, registers, and grilles, is to conceal them completely. In restoration work, such as that by Vincent Kling (*these two pages*), merely taking soundings is a problem; however, architectural elements such as moldings often prove helpful in screening equipment. Sometimes vents can be incorporated in other elements of the interior—a return in a chimney or in a blank lighting cone, for instance—though the functional honesty of this technique can be questioned. Another concealment technique is the use of a ventilating ceiling—a system in which a suspended ceiling of acoustical tiles forms a supply plenum, the vents being in an all-over pattern and therefore small enough to be virtually invisible.

Exposing mechanical equipment and expressing it as part of the interior design scheme would seem to be the most challenging approach for designers, and there are signs that the trend is again in this direction, as the Boston City Hall, Kitty Hawk Museum, and other recent work would indicate. The return to this

In redecorating the Union League Club of Philadelphia (left), *the interior design department of Vincent G. Kling, Architect, has incorporated air conditioning without impairing the Victorian splendor of the building. The handsome card room* (below), *restored with a masculine elegance that is rare in period decorating, is the appropriate color of smoke, with scarlet borders on smoke velvet carpet and draperies and scarlet-lined trophy niches. Air-conditioning is completely concealed: supply ducts were fished down through the walls, and diffusers masked by the cornice* (sections); *returns were incorporated in the unused chimneys.*

FOR PHOTO CREDITS, SEE P. 265

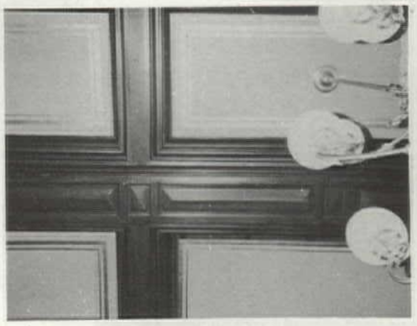


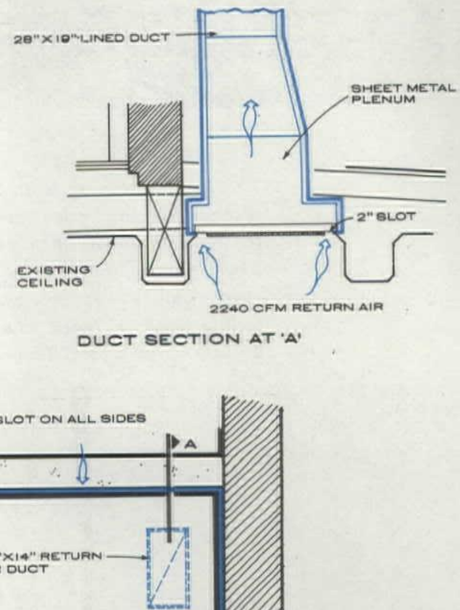
functionalist approach, which was demonstrated in the United Nations General Assembly building, is due in the main to the dissatisfaction of architects with the efficiency as well as with the idea of the suspended ceiling. A new building in Des Moines by SOM uses ducts (with integral diffusers) exposed between the precast tees of the ceiling and floor slab (*see last page, this article*). Exposing an air-conditioning system in this way can be done only, of course, in a new building in which the interior design is considered from the beginning of the project.

Between these two approaches—concealment and expression—is a middle ground where most good examples commonly fall. The stripline diffuser, for instance, is in this category, since, although it is exposed, it is usually undisturbing visually. This is often due to using a stripline diffuser as an architectural element such as a reveal, a cornice, or a border of some kind. Also in this category is the ceiling-grid system of vents that has been the standard for several years. While most of these grids are exposed, they become such an integral part of the over-all design that they are not disturbing intrusions.

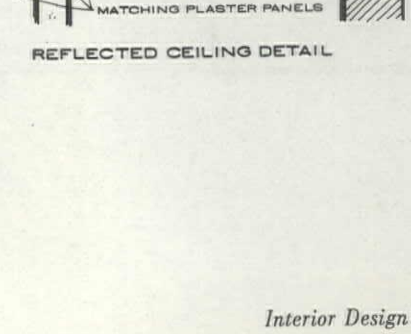
It is in this way that an interaction between exposure and concealment is effected. When devices are expressed in repetition, the rhythm they establish makes them virtually inconspicuous as mechanical devices. Repetition and scale, then, may well be the most important factors in this design consideration. If air-conditioning equipment either repeats the rhythm of some other element in the interior (such as the lighting pattern or the perimeter) or establishes a ryhthm of its own (such as a grid or a parallel-line effect), it can be so unobtrusive as to seem concealed—whether it is exposed or not.

In the Old Café of the Union League Club (below), *Kling's office revived a technique from the days when cut-and-pierced rosettes were used to cover ventilator openings in theater ceilings. In this drinking room, the return is concealed in the ceiling: the duct funnels out to fill one of the rectangular spaces between the wood beams* (drawings, below); *a gilt-banded panel* (lower right panel, in photo, right) *is cut 2 in. short on all sides and suspended as a cover to the duct. The void between the beams and the perimeter of the panel acts as the return vent. Stewart A. Jellett Company was the mechanical engineer.*

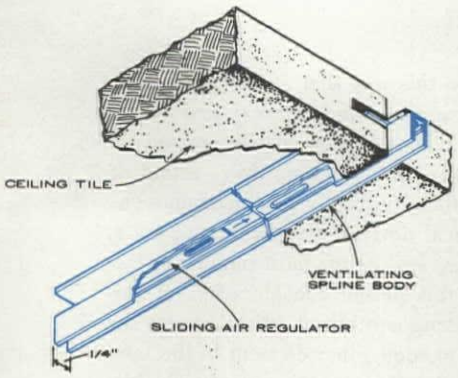


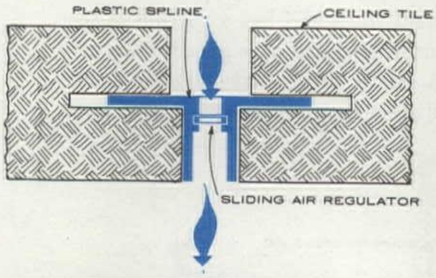


DUCT SECTION AT 'A'



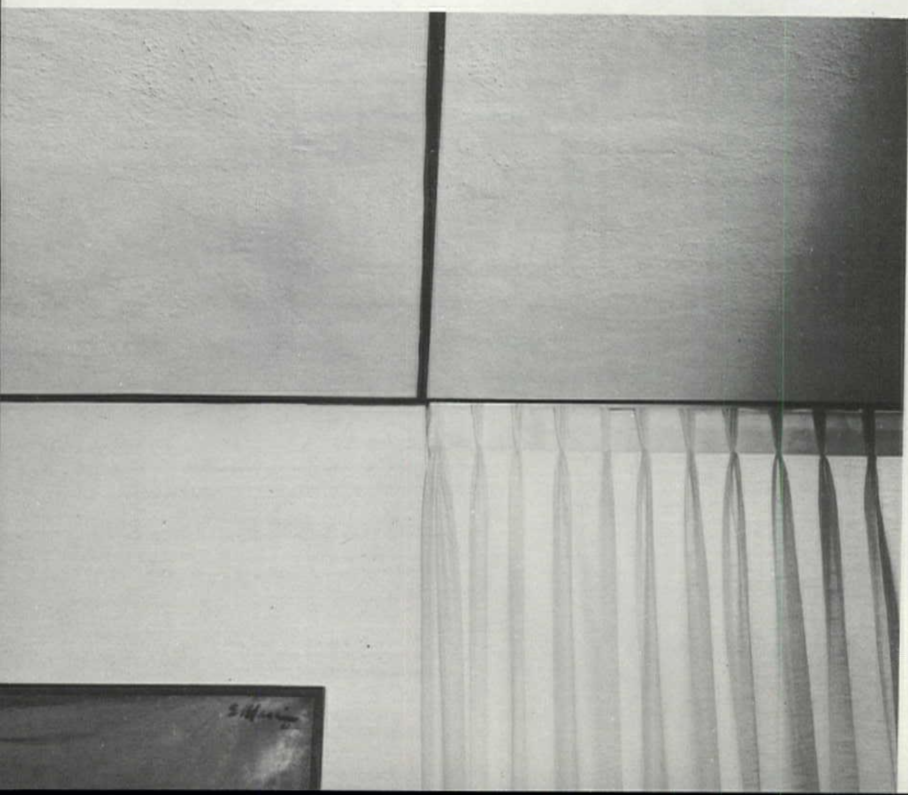
REFLECTED CEILING DETAIL

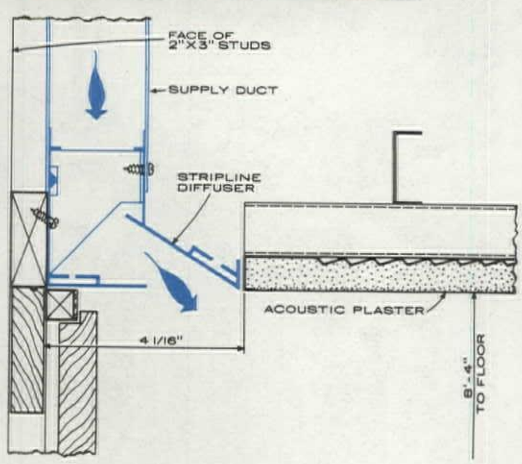




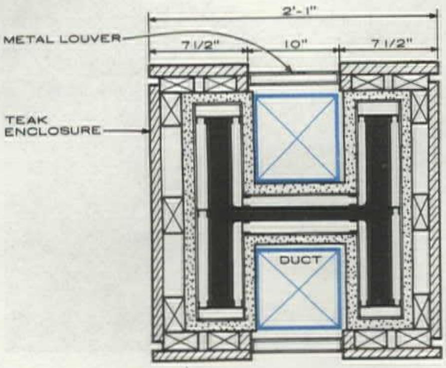
In one of the waiting rooms of the Alton Oschner Clinic in New Orleans (left), *Architects-Engineers Ellerby & Co. have used a ventilating ceiling system in which the splines, rather than the acoustical tiles, contain the diffuser perforations. The visible part of the splines is ¼ in. wide* (above). *Air distribution can be balanced by sliding a plastic regulator in a channel beneath the perforations.*

The Knoll Planning Unit has concealed a perimeter stripline diffuser in the expressive reveal between wall and ceiling planes of the office for the president of Cowles Publications (right and below). *To emphasize the division of the room into two areas—a work space and a lounge space—the Planning Unit divided the ceiling with a black channel, which reiterates the perimeter diffuser. Syska & Hennessy were the mechanical engineers.*

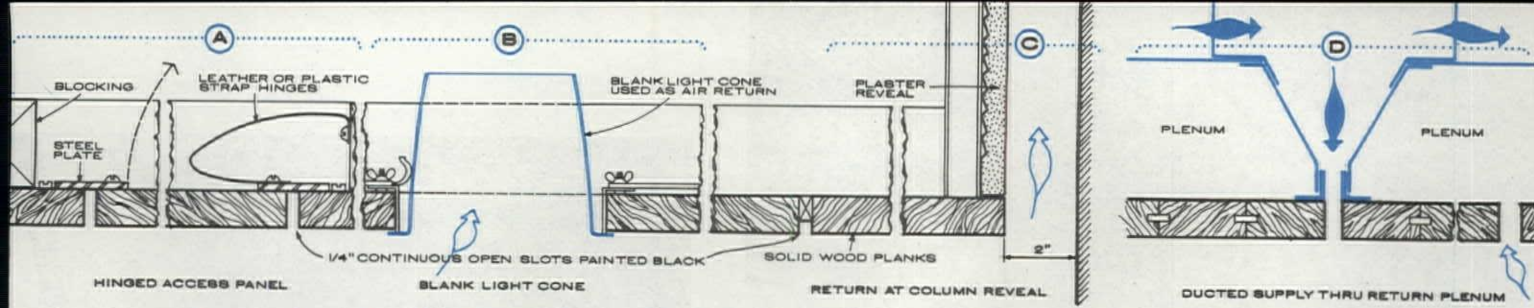




In the cafeteria of Vincent Kling's American Cyanamid Company headquarters (above), a louvered stripline diffuser reads as a black line at the bottom of the clerestory spandrel; the return is through the spaces between butternut boards on the low soffit surrounding the central space. Carson, Lundin & Shaw, Architects, have used a perimeter stripline return the color of the ceiling in such a way as to make it read as an appropriate cornice in the grandly scaled Board Room of the Manufacturers-Hanover Trust Company headquarters in New York (right). Meyer, Strong & Jones were the mechanical engineers for both projects.

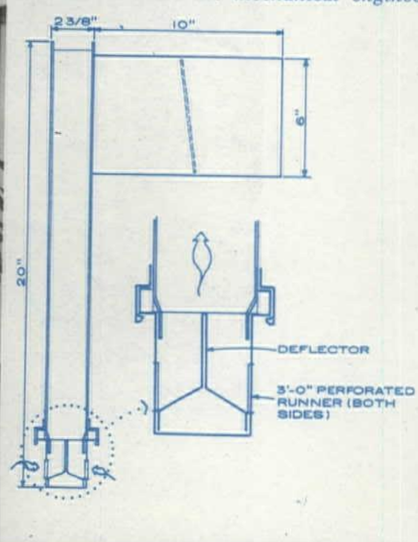


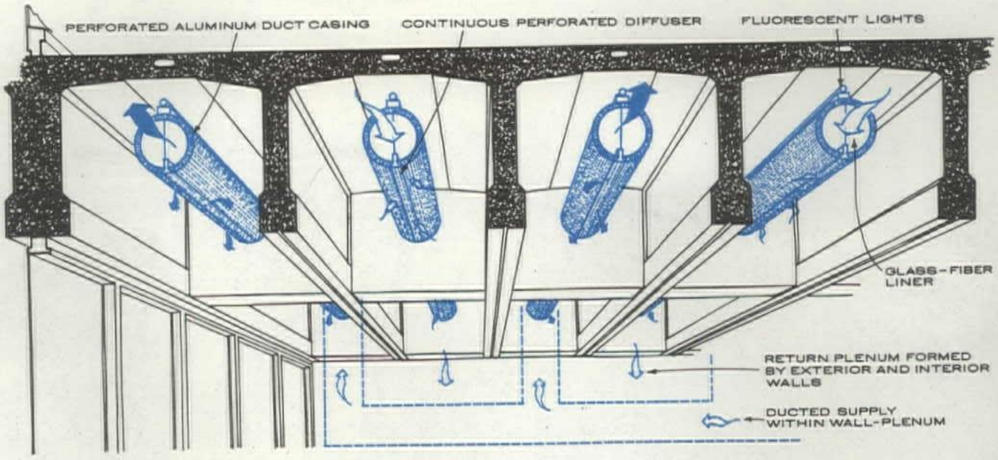
Since solid lighting diffuser panels were used in the suspended ceiling of the officers' platform at the Manufacturers-Hanover Trust Company headquarters, Architects Carson, Lundin & Shaw had to place air-conditioning vents elsewhere. Ducts were incorporated in the columns (section, left) and enclosed by black anodized aluminum louvers that serve as diffusers. The louvers are used on two faces of the teak-enclosed columns.



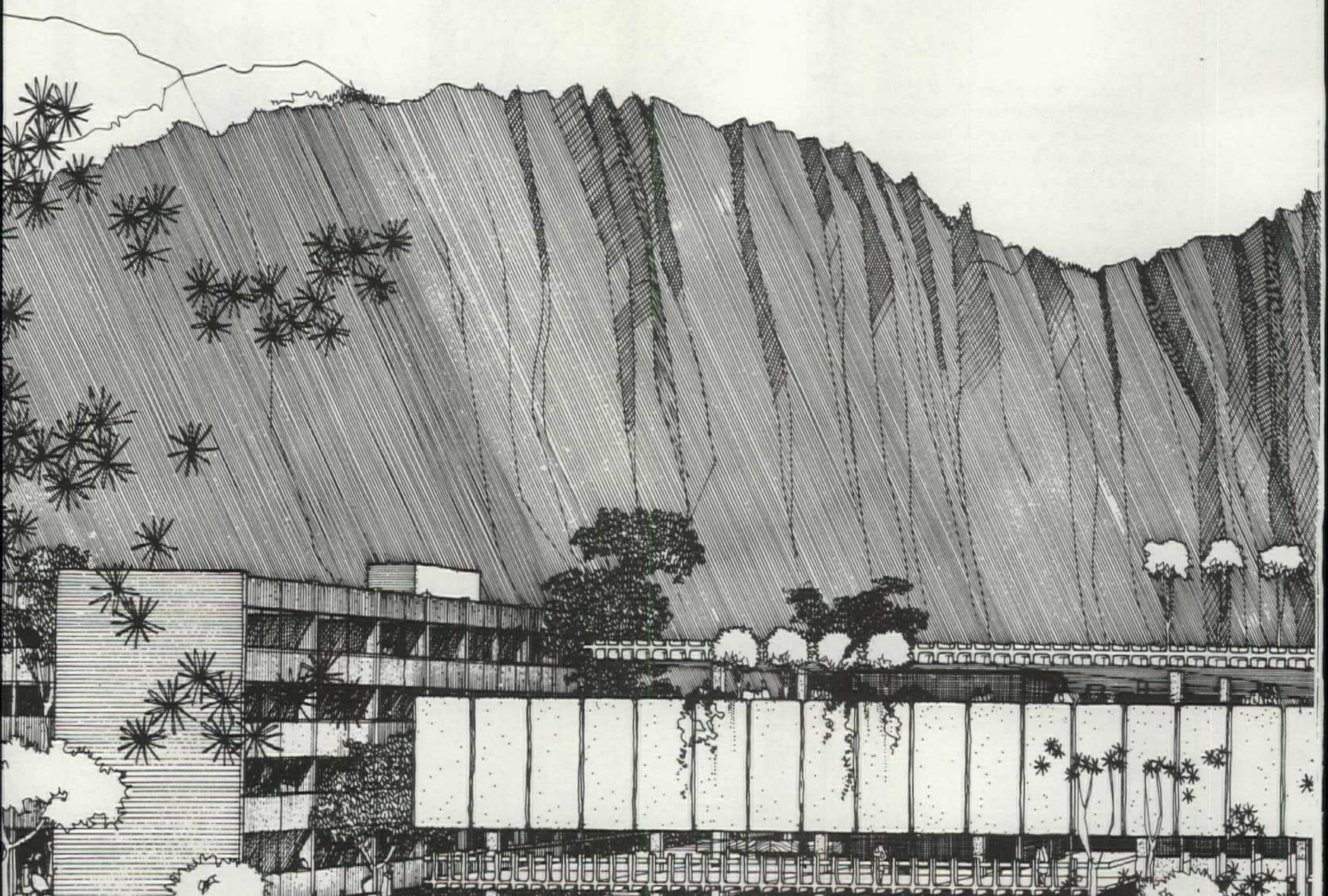
Ceilings of spaced wood planks are often used by Designs for Business to conceal mechanical equipment. The firm has provided hidden access to regulating valves by designing single boards as hinged traps (detail A, above). *Where the wood ceiling forms a return plenum, as in the corridor below, return is through a blank lighting cone in line with and matching other lighting fixtures* (detail B) *and also through a reveal surrounding the column* (detail C). *In the reception room of the firm's own offices* (below), *continuous vents to the return plenum occur between every fourth board; supply is by way of identical vents that are ducted to trunks above the plenum* (detail D). *For both installations Cosentini Associates were the mechanical engineers.*

For the offices of The Consolidated Mining and Smelting Company of Canada Limited (COMINCO) in Montreal (left), *the Knoll Planning Unit, with Kenneth G. Warren as project associate, designed a suspended ceiling grid that incorporates supply and return air vents. The part of the 4'-8" modular grid visible beneath the lighting diffusers is deep in section* (below) *so as to accommodate perforations for vents as well as to reveal COMINCO's metals, of which it is composed. Ellard-Willson & Associates were the mechanical engineers*





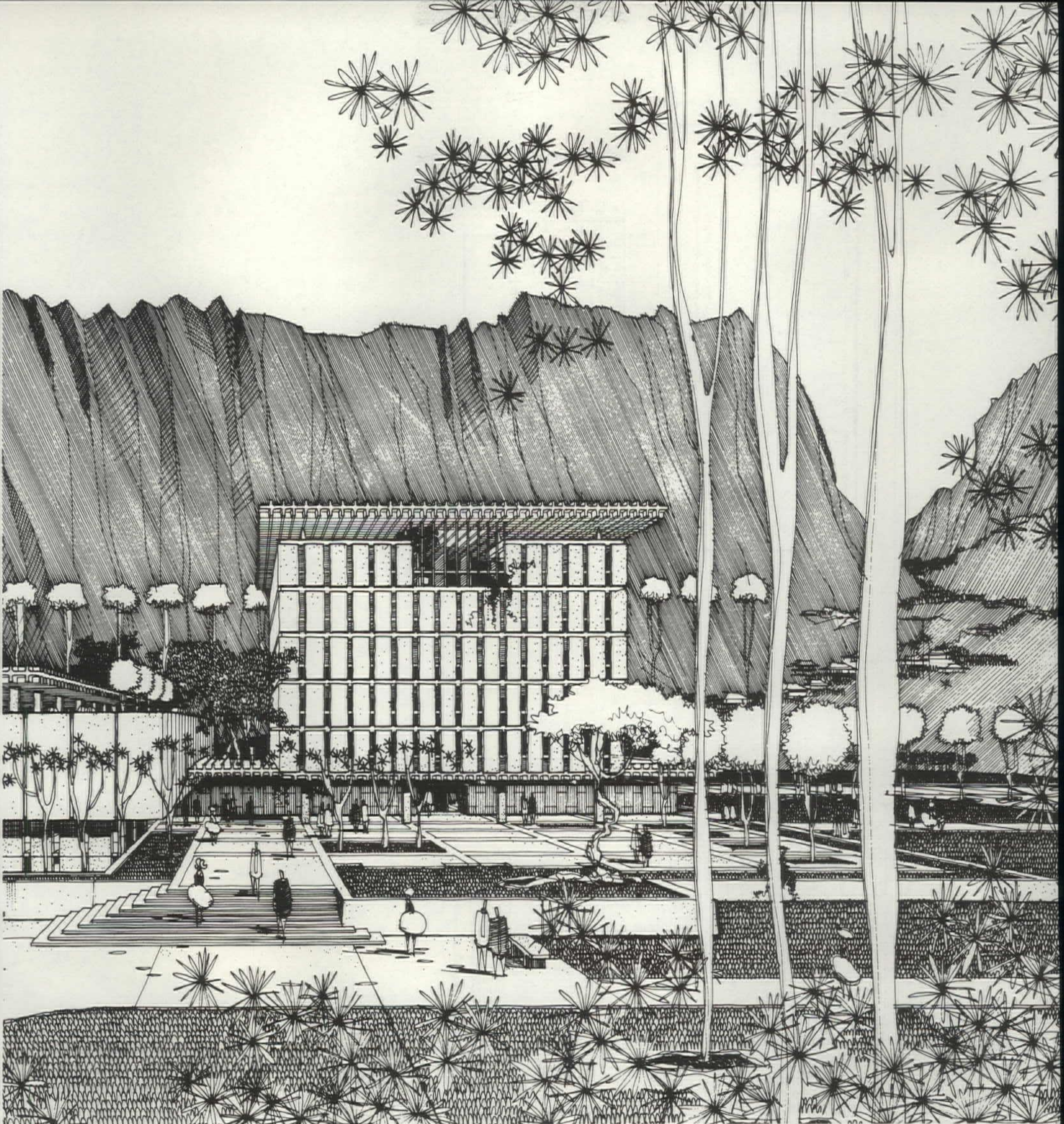
For Skidmore, Owings & Merrill's American Republic Insurance Company Building in Des Moines, mechanical engineers Syska & Hennessy built a full-scale mock-up of their ceiling system (below). *An exposed 16-in. diameter duct branches out into each 6-ft bay from trunk ducts in vertical plenums; a continuous diffuser runs along the bottom of each suspended duct. Bays alternate supply and return. Aluminum casings are perforated to allow the glass-fiber duct liners to function as sound absorbers. Above each branch duct is a high-output fluorescent lamp that was shown to give 65 footcandles of indirect illumination* (drawing, right).



24-Hour Radiant Cooling

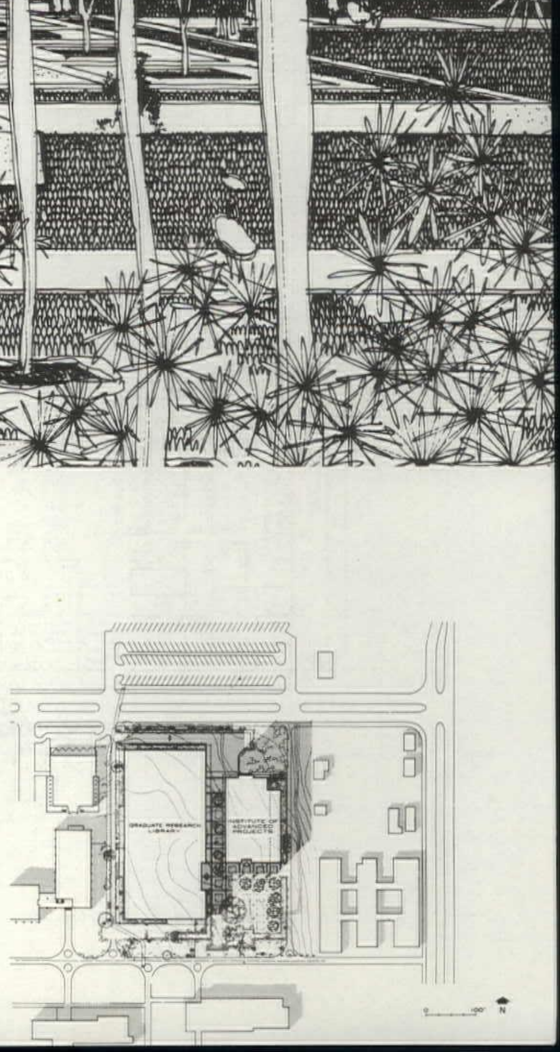
The drawings shown here and on the following pages of two proposed new structures for the University of Hawaii at Honolulu suggest how ingeniously the mechanical system can be integrated into the total architectural scheme, if considered at the very outset of planning. An excellent case in point is this preliminary design by Associated Architects A. Quincy Jones & Frederick E. Emmons of Los Angeles and Hogan & Chapman of Honolulu.

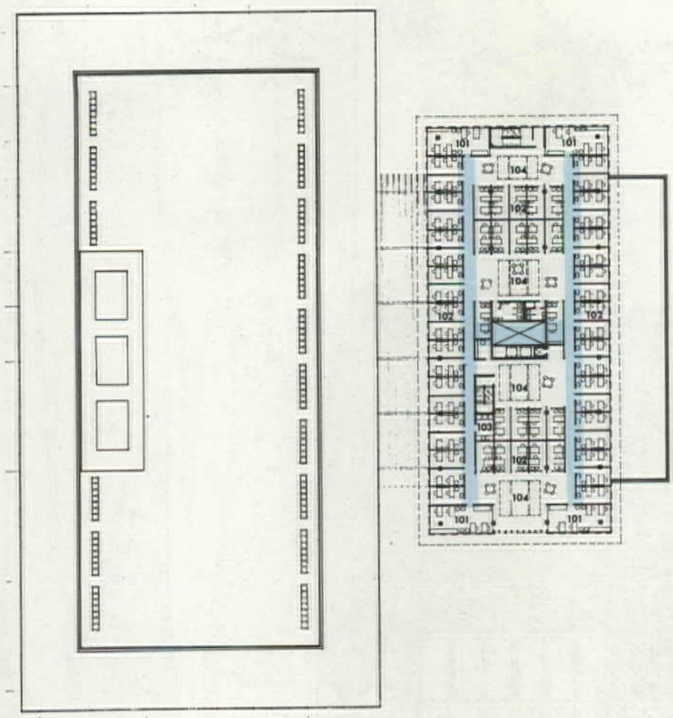
The new Graduate Research Library and the Institute of Advanced Projects—the two buildings under study here—are part of the larger "Center for Cultural and Technical Interchange between East and West," which has as its goal "the improvement and furtherance of mutual understanding between the United States and the countries of the Asian-Pacific area." Toward this end, these two structures will provide study and research facilities for visiting scholars and the



university's graduate students, and appropriate accommodations for the care and storage of valuable collections of books and documents, microfilm libraries, and electronic data processing equipment. Consequently, both structures required extensive mechanical facilities to attain an ideal and constant environment for people as well as objects within them.

The low building (*left in drawing above*) houses the reading rooms and reference departments for the student body. Since the Graduate Research Library must serve a maximum number of students as efficiently and speedily as possible, the building is limited to three large





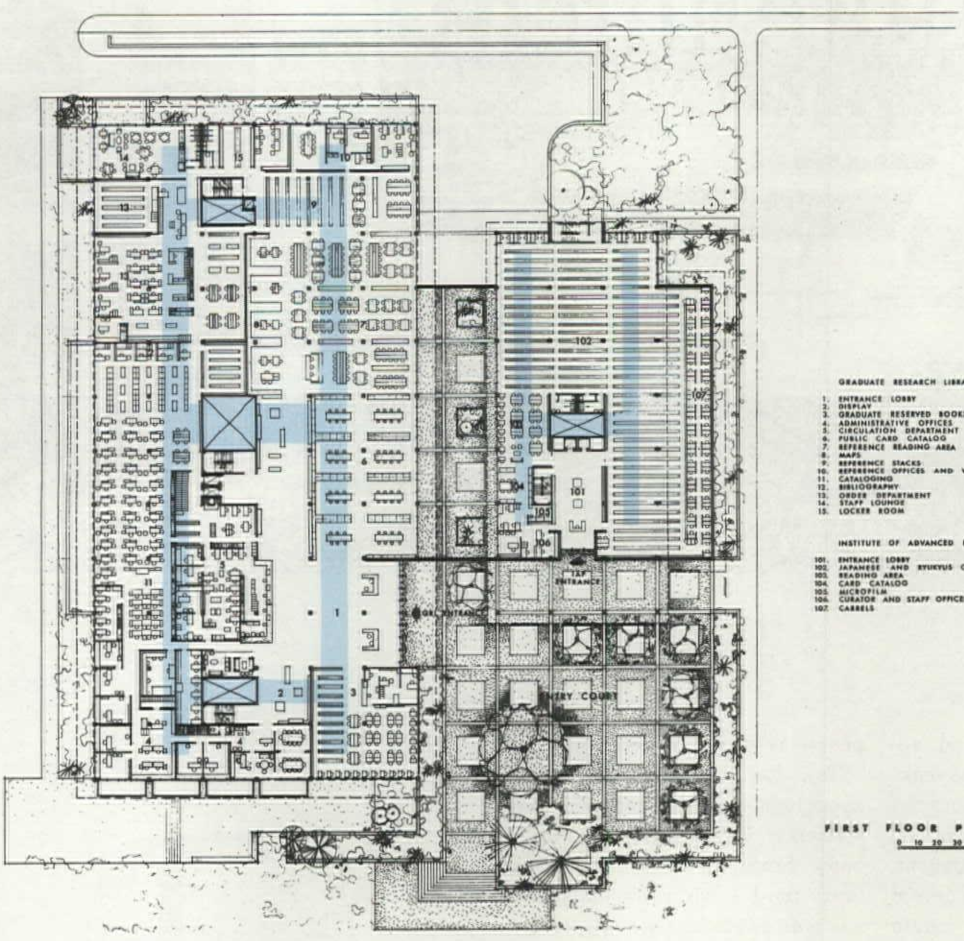
INSTITUTE OF ADVANCED PROJECTS

101. SENIOR SCHOLARS' DOUBLE OFFICES
102. SENIOR SCHOLARS' SINGLE OFFICES
103. KITCHENETTE
104. GARDEN

SIXTH FLOOR PLAN

0 10 20 30 40 50

N



GRADUATE RESEARCH LIBRARY

1. ENTRANCE LOBBY
2. DISPLAY
3. GRADUATE RESERVED BOOKS
4. ADMINISTRATIVE OFFICES
5. CIRCULATION DEPARTMENT
6. PUBLIC CARD CATALOG
7. REFERENCE READING AREA
8. MAPS
9. REFERENCE STACKS
10. REFERENCE OFFICES AND WORKROOMS
11. CATALOGING
12. BIBLIOGRAPHY
13. ORDER DEPARTMENT
14. STAFF LOUNGE
15. LOCKER ROOM

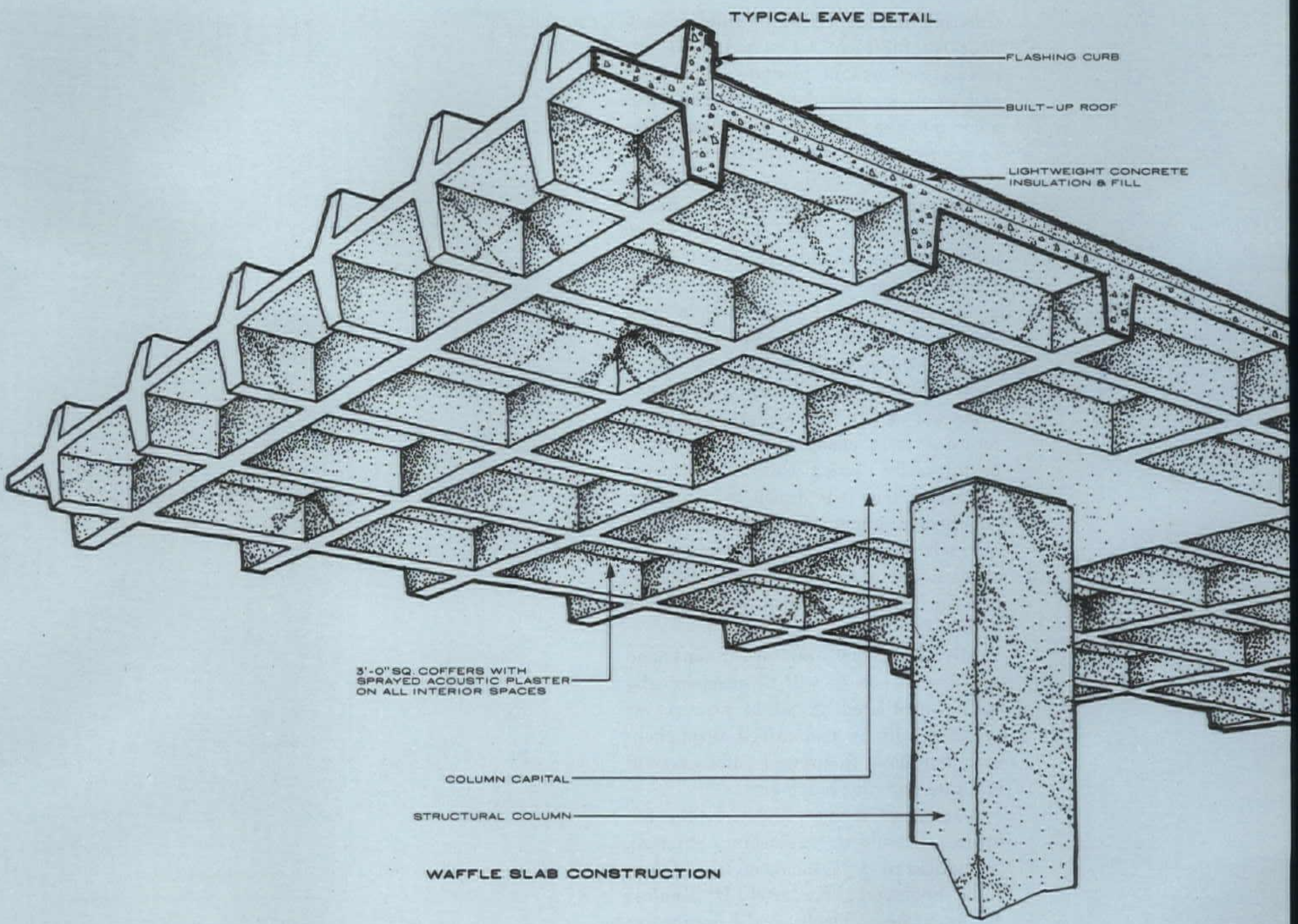
INSTITUTE OF ADVANCED PROJECTS

101. ENTRANCE LOBBY
102. JAPANESE AND RYUKYUS COLLECTION STACKS
103. READING AREA
104. CARD CATALOG
105. MICROFILM
106. CURATOR AND STAFF OFFICES
107. CARRELS

FIRST FLOOR PLAN

0 10 20 30 40 50

N



WAFFLE SLAB CONSTRUCTION

floors. On the other hand, The Institute of Advanced Projects will be open to only a limited number of visiting scholars, students, and staff. Therefore, a six-story solution with smaller floor areas, offering greater privacy for the individual, was proposed. The two buildings are to be placed side by side so that certain facilities, such as the mechanical equipment at the basement level and photo-duplicating and electronic data equipment at the first floor level, could be shared.

The structural system chosen—the two-way waffle slab of reinforced concrete (*detail above*)—offered several advantages: it will provide loft-type space for expansion, rearrangement and placement of maximum book loads in any part of the building; it will provide integral acoustical treatment; incorporate the lighting system; eliminate the need for a suspended ceiling, thus cutting down on ceiling heights; will introduce a visually pleasing coffered ceiling, which will also give the building its distinctive roof and eave design. Most importantly, however, it will permit the incorporation of an integral air-conditioning system.

The "airfloor" system (*details overleaf*), specified previously by the architects for some of their builder houses, provides air distribution through a continuous grid of ducts between two layers of concrete. Because the ducts are an integral part of the concrete structure, the building mass will remain cool, and, with 24-hour operation, will equalize the occasionally high outside temperatures. In effect, the system provides a method of radiant cooling.

The following factors formed the basis for the design of the air-conditioning and ventilating systems: (1) no space heating required in buildings; (2) operation of system on a 24-hour, year-round basis; (3) maximum design outside air: 87 F dry bulb, 74 F wet bulb, 106 grains of moisture per pound of dry air; (4) minimum design outside air: 65 F dry bulb, 62 F wet bulb, 76 grains of moisture per pound of dry air; (5) inside design conditions: 74 F dry bulb, 50 per cent relative humidity, 63 grains of moisture per pound of dry air.

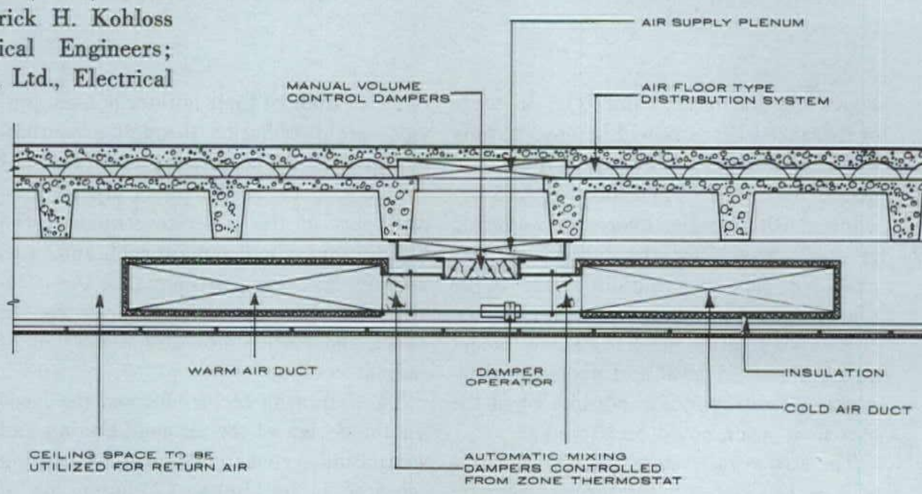
A central air-conditioning plant is to be located in the basement of the Graduate Research Library. This plant will consist of three 300-ton, hermetic centrifugal water-chilling machines, chilled-water pumps, and condenser water pumps. Three cooling towers for condenser water cooling and rejection of heat to the atmosphere are to be located in an enclosure on the roof of the library. The triple plant will provide economical low-load operation, separation of the two buildings, and flexibility for incremental construction.

Each of the three built-up central systems will include the following elements: (1) outside air intake and filters; (2) outside precooling coil to dehumidify outside air used for ventilation; (3) return air fans to bring air from conditioned spaces back from ducts to apparatus; (4) high-efficiency filters and activated charcoal filters to clean the mixture of return air and cooled outside air, and to retard acidic attack on books; (5) supply air fans to blow air into two supply air streams in parallel; (6) two supply air streams, one with a cooling coil to provide a source of cold, dry air, and one with a heating coil to use water from the refrigeration machine condenser and provide a source of warm, dry air.

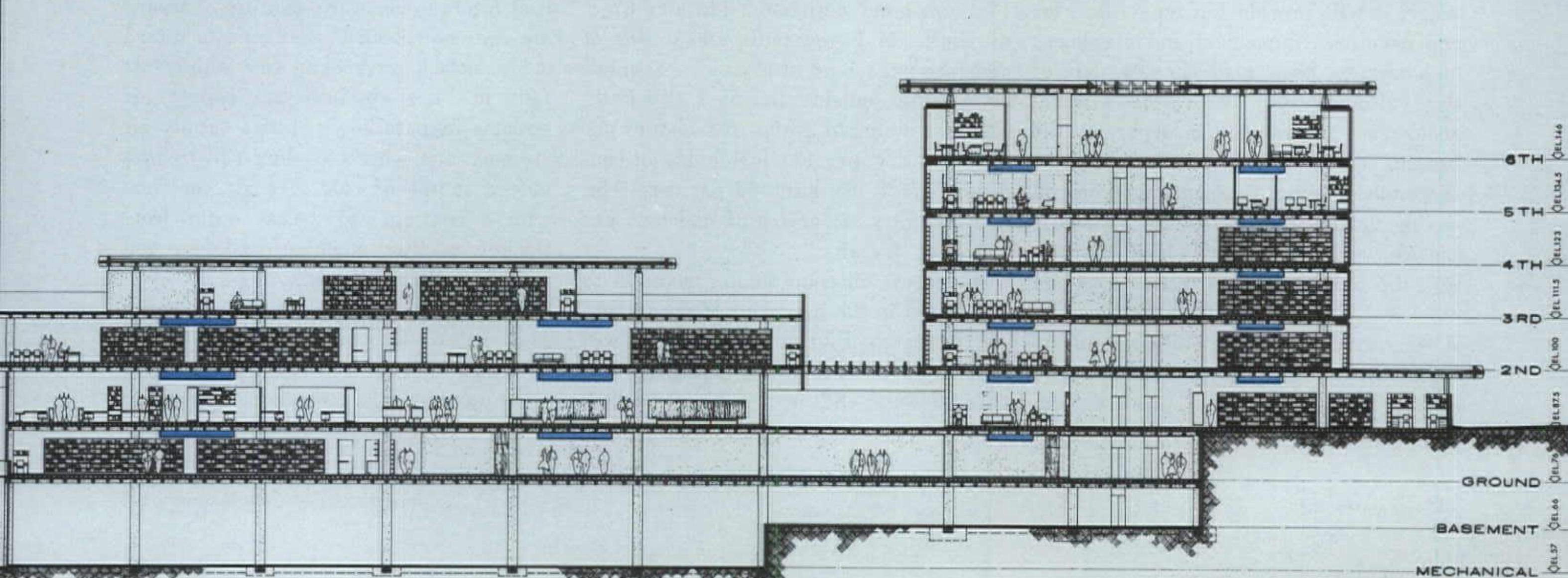
Air distribution in both of the buildings follows this sequence: (1) a low-velocity, dual-duct system supplies air from apparatus in the basement through duct risers in air shafts to horizontal distributing ducts in furred plenums at each floor (*as indicated on plans*); (2) air-mixing dampers in plenums blend cold and warm air and deliver air from plenums into the "airfloor" at temperatures as determined by zone thermostats; (3) at every floor, cool air is circulated through the "airfloor" to keep the floor's structural mass cool and to supply air to interior spaces through floor registers and perimeter floor and wall registers: (4) at the perimeter of each floor in both buildings, chilled water coils re-cool air in the "airfloor" (this air is supplied to areas subject to solar and transmission heat gain at exterior walls); (5) air is returned from occupied spaces through grilles on the vertical sides of the furred plenums where it is drawn by return-air fans back to apparatus. Perimeter recooling coils reduce the air-conditioning circulation requirements by intercepting the exterior heat loads before they enter the building.

All toilet rooms, janitor's rooms, and other small spaces will be mechanically exhaust-ventilated. A slight positive air pressure will be maintained throughout both buildings to prevent infiltration of moisture and dust-laden air.

Associated on this project are the following consulting engineers: Shimazu, Shimabukuro & Associates, Inc., Structural Engineers; Frederick H. Kohloss & Associates, Mechanical Engineers; Ho, Okita & Associates, Ltd., Electrical Engineers.

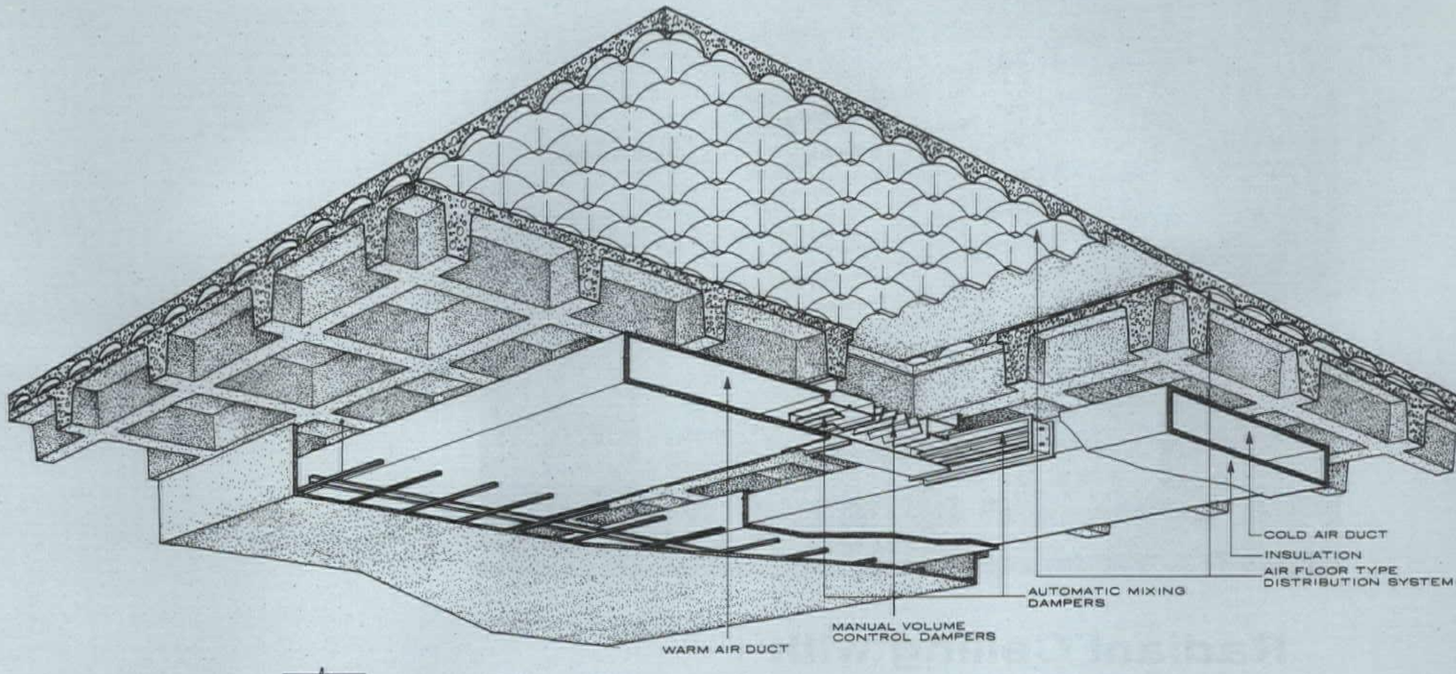


SECTION SHOWING AIR CONDITIONING DISTRIBUTION SYSTEM

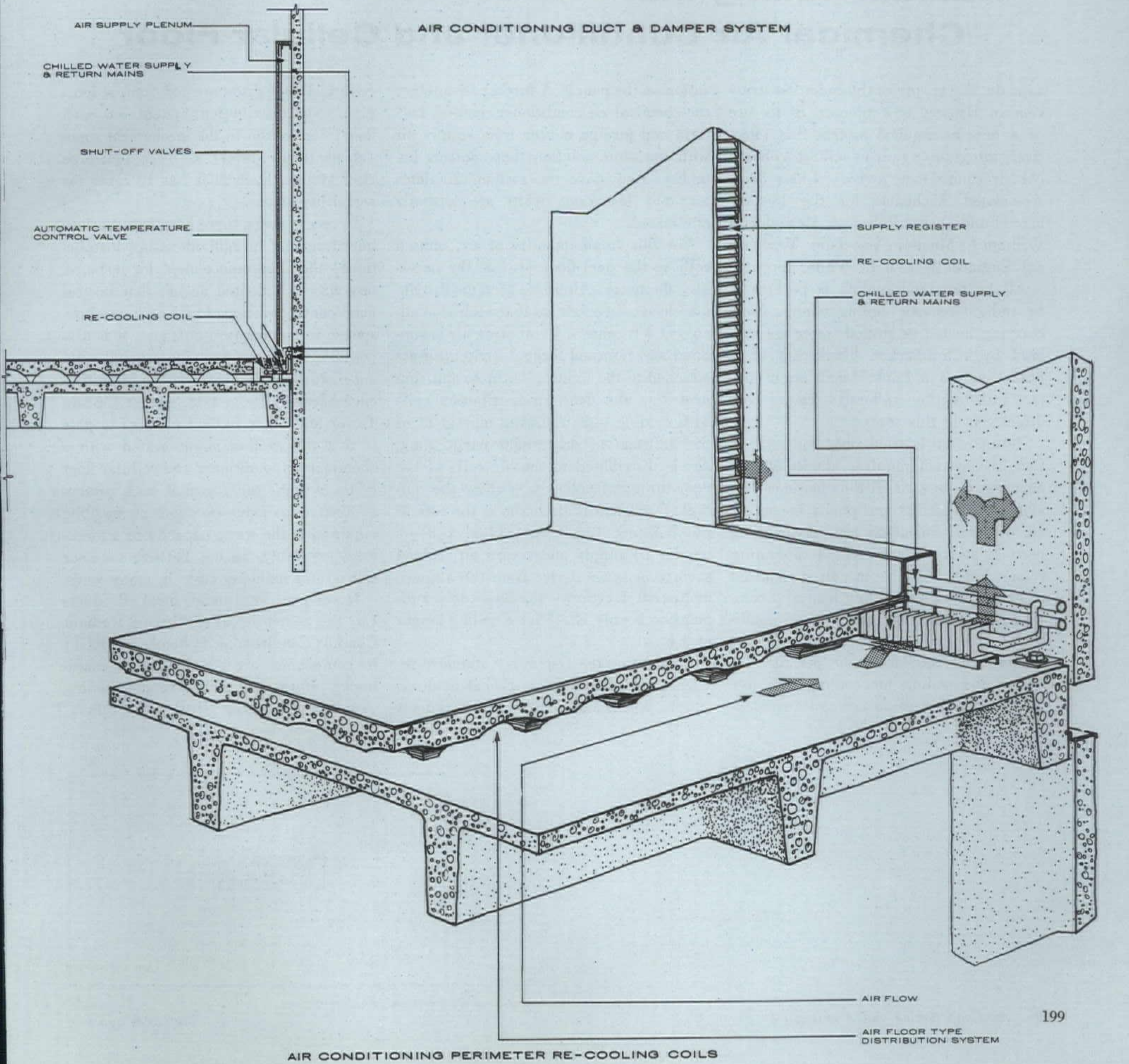


TRANSVERSE SECTION

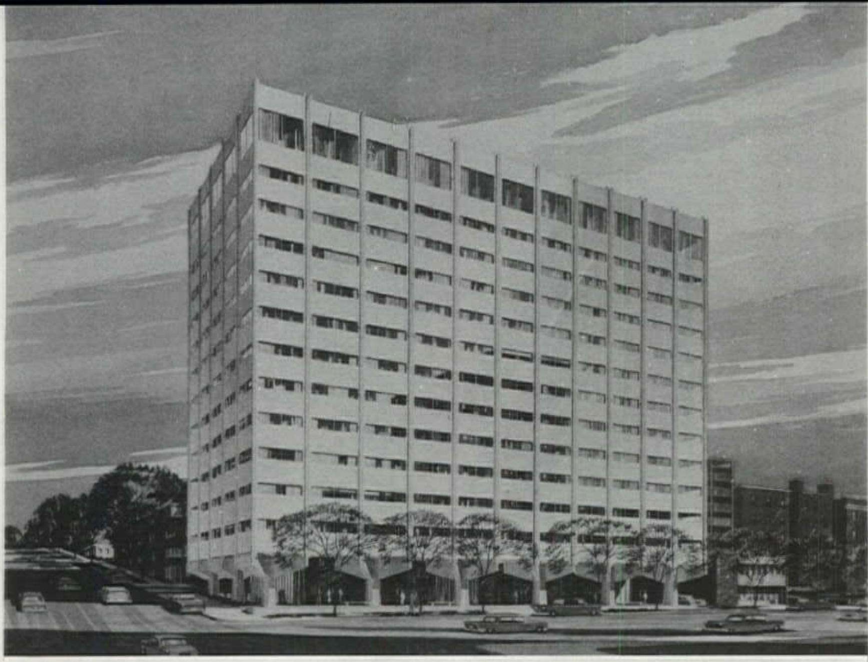
0 25'



AIR CONDITIONING DUCT & DAMPER SYSTEM



AIR CONDITIONING PERIMETER RE-COOLING COILS



Radiant Ceiling with Chemical Air Conditioner and Cellular Floor

Lincoln Tower, presently under construction in Denver, is a pioneer in its use of a new mechanical system that effectively integrates a radiant ceiling, a chemical air conditioner, and a cellular floor. Associated Architects for the 13-story office building are Robert A. Heister and William C. Muchow Associates. Mechanical Engineer is Ken R. White, Inc.

All heating and cooling is performed by radiant-acoustic ceiling panels. Coils carrying heated or chilled water are covered by a foil-backed blanket of glass fiber 1 in. to 3 in. thick. Panels are in contact with lighting troffers to remove heat directly from this source.

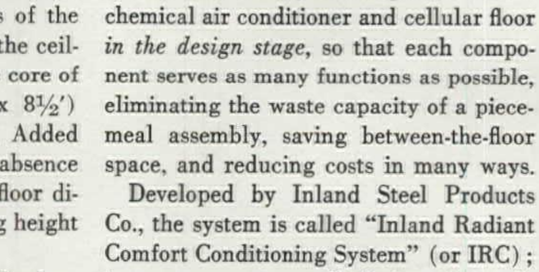
Because air is used only for ventilation, the system requires almost 50 per cent less moving air. It thus becomes feasible to dehumidify and purify in-coming air with a chemical air conditioner, long used in such critical areas as operating rooms, but prohibitive in cost if required to handle the total cooling load of a commercial building. The chemical air conditioner, by maintaining a low relative humidity, at the same time permits full use of the ceiling for cooling—the low water temperatures do not cause condensation on the panels. A further advantage: the chemical air conditioner removes bacteria and foreign matter from supply air with the same solution that controls humidity. And since the system circulates air at a low rate, drafts are virtually eliminated.

For this small quantity of air, unused cells in the steel floor provide the necessary ductwork. Alternate sections distribute electricity or air, so that each is available at 4 ft centers. Ventilating air is supplied and returned through strip diffusers attached to the lighting fixtures, and connected to the floor air-distribution cells with flexible pipe, allowing movement of the diffusers to suit tenant partitioning. Air is distributed to the air cells of the floor through header ducts above the ceilings. Two vertical air shafts at the core of the building (each only 14½′ x 8½′) handle all supply and return air. Added savings in space derive from the absence of branch ductwork—the floor-to-floor dimension is only 12′-4″ for a ceiling height of 9 ft.

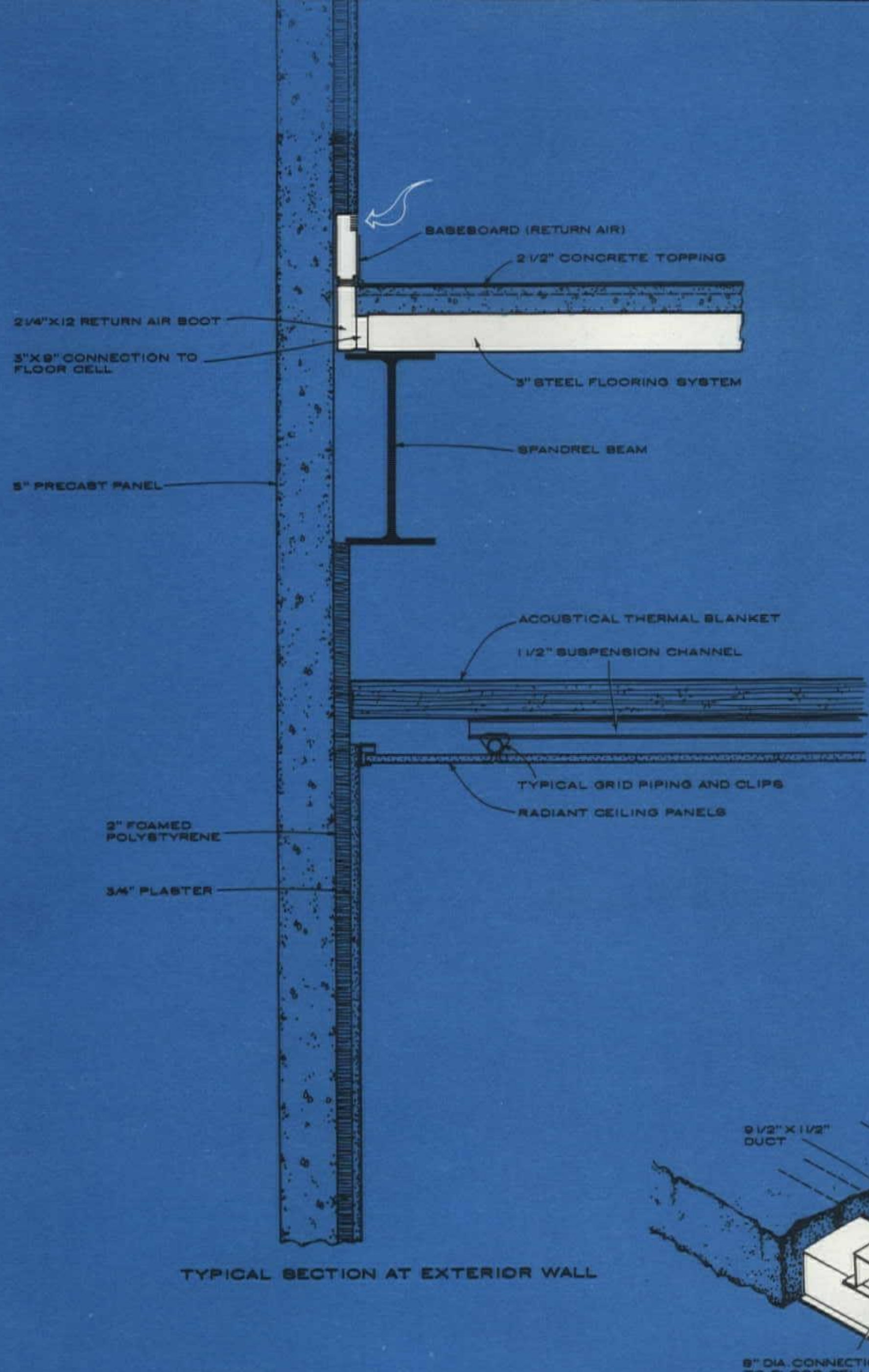
Completing the system is a standard refrigeration plant used as a heat pump to supply hot or cold water to the radiant ceiling. Panel grids are fed from a four-pipe loop distribution system on each floor; connection to the mechanical room (at penthouse level) is by a four-pipe riser system. Each floor has 10 zones for versatility of use.

In recent years, there have been various improvements in radiant-ceiling installations—the aluminum panels, for instance, now have a patented design that insures good contact with grid pipes for quick response to temperature changes; it is also possible to remove any single panel without disturbing the rest. But the big difference between the system used at Lincoln Tower and other radiant ceilings to date is that this ceiling is integrated with a chemical air conditioner and cellular floor *in the design stage*, so that each component serves as many functions as possible, eliminating the waste capacity of a piecemeal assembly, saving between-the-floor space, and reducing costs in many ways.

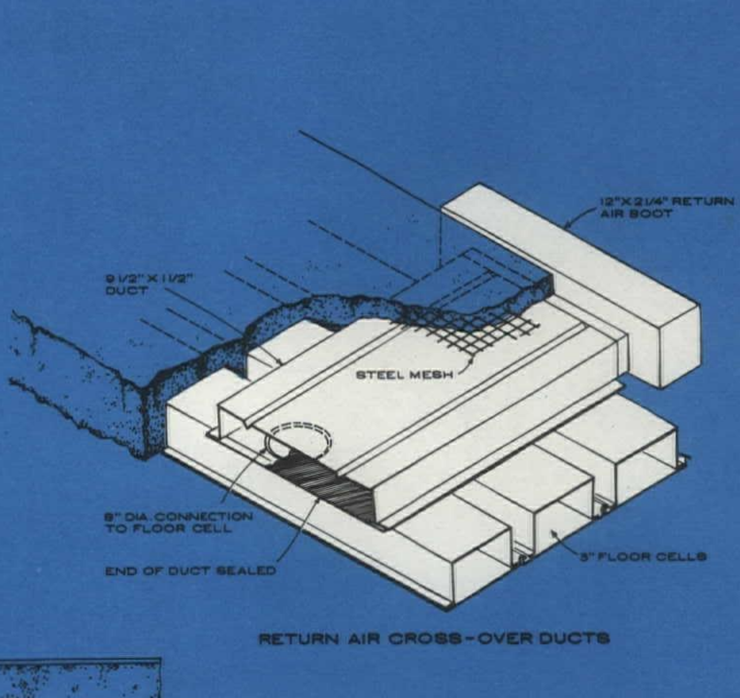
Developed by Inland Steel Products Co., the system is called "Inland Radiant Comfort Conditioning System" (or IRC); its components are a Kathabar air conditioner, Burgess-Manning/Inland ceiling panels, and Inland's "Hi-Bond Celluflor."



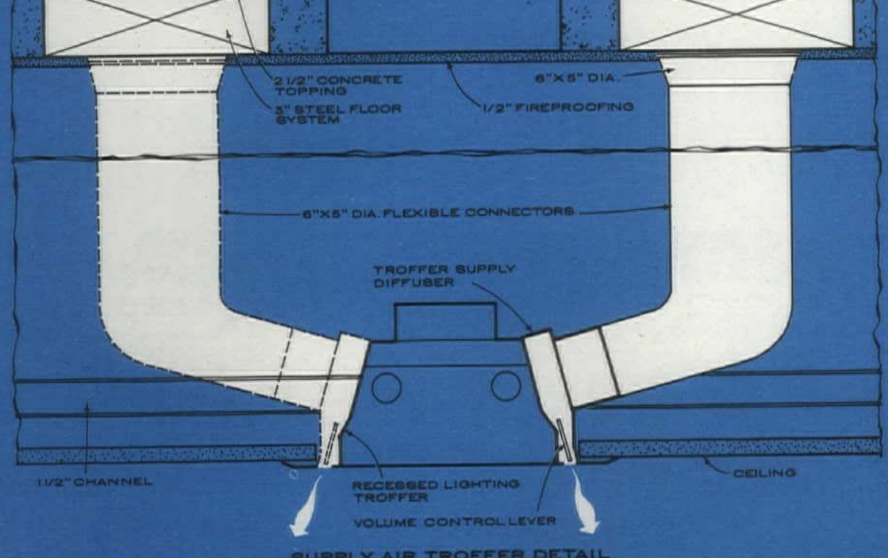
TYPICAL FLOOR PLAN



TYPICAL SECTION AT EXTERIOR WALL



RETURN AIR CROSS-OVER DUCTS



SUPPLY AIR TROFFER DETAIL

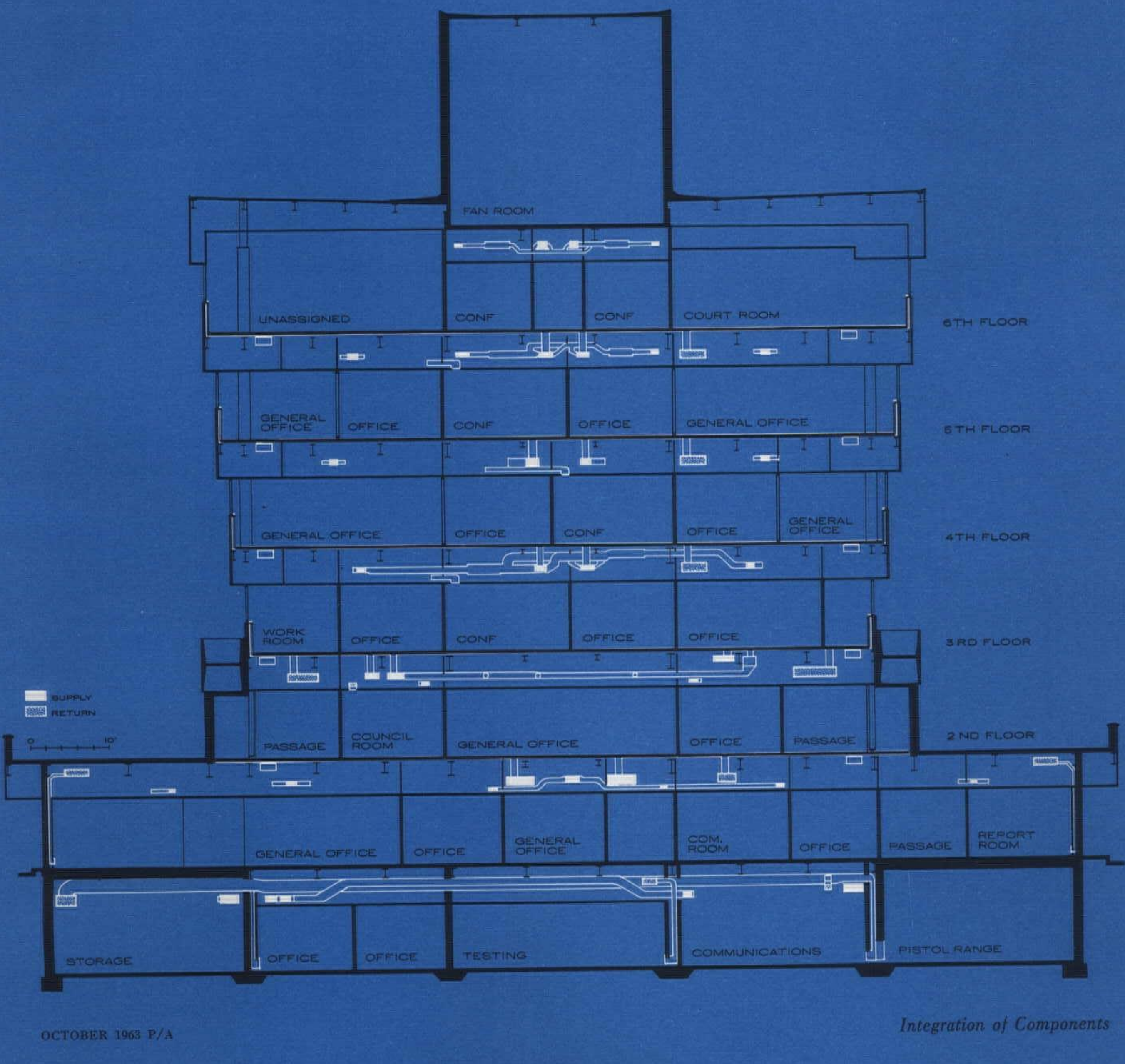
PHOTOS: BALTHAZAR, COURTESY OF ARMSTRONG CORK CO.

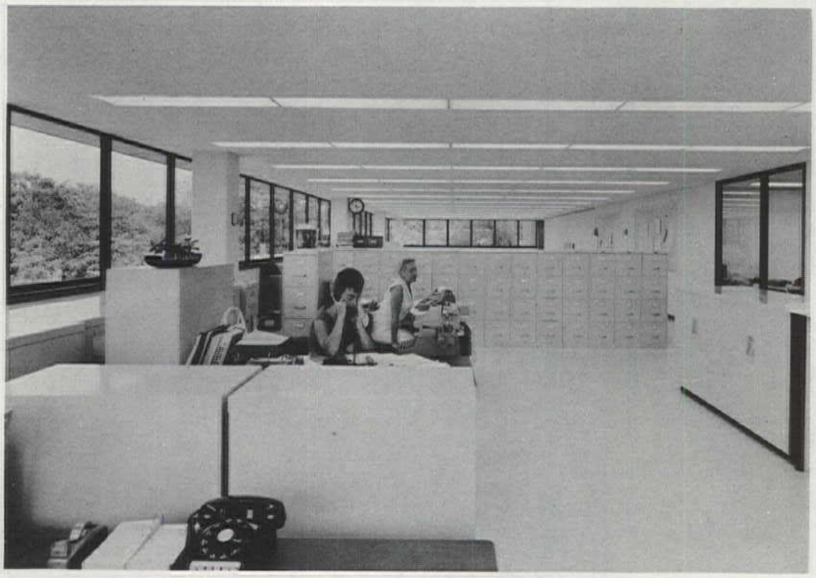
Ventilating Ceilings Throughout

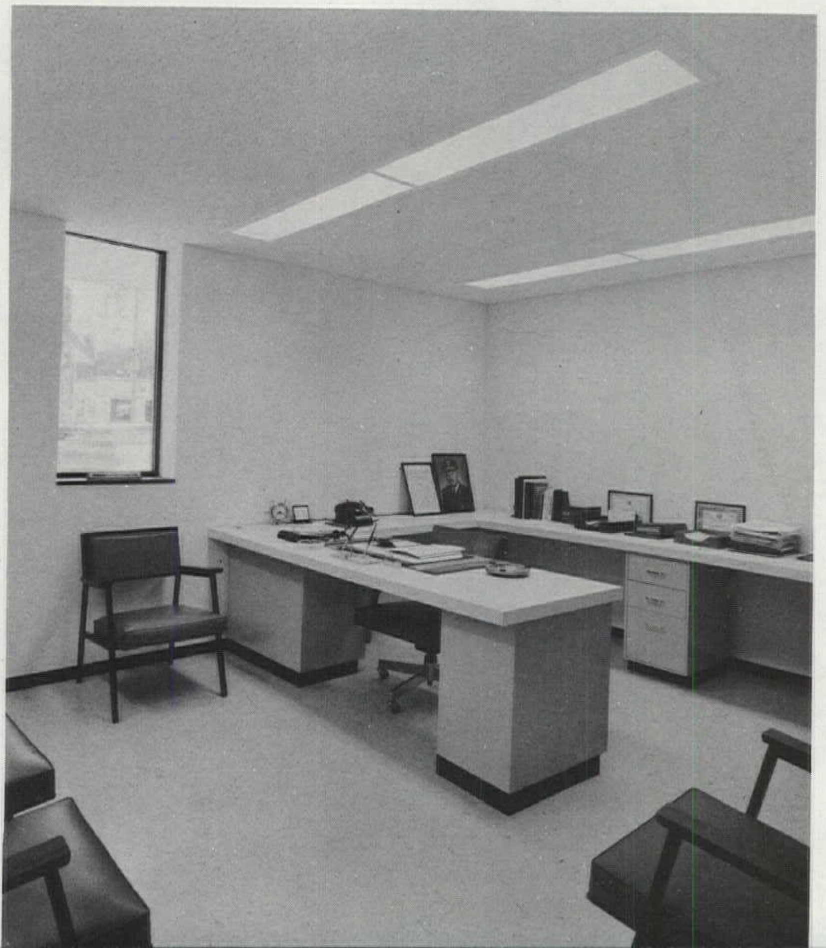
Alden B. Dow's design for this air-conditioned city hall at Ann Arbor, Michigan, was based to a large extent on his decision to use ventilating ceilings throughout the building. Even on the exterior, the volumes of the plenums are clearly expressed in the deep plastered spandrels; a visually prominent central spine encloses the mechanical penthouse and the vertical lines leading from it.

The 4'-0" depth of the plenum was required to provide clearance for structural steel, air-conditioning ducts, and a pneumatic tube system (which required 10 in. clear depth and had to remain level). Although the plenum constitutes roughly one third of the building volume, the system employed was economical compared to alternative designs, according to the mechanical engineers, Hyde & Bobbio.

In this system, cellular steel floors have been used to carry return air and to supply the window-sill diffusers, which supplement the ventilating ceilings along the periphery. One alternative scheme, in which the cellular floor would have been replaced by ducts, required an even greater total floor depth. Another







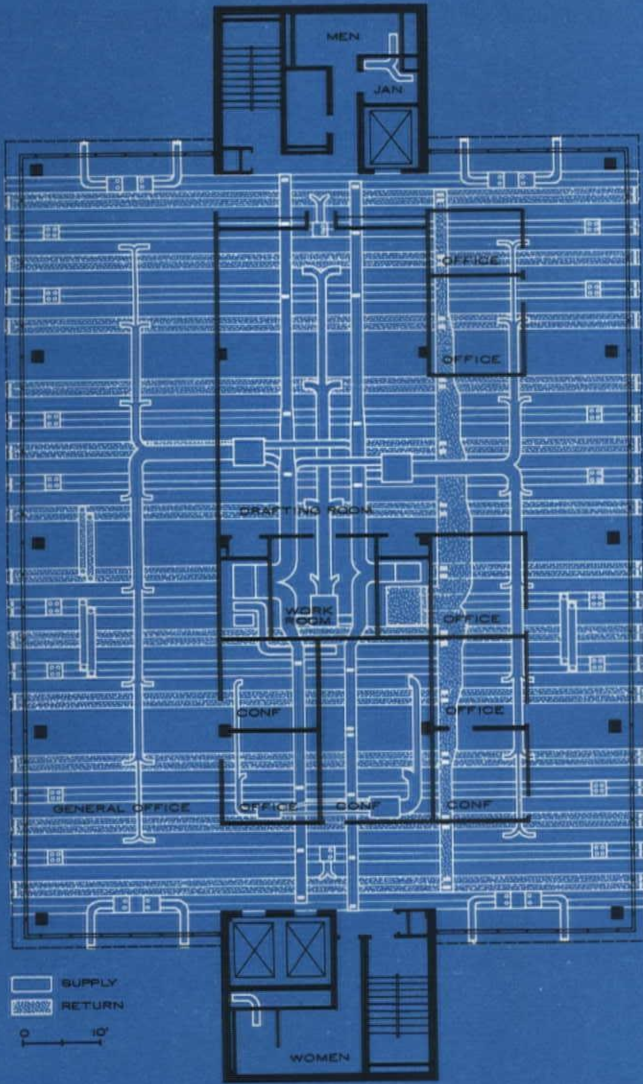
alternative, in which the cellular floors would have replaced all ducts, permitting smaller floor depths, would have been more expensive because of the large number of mixing boxes required (since the capacity of each mixing box in a cellular floor is limited). The possibility of using deeper beams with the mechanical system selected, so that more ductwork could pass through them, was also considered and rejected on the basis of economy.

The design of the ventilating ceilings varies according to the function and location of the spaces served. In exterior spaces (*left, middle and bottom*) and interior spaces such as conference rooms (*left, top*), which have substantial cooling loads, ceilings are 100 per cent ventilating tile, delivering 2 cfm per sq ft of room area. In the interior spaces with smaller loads, such as private offices, 50 per cent of the ceiling is ventilating tile (alternating with visually identical acoustic tile), so that under the same static pressure only 1 cfm is delivered per sq ft of room area. For drafting rooms and machine rooms, where electrical equipment generates additional heat, higher static pressures are used with 100 per cent ventilating tile to increase the volume of air delivered.

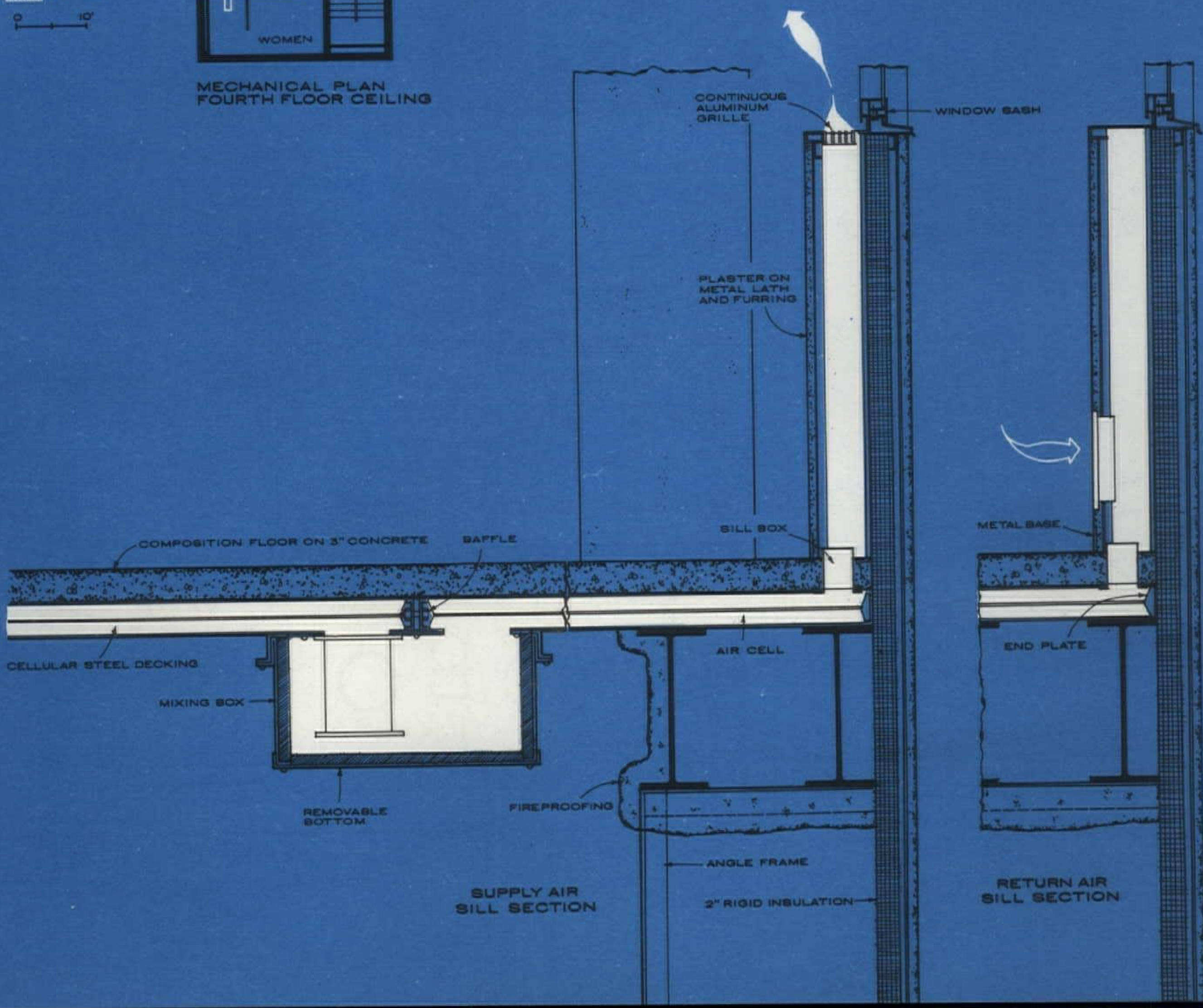
Hot and cold high-pressure ducts leading from the penthouse supply mixing boxes, which deliver thermostatically controlled air to low-pressure ducts serving the plenums. Baffles extending up to the structural slab above partitions act as barriers for both air and sound.

Return-air grilles are located at the base of the exterior walls. Interior offices have undercut doors for return air. Conference rooms have exhaust systems and no returns.

Concerning his use of ventilating ceilings, the architect comments: "A ceiling has to do many things today. When each need is satisfied by a separate product or system, the ceiling only becomes cluttered and expensive. We chose the ventilating ceiling system primarily because it combines three important jobs—fireproofing, air distribution, and acoustical control —in one product and one application."



MECHANICAL PLAN
FOURTH FLOOR CEILING



SUPPLY AIR
SILL SECTION

RETURN AIR
SILL SECTION

PHOTOS, EXCEPT AS NOTED: LOUIS REENS

2200 Microclimates

For utmost flexibility in providing variable temperatures for guests of the New York Hilton hotel, a three-pipe fan-coil system has been used in each of the 2200 guest rooms. With the three-pipe system—one pipe is for chilled water, one for hot, the third a common return—the visitor arriving in August from the Latin American winter can have heat, while at the same time a unit in another room can cool an Alaskan businessman. Two-pipe systems provide either hot or chilled water at any one time, but not a year-round choice of both.

The fan-coil units are placed at the apex of V-shaped bays, which project beyond the column line. Pipes connect to risers on the outside faces of the columns, which have a slate-gray aluminum skin (*drawings below*).

On the interior, a 21-in.-high window bench faced with wood-grained plastic laminate encloses the unit and its pipes. The fan control is recessed in the bench top; the temperature control is, much to the architects' chagrin, on the vertical face of the bench. Fresh air is supplied by operable hoppers.

Architects for the hotel were William B. Tabler, with Harrison & Abramovitz as Consultants. The Mechanical Engineers were Cosentini Associates.

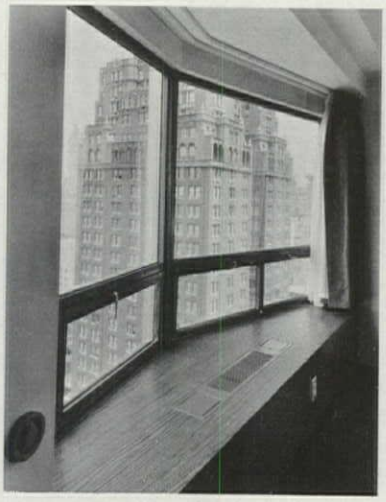
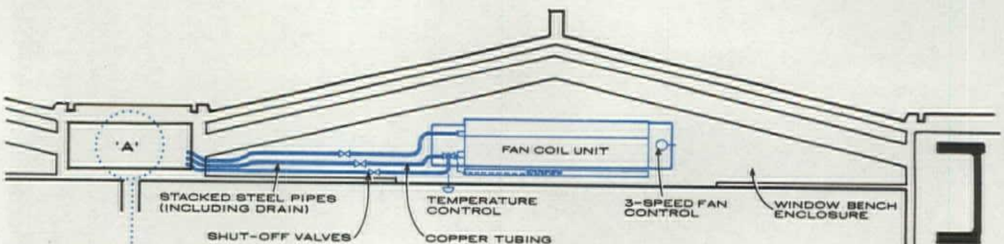
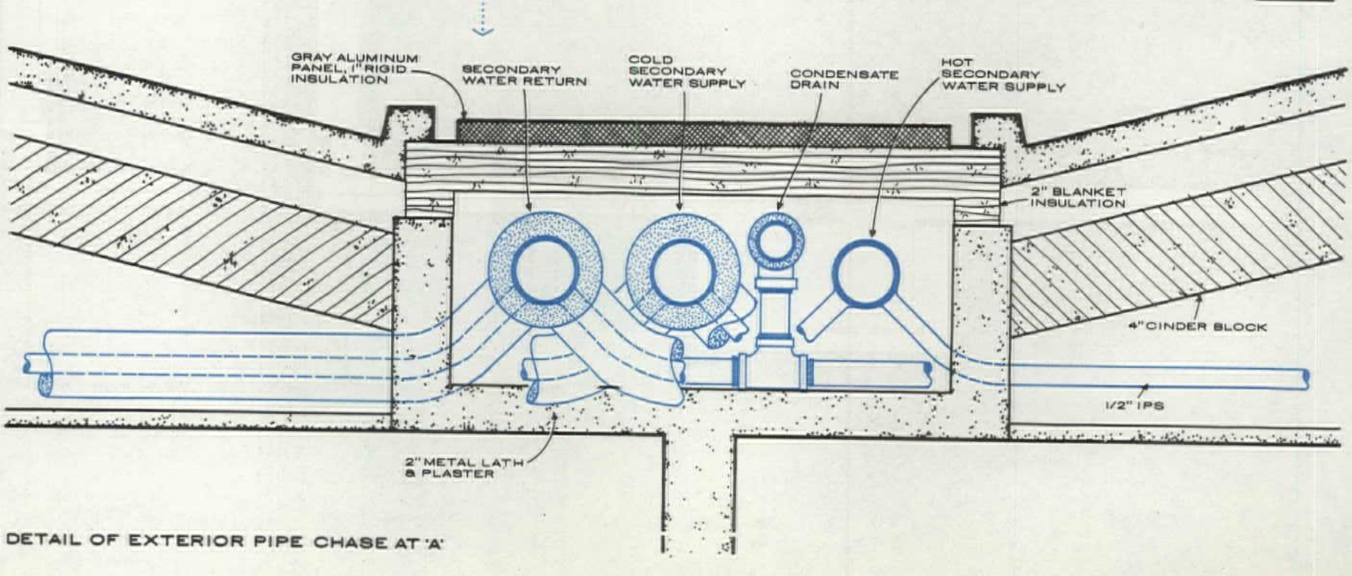


PHOTO: C. RAY SMITH



PLAN OF TYPICAL BAY



DETAIL OF EXTERIOR PIPE CHASE AT 'A'

Acoustical Admonitions

BY LAYMON N. MILLER

Two acoustical aspects of noise and vibration from air-conditioning equipment are airborne and structure-borne noise. Sources and measurements of these serious annoyances are suggested by a member of Bolt, Beranek & Newman, Acoustical Consultants, Cambridge, Massachusetts, and New York.

Air conditioning is an accepted standard in most new buildings, but the noises associated with some air-conditioning systems do not find such ready acceptance by the new building occupants. These noises can occur in all kinds of buildings, as the following examples indicate:

• The low-frequency, rumbling noise of an improperly vibration-isolated fan was so severe that a new building owner dared not show the top office floor to prospective tenants.

• In a chemical research laboratory, the building vibration caused by the refrigeration compressor made it impossible to use sensitive chemical balances to weigh minute quantities of materials.

• Overhead lights vibrate and cabinet doors rattle in a medical school classroom when a cooling tower is in operation on the roof deck above.

• Residents bordering a shopping center are disturbed at night by the noise of rooftop cooling towers on the nearby shops.

• One new office building is disturbingly noisy throughout, because all of the air is distributed in ducts at 3000 to 4000 fpm to the final mixing boxes.

• Hissing or whistling air leaks in high-velocity ducts are a frequent cause of annoyance to office occupants. High-velocity air outlet through diffusers sometimes makes the diffuser vanes rattle or sing. Even in moderately low-velocity systems, excessive noise may sometimes be made by dampers, turning grids, and diffusers that serve quiet offices, conference rooms, classrooms, or auditoriums.

• Starved air inlets to large fans can cause pulsation in the output that is transmitted as low-frequency rumbling into nearby areas served by the fan.

From his own experiences, the reader can probably recall other types of unique ventilation or refrigeration equipment noise problems.

Airborne and Structure-Borne Noise

In this short review, we cannot go into any details regarding the nature and solution of the above problems, but we will discuss briefly two of the important acoustical aspects of the noise and vibration from air-conditioning equipment. This pertains to the role of *airborne* and *structure-borne* noise in a typical ventilation noise problem.

Each of the above-described noise situations can be characterized as being either an airborne or a structure-borne noise problem. Airborne noise is essentially the noise that is radiated or transmitted by air paths to the listener, although it sometimes encounters solid walls which tend to reduce the transmission. Structure-borne noise, on the other hand, is usually caused by a piece of vibrating equipment that is connected by more-or-less rigid supports to a building structure. Vibrational energy is thus imparted to the building, where it may be transmitted by structural paths (columns, beams, floor slabs, partitions, etc.) radiating out from the source. These vibrating structural elements of the building set up vibrations in the air along their surfaces, and this air vibration, if intense enough, may manifest itself as audible sound or noise.

Measurement

For some installations that have caused serious noise problems, it has been necessary to measure the relative amounts of airborne noise and structure-borne noise or vibration to determine the dominant paths of noise into the critical area. This procedure is followed frequently as a means of determining whether the installed equipment has adequate vibration isolation in its mounting system. Special techniques must sometimes be followed in order to differentiate between airborne and structure-borne paths.

An effective procedure for separating airborne and structure-borne noise in a machinery installation has recently been used. The airborne sound of a troublesome compressor in its mechanical equipment room was tape-recorded through a microphone and a portable magnetic-tape recorder. The tape-recorded signal was then played back through a loudspeaker in the mechanical equipment room at the same sound-pressure level as produced by the original machine. In the nearby office area, which had been disturbed by the compressor noise, sound levels were then measured both for the normal operation of the compressor (with its associated airborne *and* structure-borne paths) and the tape-recorded playback of the compressor (with only its airborne paths, since the loudspeaker was supported resiliently in the machinery room and did not provide any significant structural paths). In this case, it was readily determined by the higher noise levels, due to the actual compressor operation, that the structural paths were responsible for producing the high noise levels in the nearby office.

Another procedure that is sometimes used to help differentiate between airborne and structure-borne paths is to short-circuit the existing vibration isolation mounts under the machine and thereby increase the amount of vibration that is transmitted into the building structure. The short-circuiting of the mounts can usually be accomplished by placing or forcing solid blocks or wedges across the isolation joint so that the vibrating machine makes solid, rigid contact with the building structure. When this is done, one would normally expect an increase of intruding noise or vibration into the nearby critical area. Depending on the amount and nature of the change of noise heard in the critical area when the mounts are short-circuited, it is frequently possible to decide whether the isolation mounts are adequate or whether the airborne or structure-borne paths dominate.

In addition, one may calculate approximately the amount of airborne sound that can be transmitted through walls or floor slabs into adjoining areas, and compare these calculated values with actual measured values of transmitted noise. Depending on the degree of agreement between the calculated and measured values, one can frequently judge if the noise is predominantly airborne or structure-borne into the critical area.

Good Design Provides Protection

In almost all installations of large pieces of air-conditioning or air-handling equipment, it is important to protect against the intrusion of noise by both airborne and structure-borne paths. It is the aim of good acoustical design to provide this protection. This review should serve as a reminder that appropriate acoustic treatment should be incorporated in the original designs, otherwise serious noise problems will later involve expensive and sometimes only marginally satisfactory solutions.

Composite Floor/Ceiling

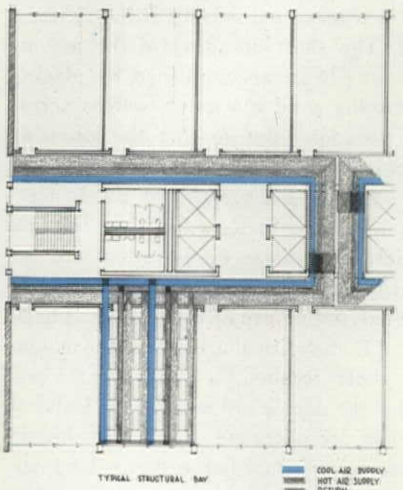
Last spring, fourth-year students at Pratt Institute's School of Architecture made a study of a multipurpose ceiling/floor system to house mechanical and electrical distribution equipment. The program called for the design of a typical structural bay that would provide air conditioning, lighting, sprinklers, sound system, and control of acoustics. One of the best solutions submitted was by David Rosenblatt (group leader), Richard Farrara, Robert Esnard, and Fred Klenk, who utilized a bay of a typical high-rise office building.

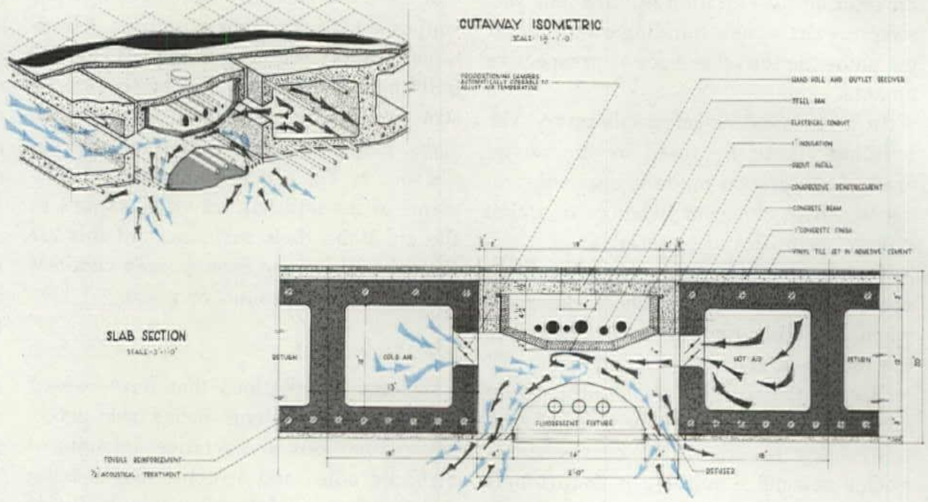
By combining structural components and distribution equipment into a simplified and economical ceiling/floor system, the team was able not only to eliminate the cost of using a suspended ceiling but was able to reduce the floor-to-floor height as well.

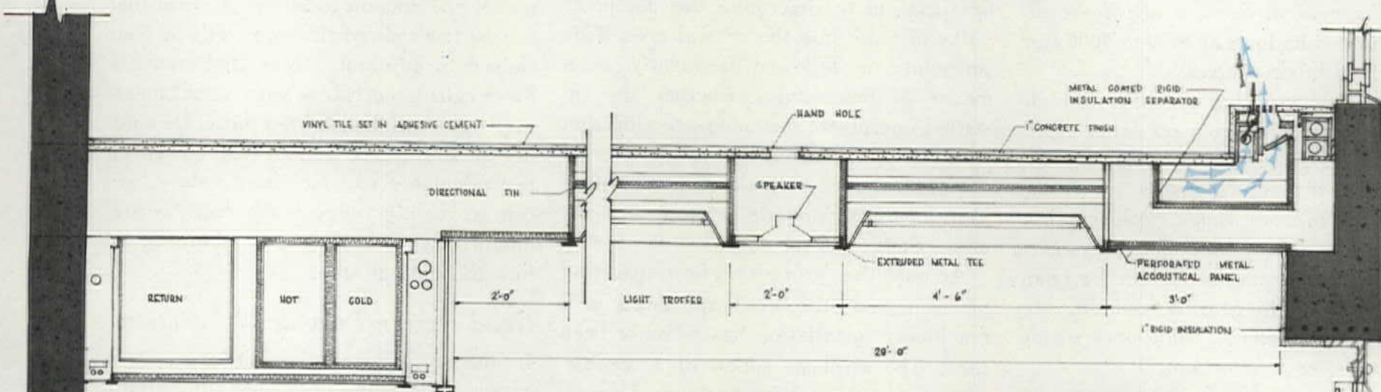
Flexible clear-span area for office space was created by employing precast hollow-core beams that span 29 ft from an exterior spandrel to an interior bearing wall. Each beam is 3 ft wide, 20 in. deep, and 5 ft o.c.

Light troffers, 4'-6" long and 16 in. wide, are placed in a 2 ft hiatus between the precast beams. Each row of lighting fixtures is 5 ft. o.c., and each fixture is separated longitudinally from its neighbor by 2 ft. A glass diffuser is mounted to the underside of the lighting fixture.

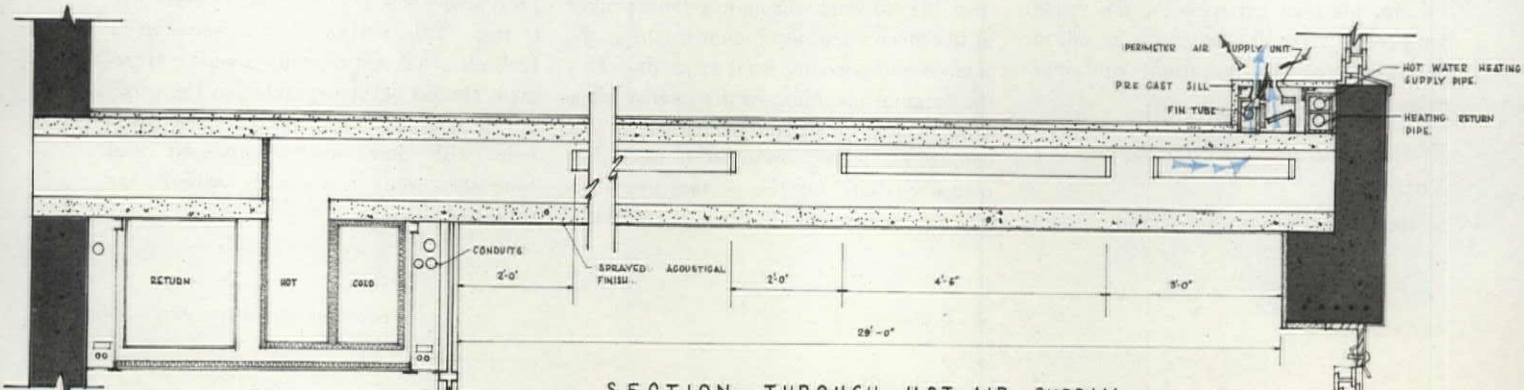
Conditioned air is delivered to and returned from the room through 4'-6" air diffusers integrated alongside the lighting fixtures. Slab cores adjacent to alternate lighting fixtures supply air while intermediate slab cores return air. Corridor ducts, which feed the hollow cores, receive the air from a central supply in the building. Located above each lighting fixture is a mixing chamber which blends hot and cold air to required temperatures. Conditioned air then flows from the mixing chamber through the air diffusers into the room.







SECTION THROUGH MIXERS & TROFFERS SCALE 1"=1'-0"



SECTION THROUGH HOT AIR SUPPLY SCALE 1"=1'-0"

Maximum Benefits from Mechanical Engineer

BY DONALD R. BAHNFLETH, P.E.

Ways in which the architect can obtain maximum benefits from his collaboration with his mechanical engineering associates are discussed by the Editor of Heating, Piping & Air Conditioning, *a Reinhold Publication.*

Each of the professionals involved in the design of a structure brings certain experience, skills, and knowledge to a design. These skills complement, rather than supplement, those of the other disciplines involved. In essence, then, design becomes a team effort and the success of a project will depend upon how well the team functions. It is our aim to review briefly how the team effort might be improved to the benefit of the owner and the construction industry.

Weight of evidence and controlled investigations indicate the importance of the physical environment to the health, well-being, and productivity of the individual. The way in which control of the environment is best achieved in a particular structure is intimately related to the structure and its intended purpose. To divorce the systems that ultimately provide thermal comfort, and the other necessary mechanical services, from the design of the structure, is no less disastrous than designing the mechanical systems and then wrapping the structure around them. Either approach can result only in dissatisfaction for the owner. Thus, one step in achieving maximum benefit from the engineer with whom the architect works is to enlist his services early—preferably during the conceptual stages of design.

Engineering is commonly defined as the art and science of practical application of knowledge of the pure sciences. Considerable emphasis—particularly in building design—must be placed on the words "art" and "practical." The consulting mechanical engineer today has a broad range of energy sources, primary heating and cooling equipment, and terminal heat exchange (including air delivery) devices from which to choose ones that are appropriate for a particular project. Selection of these within the context of the practical is as much art as science. The latitude of choice in serving an owner's need is severely limited when the potential solutions are not considered in the planning stage of a given project.

Establish Quality Level

The level of quality sought in the design should be clearly established in its conceptual stages. Within the range of mechanical system design concepts available, there are various levels of quality in terms of economic costs, degree of control, and so on. Mutual establishment and understanding of this parameter in the early stages will eliminate obvious difficulties when the design task is completed.

When establishing the level of quality, it is desirable to place the cost and contribution of the various elements or components of the structure in proper perspective. Where misplaced cost-consciousness occurs with respect to the mechanical systems, experience shows that the owner will incur considerable additional expense and inconvenience in correcting this situation to achieve full satisfaction of an otherwise functional design.

Time Requirements

How much time is required during the preliminary stages of design to assure selection of the mechanical system best suited for a particular project? Abraham Lincoln, when asked how long a man's legs should be, replied that they should be long enough to reach the ground. Innovation, the seed of progress, can occur only when planning time is commensurate with a project's scope. Clearly, the extent of the preliminary planning will be related to the originality of the architectural design, the complexity of the structure, and the functions to be carried out therein. Preliminary mechanical engineering on a routine project may require 10 per cent of the total design time, while a research laboratory or hospital with its many faceted facilities may require as much as 25 per cent of the effort. Some part of this, but not all, must be spent in conference. To set a fixed time for planning would deny the obvious differences in buildings and systems.

Once preliminary planning is completed, every effort should be made to get final working drawings to the consulting engineer as early as possible, to assure adequate time for completion of design computations and preparation of mechanical drawings. Interim solutions based on sketches can be made, but clearances, riser locations, and other physical factors often change when sketches are translated into architectural working drawings. The effect of such changes on interim solutions and mechanical design progress are obvious.

The interrelationship of architectural design parameters and those applicable to the environmental control systems must be and generally are recognized. The mechanical systems must be related to all aspects of a structure's design, including aesthetic qualities in those areas where the mechanical systems are visible and must be considered.

Design Parameters

Broadly speaking, the architectural parameters affecting mechanical design can be lumped into two categories—physical and thermal. The physical parameters embrace space limitations and dual use of structural components. The thermal parameters are those that either impose or control the heating and cooling loads on the air-conditioning system. Joint establishment of limits of these parameters during the preliminary stages of design will lead to maximum integration of the mechanical, structural, and architectural factors.

Systems, Not Collections

Today's technological innovations permit greater integration in building construction than was possible as little as five years ago. The growing recognition of the need to consider a building as a system rather than a collection of parts, and innovations now under development, will exert continuing pressure for full integration of a structure and its components. Full use of the concepts, equipment, and materials available will result only through early planning and close cooperation of the design professions.

In this issue of P/A are many fine examples of the way in which mechanical and architectural systems have been integrated, benefiting the owner both in terms of aesthetic qualities and total system performance. This is the basic responsibility of the building industry's design professionals. Can we afford to give the owner less?

FUTURE TRENDS

BY SIDNEY J. GREENLEAF

P/A's consulting editor for this issue comments on the nature of possible future developments in the air conditioning of buildings.

There is no question that the quantity of air conditioning will increase with time. It is already obvious that the inclusion of these systems is construed by the public, and therefore by building owners, as an absolute necessity. There are few places on earth where climatic conditions are such that some mechanical control is not necessary. The question seems to be: Will there be basic scientific advances in technology as applied to this field, or will we be limited to refinements of present techniques and equipment? Research effort that could develop completely new methods is beyond the financial capabilities of the equipment manufacturers, and the major source of research and development funds, the Federal Government, is not heavily interested in direct applications in this area. Environmental control interest on the part of the military is generally limited to the confines of space vehicles, environmental research chambers for the study of animal and human physiology, and the effect of climate on machines, clothing, and other hard and soft goods.

Types of Advance

Ideas in this field originate from consulting engineers, equipment manufacturers, and the several universities engaged in direct research. Advances in heavy equipment design, mostly refinements, are limited to those manufacturers who can afford a research program. These programs are by necessity market-oriented. The contributions of the consulting engineers involve, in general, new methods of combination of equipment, or new methods of integration of systems into structural and architectural design. The work of the universities is closest to the type of research necessary to develop the new methods of energy transfer, generation, and storage which would revolutionize our present technology.

New Energy Sources

Little has been accomplished in the development of new energy sources that would provide motive power for air conditioning, especially on a small scale. While nuclear energy is feasible for large central municipal plants when combined with electric power generation, we do not foresee its use in the immediate future for individual buildings. The technology of the transmission of energy has been refined and perfected to a great degree, but the methods themselves are antiquated. The transmission of electricity by wires, heat-carrying fluids and gases by pipes and air by ducts, regardless of high pressures or high temperatures, still remain the original means used. The development of solar energy has been seriously retarded by the lack of efficient and economical storage systems. The heat pump, which is a logical source of heating and cooling, has been limited in application because of high electrical energy costs. This objection can be overcome in many areas, however, by the use of gaseous fuels. The most basic concept of air conditioning—the transfer of heat from the human body to air and building materials—stands in need of additional research. The thermoelectric principle, if perfected, may utilize the building materials as heat sources and sinks. It is through this approach that some real changes in the technology will come about.

Multipurpose Components

Some of the presentations in this issue are the results of sincere efforts by materials manufacturers to produce building components that include air distribution channels or plenums. These efforts will probably be intensified in the future, undoubtedly with mixed effects. The difficulty often lies in that the natural rigidity and modular nature of these structural systems do not always correspond to the flexibility characteristics of the mechanical systems that may be functionally required. There is also a natural tendency on the part of the manufacturer to dramatize the use of his product by assigning some portion of the total aspects of air conditioning—e.g., radiant cooling—a disproportionate importance because of its direct relation to his product.

In his consideration of these structural-mechanical systems, the architect must be extremely cautious, so that his natural tendency to accept integration does not restrict either his aesthetics, economics, or the mechanical requirements of the building.

Noteworthy Refinement

A particularly noteworthy refinement discussed in this issue is the "bootstrap heating" system in the Toronto Professional Building. The extraction of heat from inner areas and re-use of this heat at the perimeter is an efficient and natural system, and the limitations of electrical energy cost, as stated, need not be a deciding factor if some other form of energy, such as natural gas, or even steam (turbine) is used. This type of system will see widespread use in the future.

The significant advances in the future will probably come about as by-products of the national defense and space efforts. Direct conversion of energy, solar energy storage, thermoelectric phenomena, transmission of energy without wires, the determination of new human physiological and neutral responses, the effects of light, sound, and other external factors on comfort, are all under constant investigation, and may have direct application to air conditioning.

Engineering of Systems

Of equal importance to the development of machines and technology is the development of engineers and architects to utilize the new technology. The engineering of systems is a technical architecture, a field which is woefully undermanned at present. The engineering schools, for their part, are not producing graduates for this purpose. And the schools of architecture are not, in general, devoting enough attention to this subject because of the large number of other subjects competing for the limited time available. Engineers should be trained specifically for this purpose, with a substantial architectural minor (see p. 212, MECHANICAL ENGINEERING CRITIQUE). At the present time, it is often difficult for an architect to find an engineer with whom he can communicate on an aesthetic level, or with whom he can work as a team.

The future? We anticipate real advances in technology, more awareness by the architect of the importance of environmental control and the relations of systems, structure, and function, and, we hope, more architecturally qualified engineers.

D. C. Oliver & Son, Designers and Builders, Dallas, Texas

Future Educational Plans

BY WILLIAM J. McGUINNESS

Changes in the educational programs for designers of mechanical and electrical equipment for buildings are reviewed by the Chairman, Department of Structural Design, School of Architecture, Pratt Institute.

Major revisions are now underway in the educational philosophy underlying the training of architects and their engineering collaborators. The next decade may mark the establishment of an entirely new and different framework for the professional background of those who will control the design of man's total environment (architects) and for their associates who will be responsible for the design of the technical facilities for environmental control (engineers for structure and equipment). A design *team* is envisioned.

It is the principal purpose of this month's column to discuss the much-needed changes in education for designers of mechanical and electrical equipment for buildings and communities. First, however, it appears essential to review briefly the changes already put into motion by architects to broaden their own educational structure. Following this review, this writer will suggest methods of implementing plans for broader education in general architecture, with emphasis on the architect's grasp of the essentials of mechanical design and his control of the designer.

Education of the Architect. In September 1961, a three-man commission chosen from among the AIA membership was appointed to study the architect's position in designing for man's total environment and to relate this to his educational process. The appointees were Robert F. Hastings, S. C. Hollister, and G. Holmes Perkins. Later this commission was augmented by Philip Will, Jr., Maurice W. Perreault, and, ex-officio, Olindo Grossi, then President of the Association of Collegiate Schools of Architecture. The commission, now renamed the Special Committee on Education, made its report in April 1963. The gist of its recommendations was as follows:

1. That architectural study comprise not less than seven years and include, in its later phases, a distinct specialty.

2. A suggested uniform, basic course in general architecture of not less than four years, as part of the seven (plus) years of education. Thus, specialists would sacrifice nothing of the important basic work and all would be primarily qualified as "generalists" and equal in professional importance prior to, and during, their practice of the specialty.

3. An internship program following the precedent established by the medical profession is a fundamental necessity.

4. That engineering be set up on a parallel basis for those who will serve as engineers on the architectural team.

Architectural Engineering. Item 4 of the above list deserves special comment.

Despite the greater number of engineering schools (170 as compared to 61 in architecture), it is evident that engineering graduates, and particularly those in mechanical and electrical specialties, do not gravitate toward architecture. An appraisal of this situation can be gained from a study of the approximate annual salaries earned by graduates with three years of experience. These figures are taken from two authoritative sources and reflect architectural salaries as well as those for engineers whose work is directly related to architecture.

Architect	$ 6500
Structural Engineer	7000
Mechanical Engineer	7500
Electrical Engineer	8000

The mechanical and electrical specialists are paid more, not because they are better trained or more important, but only because there are not enough of them.

Hope for more practitioners in these fields hinges on the schools of architectural engineering. There are 32 of these; they have four- and five-year courses which could be lengthened. At the June 1963 meeting of the American Society for Engineering Education, the present and future contribution of these schools was appraised. This panel, (1 of 175 events and the only one related to architecture), was moderated by Professor Vincent L. Pass of Penn State and comprised:

Panelist	*College*	*Subject*
T. W. Mackesey	Cornell	Concepts
H. A. Pfisterer	Yale	Structure
W. J. McGuinness	Pratt	Environment
S. C. Hollister	Cornell	Professional

The discussion made it quite apparent that these are schools emphasizing a structural approach. Begun about 1920 and much improved, but not appreciably changed in orientation, they presently contribute almost nothing to the mechanical and electrical needs of modern architecture. Although strong in mechanics and structural design, their courses in equipment design are of no greater depth than those for architects. The subjects of fluid mechanics, themodynamics, electrical theory, and heat transfer are almost nonexistent in these schools. With their 20 or more credits in purely architectural subjects, they offer a unique background for appropriate training in design for buildings that the usual curriculum in mechanical and electrical engineering largely omits. Perhaps they could adopt these much needed specialties. Their graduates should be engineers.

Architectural Specialists. Architectural education is bursting at its seams. In the present five- and six-year architectural curricula, a graduate with a planning major or a structural major has, in general, stolen time from architecture and is not highly regarded as an architectural "generalist." A mechanical equipment major is unheard of.

If we really hope to benefit from the experience of the medical profession, all architects should be fully and equally qualified before beginning a specialty. As in the case of doctors, it may ultimately be more usual to be a specialist

Continued on page 265

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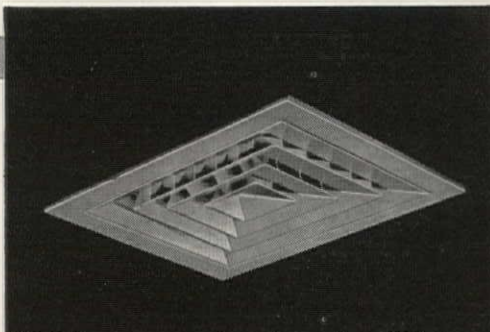

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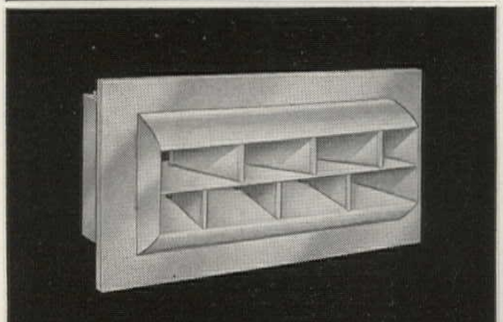

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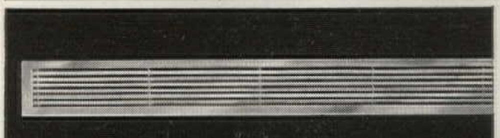

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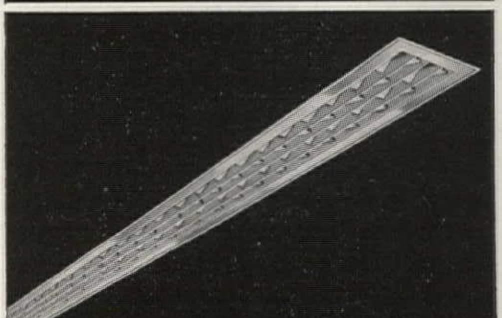

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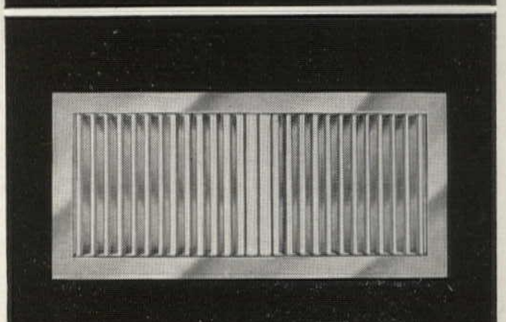

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Fine Hardwood Paneling

BY HAROLD J. ROSEN

Terms most frequently used in specifications covering fine hardwood paneling are defined by the Chief Specifications Writer of Kelly & Gruzen, Architects-Engineers.

There are many factors involved in achieving an installation of fine hardwood paneling. A basic understanding of the terms used will enable the architect and specifications writer to obtain the desired results.

Classification of Wood. Botanically, hardwoods are classified as deciduous trees, which bear leaves that are replaced each year. Softwoods are coniferous and have cones and needles that remain green the year around.

Types of Veneer Cuts. The manner in which veneers are cut is an important factor in producing various visual effects. Two logs of the same species, but with their veneers cut differently, will have entirely different visual characteristics, even though their color values are similar. For veneers, six principal methods of cutting are used.

1. Rotary. The log is mounted centrally in a lathe and turned against a stationary razor-sharp blade, in a manner similar to the unwinding a roll of paper. Since this cut follows the log's annular growth rings, a bold, variegated grain marking is produced. Rotary-cut veneer is exceptionally wide, and cannot be sequence-matched.

2. Half-Round. This is a variation of rotary cutting in which segments of the log are mounted off-center in the lathe. It results in a cut slightly across the annular growth rings, and, visually, shows modified characteristics of both rotary and plain-sliced veneers.

3. Back-Cut. The log is mounted as in half-round cutting, except that the bark side faces in toward the lathe center. The veneers so cut are characterized by an enhanced striped figure and sapwood along the edges.

4. Plain- or Flat-Slicing. The half log is mounted in a movable frame with a stationary knife. The heart-side of the log is placed flat against the guide plate and the slicing is done parallel to a line through the center of the log, producing a variegated figure.

5. Quarter-Slicing. The quarter log is mounted as in plain-slicing, except that the growth rings of the log strike the knife at approximately right angles, producing a series of straight stripes in some woods and varied stripes in others.

6. Rift Cut. This is generally produced from oak species that have medullary ray cells which radiate from the center of the log like the curved spokes of a wheel. The rift or comb grain effect is obtained by cutting perpendicularly to these medullary rays either on a lathe or a slicer.

Veneer Matching. As a log or a segment of a log is cut, the series of resulting veneer sheets is termed a "flitch." The hewn or sawed log, or a section of a log, made ready for cutting into veneers in this flitch are kept in sequence as they come off the cutting lathe or slicer, so that they may be matched and joined to make panel faces. The joining of the veneers is accomplished by means of a "tapeless splicer," which glues the long edges of the veneers together in whatever pattern is to be employed. The types available are many and varied, and the effects obtainable are limitless. Certain standard matching patterns are available as follows:

1. Book Match. Every other sheet is turned over, as are the leaves of a book. Thus, the back of one veneer meets the front of the adjacent veneer, producing a matching joint design.

2. Slip Match. Each sheet is joined side by side and conveys a sense of repeating the flitch figure. This is most commonly used in quarter-sliced veneers.

3. Balance Match. Each sheet is clipped equal width for each panel, resulting in a balanced appearance for each panel.

4. Center Match. Same as Balance Match, except that there are an equal number of veneer sheets on each side of the panel center-line.

5. Vertical Butt and Horizontal Book Leaf Match. Where the height of a flitch does not permit its fabrication into the desired height of panel, it may be matched vertically as well as horizontally.

6. Special Matching. Herringbone, diamond, reverse diamond, box, reverse box, "V," inverted "V."

7. Sequence or Blueprint Matching. This is derived from the same flitch, with all panels numbered by the manufacturer for erection on the job.

Panel Construction. The four types of core construction generally used in plywood panels are:

1. Lumber Core. Consists of a heavy core of sawn lumber with crossbanding and face veneers. The thick center core permits doweling, splining, and dovetailing.

2. Veneer Core. Plywood construction consisting of 3, 5, 7, or more odd-numbered plies of veneer, laid with grain direction of adjacent plies at right angles to each other. Normally, there is less contraction and expansion than lumber core but it is less easily doweled.

3. Particle Board Core. Core consists of chips or flakes of wood that are resin-coated and impregnated, and fused together under heat and pressure.

4. Mineral Core. Used for fireproof panel construction. Veneers are bonded to a hard, noncombustible surface.

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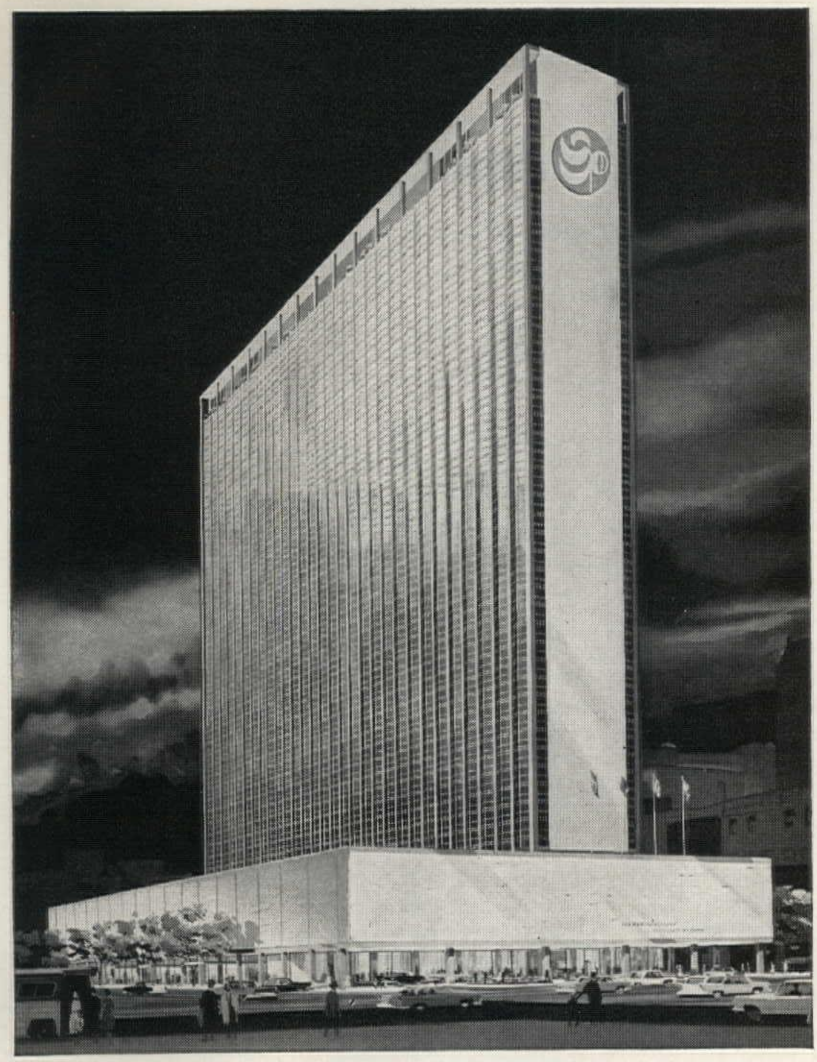

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Aesthetics and the Law: Part 2

BY JUDGE BERNARD TOMSON AND NORMAN COPLAN

In the second of three articles, Nassau County District Judge and a New York attorney discuss the controversial Seagram Building tax assessment case.

In last month's column we reviewed a recent determination of the highest court of New York (*People of the State of New York* v. *Stover*) upholding a municipal ordinance that was designed to preserve aesthetic values in a residential area. The recognition by the Court of aesthetics as appropriately a direct concern of the municipality was based, in part, upon an earlier determination of the United States Supreme Court (*Berman* v. *Parker, 348 U.S. 26*), in which that Court stated:

"The concept of the public welfare is broad and inclusive. . . . The values it represents are spiritual as well as physical, aesthetic as well as monetary. It is within the power of the legislature to determine that the community should be beautiful as well as healthy, spacious as well as clean, well-balanced as well as carefully patrolled."

At about the same time, however, that New York's Court of Appeals in the Stover case was articulating its belief that aesthetics is a significant element of public welfare, the Appellate Division of the Supreme Court of New York, in a tax case (*Joseph E. Seagram & Sons, Inc.* v. *Tax Commission*), rendered a determination that seems unconcerned with its effect on aesthetics.

This case involved the question of the appropriate real estate tax basis for an office building containing unusual aesthetic and architectural features. The office building in question was erected by Joseph E. Seagram & Sons, Inc., at 375 Park Avenue in New York City, at a cost, inclusive of tenant improvements, of approximately $36,000,000. The building was leased, in part, by the owner, and by other tenants. Said building was described by the Court as follows:

"The building in question is an unusual one in its nature, though not unique. It has these distinctive features which are the hallmarks of its class: It is generally known by its name (having relationship to the owner) instead of a street address; it is constructed of unusual and striking materials; its architecture is noteworthy; and it is well set back from the streets on which it fronts, the space involved being employed in distinctive decorative effects. The net effect is that this building, and the limited number that resemble it, gives up a substantial fraction of the land that might be built upon, with a consequent diminution of the rentable space, and its construction involves a cost materially in excess of utilitarian standards.

"These buildings serve their owners in a fourfold way: 1. They house their activities. 2. They provide income from the rental of the space not used by the owner. 3. They advertise the owner's business. 4. They contribute to the owner's prestige."

The usual basis for assessment of commercial property is its market value, based upon a capitalization of the building's net income. Such capitalization, as calculated by the Court, amounted to approximately $17,800,000. This figure was substantially less than the assessment placed on the building by the City Tax Commission. The unusual architectural and aesthetic features of the building were not reflected in the market value under the traditional method of calculating the same, and for this reason, the Court concluded that the usual method of determining value for tax purposes was inapplicable, and the owner's reliance upon such method was erroneous, stating:

"In this city at present buildings in this special category, though few, are not unique. The time may come when they are so numerous that they become subject to sale, rent and the other transactions of commerce, so that by trading a market price which reflects the extra-commercial aspect can be ascertained. . . .

"It would seem to follow beyond the hope of successful contradiction that the traditional method of ascertaining value by capitalization is not applicable in this situation."

Three justices of the Court, concurring in the result, stated that the cost, as distinguished from the market value, of a "prestige building" should be a significant factor in determining the proper tax basis. They stated:

". . . to begin with, the owner did not build for commercial rental-income purposes alone, and, as a consequence, capitalization of such income without adjustments produces a false result. . . .

"It is self-evident that an owner who builds, as did this taxpayer, a prestige (monumental) building for itself, requires the leasing to other commercial tenants simply as an important way of bearing the heavy costs involved. The prestige building has a rental value not based alone on commercially rented space, but on the building's value in promoting the economic interests of an owner. Thus, such an owner is not wasting assets. Rather, he is investing in a real estate project that will contribute to the production of income in its principal enterprise. Since this practice is becoming a common feature of urban areas, such investment has ceased to be idiosyncratic and is undoubtedly translatable into market value terms. Typically, such value would be related to owner-occupancy of principal or prestige offices with choice space, the continued power to control its choice of space, and most often, identification by name of the building with that of the owner.

"On this view the rental value assigned to the taxpayer's space is understated, if there is merely charged to that space the prorated value assigned to other tenants. And, undoubtedly too, there is value to be assigned to the building as a whole, independent of commercial rental income, since the building, qua building, is also held for business purposes, unrelated to the receipt of commercial rental income.

This decision, now on appeal, has caused great concern in the building industry as a threat to the construction of aesthetically unique buildings. This will be discussed in next month's column.

Architect: Walter J. Rozycki, A.I.A.
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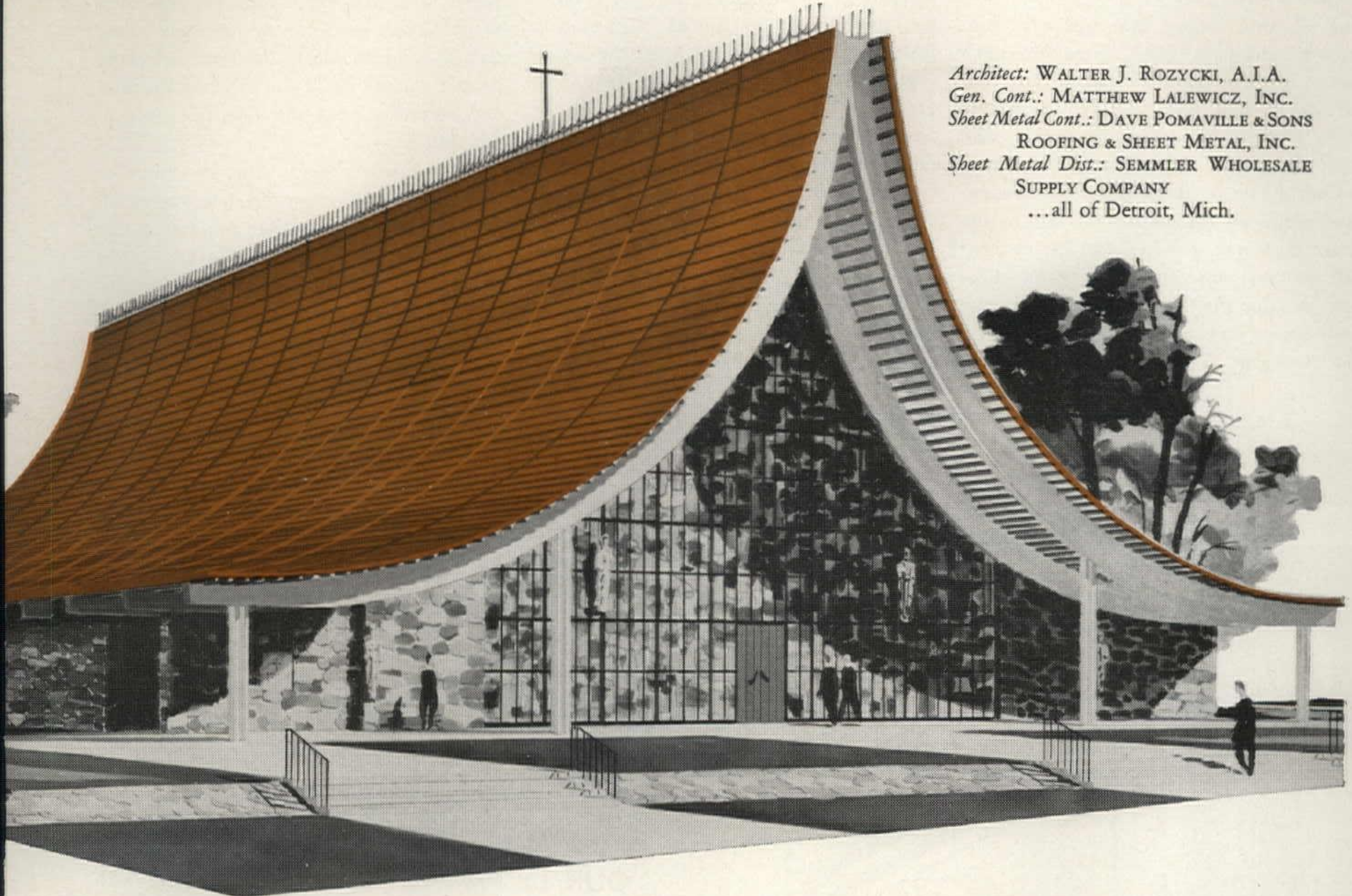

In conceiving the design of this structure the architect, Walter J. Rozycki, visualized the bold, soaring sweep of the roof as the commanding element of the overall structure, both in size and contour. Said he, "Such a roof, without the use of copper and its characteristic design flexibility, would have been virtually impossible."

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Details of construction are shown in the accompanying illustrations. The 4″ x 4″ vertical battens are spaced 10′0″ on centers; the 2″ high steps running horizontally between the battens are spaced approximately 20″ apart. Horizontal roof pans are of 24″ wide sheets of 20 oz. cold rolled Revere Sheet Copper. A tapered layer of rigid roof insulation is laid between the horizontal steps.

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and of the forces that shaped their growth. Prior to 1850, runs Warner's thesis, Boston was a city of a type that the world had seen before, a closely built pattern of attached houses and other buildings concentrated within a radius of two to three miles. The dominant mode of transportation within the urban area was walking. But in the next half century, new modes of travel came into being—the steam railroad, the horse-drawn car on rails, and the electric streetcar. This new transportation technology transformed the city even as its population expanded enormously. Boston changed from a city of the classic type into a new form: the metropolitan area.

Warner traces the effects of transportation change and other closely related factors, including innovations in sanitary engineering and in building technology and finance, on the villages of Dorchester, Roxbury, and West Roxbury, all of which were later annexed by the central city. By detailed examination of census and building records, he is able to recreate with striking clarity the blooming of suburban sprawl, as the new technology brought within the reach of many people variations of the kind of life that had formerly been the province only of the rich.

The growth process that he traces in the close-in suburbs of Boston was paralleled in most of our other pre-automobile cities. The picture that Warner draws is one of upper-middle-class families seeking to emulate the separate town houses and country estates of the wealthy by constructing a single dwelling located in a rural environment, but within easy reach of the center city by virtue of improved transportation. This outward movement of the upper middle class was in turn imitated, with less success and in an even less rural environment, by successively lower middle-class groups as radial streetcar service became more frequent and speedier. In the last stages of development of the streetcar system, the linking of the radials by circumferential routes, a densely packed maze of freestanding structures became the dwelling places of even less wealthy Bostonians. This process of succession relates two apparent extremes—the single-family house on a large suburban lot and the wooden three-decker cheek-by-jowl with its neighbor—and shows the latter to be a true, if poor, descendant of the former.

Streetcar Suburbs is an adventure in urban history that can well serve as a model for an investigation into the structure of the city. The book is both revealing in itself and at the same time gives valuable insights into what can be done to reclaim aging streetcar suburbs for modern use and for the new population groups that have replaced their original residents.

The Urban Villagers is also about a part of Boston. It is a revealing study of the Italian-American inhabitants of the former West End district by a participant-observer who lived among them in the year before they were displaced by one of Boston's earliest urban redevelopment projects. While *Streetcar Suburbs* depicts a process of growth in the city, *The Urban Villagers* reveals a no less important pattern of adjustment by a lower class immigrant group to the vicissitudes of life in one of the city's traditional "receiving areas." The pattern of change in the West End, at least in the decades prior to its redevelopment, was less one of physical change than of social adaptation to dense urban living.

Gans' study is one part of a larger research project entitled "Relocation and Mental Health: Adaptation Under

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Stress," sponsored by the National Institute of Health. While the major focus of the as-yet-incomplete larger research project is the impact of redevelopment and displacement on the social and mental well-being of the inhabitants of the West End, the emphasis of the present book is on the living patterns of the former residents, although the final two chapters do concentrate on the redevelopment process.

The author's argument is that the Italian-American residents of the West End, who constituted nearly half of the area's population at the time he lived among them, typify a working-class subculture in the urban scene. He maintains that this subculture has its own values, standards, and criteria, and that it is in terms of these that the value of the neighborhood should be judged, rather than in terms of the dominant middle-class culture of America. From this thesis, and after a well-written and perceptive evaluation of the subculture, he proceeds to the conclusion that it is wrong and inhuman to obliterate this subculture through urban redevelopment, even though the redevelopment process may make possible the achievement of other goals of the larger community of the city.

It is a telling argument, and one that must be given very serious consideration. That the West End is probably representative of only a small number of urban renewal project areas; that the West End project was undertaken early in the history of urban renewal and was perhaps carried out with less skill and consideration for human values than many other projects—these are, at best, only partial answers to Gans' argument. More meaningful and comprehensive answers are required, if the urgently needed renewal of densely populated central city areas—needed for social, economic, physical, and political reasons—is to be accomplished without causing undue harm to the people who now live in such areas. One part of the answer may be found in the shift away from large-scale clearance in the urban renewal programs now being planned in Boston and other cities. Other parts, it seems clear, must be sought in the kind of perceptive understanding of the values of urban subcultures achieved by the author of *The Urban Villagers*. This understanding is needed if the goals and values of the larger community are to be sensitively responsive to the needs and best interests of its various subcultures.

DAVID A. GROSSMAN
Director, Community Development Branch
Urban Renewal Administration
Washington, D.C.

A Vivid Recounting

DRAWINGS BY ARCHITECTS: FROM THE NINTH CENTURY TO THE PRESENT DAY, *by Claudius Coulin. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. (1962, 144 pp., illus. $12.75)*

This volume provides us with an unusual opportunity to study and compare the drawings of great architects. It permits us to observe the several characteristic techniques of the individual architects, and the schools and periods of draughtsmanship to which they belonged. And, since the drawings are arranged in chronological order, starting with the monastery plan of St. Gall, *circa* 820, and ending with a drawing made in 1961, we are presented, in the bargain, a rather unusual aspect of the history of architecture. Though such a history must necessarily be spotty, since drawings are fragile documents and relatively few of the earlier drawings have been preserved, it is a particularly vivid recounting of

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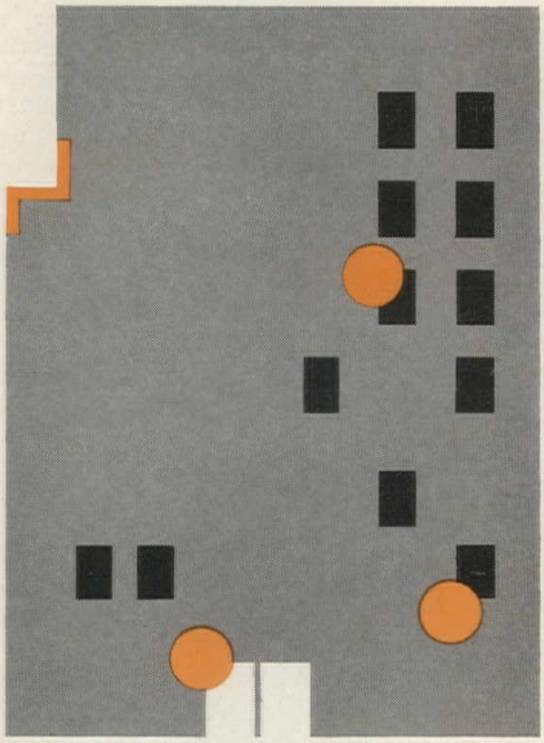

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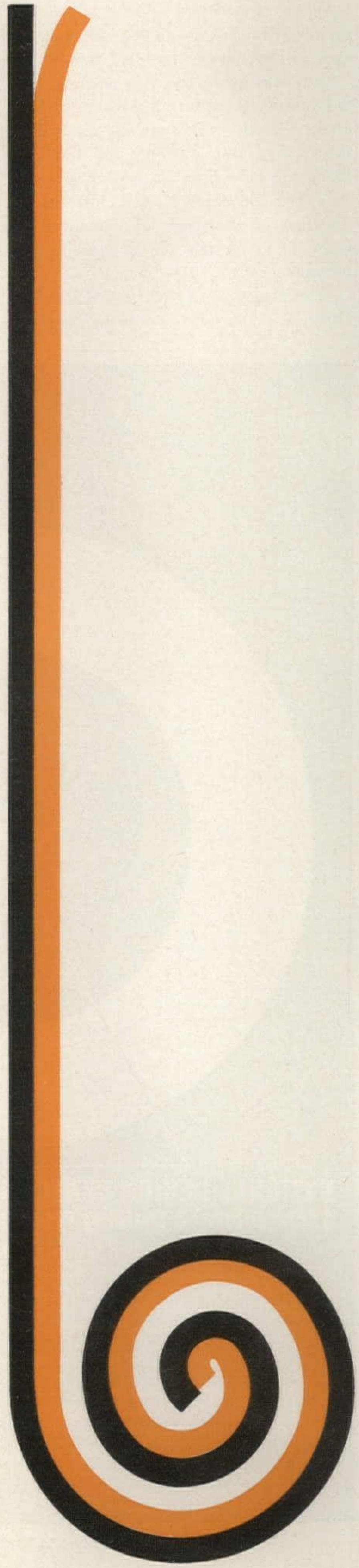

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Continued from page 228

architectural history as seen through the eyes of the "master builder" himself.

Drawings serve the very specific purposes: first, of capturing the architectural idea; second, of graphically describing this idea to the patron; and third, of fixing the guidelines for actual construction. For the student of architecture, a drawing is therefore of indispensable value in conveying the original design intention.

A photograph of Rheims Cathedral, although capable of documenting the monument with great precision, cannot possibly convey the essence of the architecture as can, for instance, Villard de Honnecourt's elevation drawing (interior and exterior of a bay of the nave, shown on p. 2). His drawing, though he was apparently not the architect of Rheims Cathedral, gives an indication of the precise "visualization" that must have preceded the construction of such an intricate Gothic building. Such drawings established the basic proportions of the building elements, and outlined the general shape of statuary (see angel, upper-left corner) and other ornaments, so that all would finally work in unison. It is interesting, incidentally, that Villard de Honnecourt, the 13th-Century architect, assembled these and many other drawings to serve as a manual for his apprentices.

One of the interesting points of comparison in the book is provided by the drawing of the Minster of Ulm, a Gothic work of the 15th Century, which immediately follows the drawing of Rheims. Where Rheims provides only guidelines for the building trades, the architect of Ulm, 250 years later, with a masterful, exact drawing, leaves nothing to the imagination of the mason.

Drawings by Leonardo da Vinci and Baldassare Peruzzi bring us to the beginning of architectural perspective, an extremely important step in the development of architectural drawings. Later, the introduction of paper, pencil, washes, watercolors, and copper engravings suggests the ever-widening choice of drawing media.

Further, the author has not neglected examples of the various types of drawings: the quick and facile sketch, for example, by Aalto, Saarinen, or Utzon; the preliminary design drawing, somewhat more refined, though not yet frozen, by such architects as Sullivan and Ponti; the meticulous drawings of Wren and Fry; and the final working drawings by Cuvilliés and Perret.

Finally, it is important to note that all drawings are reproduced in their original size, and such useful data as type of paper and drawing instrument, as well as a listing of major works by the architect, accompany each sheet. Quality of reproduction, paper, typography, and layout of the book do justice to this fine collection of architectural drawings.

I.M.R.

Before and After the Golden Age

THE GREEK STONES SPEAK, *by Paul MacKendrick. Published by St. Martin's Press, Inc., 175 Fifth Ave., New York 3, N. Y. (1962, 470 pp., illus. $7.50)*

The way in which archaeological excavations have clarified and extended historical knowledge is the deftly depicted theme of *The Greek Stones Speak.* Historical highlights concern everything from the Colossus of Rhodes (which archaeologists have proved did not actually *span* the harbor); to the personality of Marcus Aurelius (colorful but not totally admirable); to the fi-

Continued on page 236

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For the owner, these extra-weathertight windows (more than 3 times industry standards) will mean significant savings in heating and cooling costs . . . and lasting tenant satisfaction. And occupants will like the way Andersen wood windows provide weathertight comfort the year around. (The entire project is equipped with Welded Insulating Glass.)

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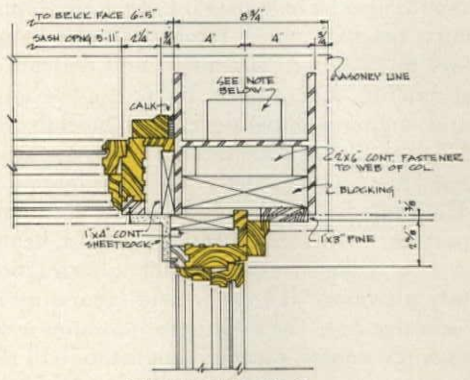
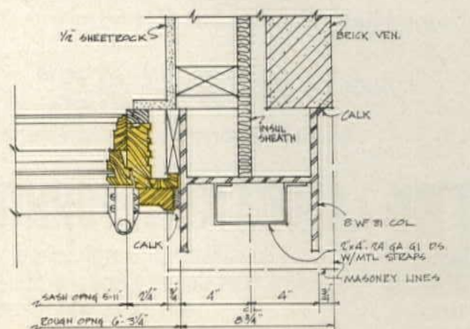
ANDERSEN CORPORATION
BAYPORT, MINNESOTA



TYPICAL JAMB-COL 3



TYPICAL JAMB-COL 16

For more information, turn to Reader Service card, circle No. 317

Continued from page 232

nancing of the Acropolis (from taxes on cultivatable land or commercial prosperity, annually paid to Athens; Pericles was criticized for using any surplus funds to beautify the building).

MacKendrick corrects the notion that the Greek population was of unmixed origin; he establishes throughout that it resembled, instead, the "melting pot" mixture of the U. S. He gives evidences of the kind of people they were. An example of their individualism: the Greek foot of measure was different in different localities. He explains *how* things were built, emphasizing that the architects in the Classical Age were the organizers—the real artists were the masons. Details of the way in which archaeologists work—their patience, their cataloguing, the logic plus zeal of their approach—add color.

As the book jacket accurately states, this volume is "for everyone interested in archaeology and all travelers to the Mediterranean." *The Greek Stones Speak* should interest laymen, students, as well as those with a professional interest in the subject. There are *facts* for the reader who is unfamiliar with the ancient Mediterranean world, there are *facts* for those who have not had any architectural education—and these are laced throughout with touches of humor and human interest. Most gratifying is the profusion of illustrations, photographs, maps, and diagrams located in the precise spots in which they are referred to in the text. Readers who consider this subject "old-hat" should enjoy such a well-organized, scholarly book as a refresher course.

J.W.F.

Dimensioning Man

ANATOMY FOR INTERIOR DESIGNERS *by Julius Panero; illustrated by Nino Repetto. Published by Whitney Library of Design, 18 East 50 St., New York 22, N.Y. (1962, 146 pp., illus. $8.95)*

With a wry sense of humor, Julius Panero presents the third edition of *Anatomy for Interior Designers* which includes the imaginative and amusing sketches by Nino Repetto. The basis of the book is the time-honored maxim that man is the measure of all things. By exploring the diurnal activities of both man and woman, Panero discusses the measurements of those pieces of furniture that enable man and his counterpart to live a more easy, comfortable, and enjoyable life.

The book is divided into six sections: the basis of all design, residential appli-

For more information, turn to Reader Service card, circle No. 401

cations, commercial applications, circulation, lighting, and measurement tables. The residential section breaks down into living, dining, family, and bed rooms; kitchen; storage space; and the human eye and television. The commercial section discusses business offices, retail stores, restaurants, and bars. Circulation section points out the differences between horizontal and vertical circulation. Lighting section shows the use of proper lighting measurements for office and home, and their effects. Tables include carpet areas, ceiling- and floor-tile quantities, formulas, properties of the circle, decimals of a foot for each thirty-second of an inch, and standard United States and metric systems of measure. Besides the common dimensions of chairs, tables, desks, and stairs, Panero also discusses dimensions that concern bridge and pool tables, junior and executive type yo-yo's, sizes of booze bottles, and stairways that eliminate annoying clients.

Panero, aptly aided by Repetto's sketches, has turned a dry subject into an interesting and informative discussion of the measured relationship between man and the furniture he utilizes.

J. B. S.

A Necessary Reference

AMERICAN ARCHITECTURAL BOOKS *by Henry-Russell Hitchcock. Published by University of Minnesota Press, Minneapolis 14, Minn. (1962, 130 pp. $4.75)*

The reprint of this indispensable bibliographical tool is most welcome. First issued in 1946, it has become a necessary reference for anyone working on the history of 19th-Century American architecture. With the impeccable scholarship we have come to expect from him, Professor Hitchcock has organized a huge mass of material in admirable fashion. Each reference is accompanied by a notation of the libraries holding the relevant item. This is an enormous convenience for the student.

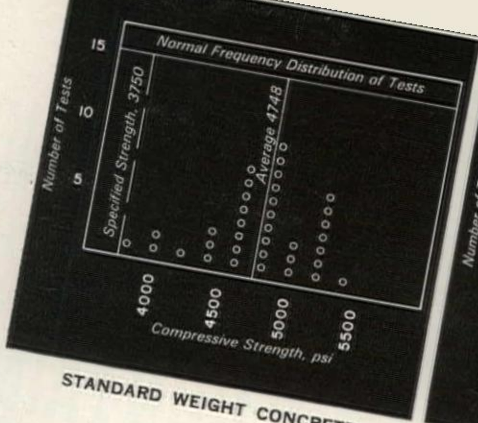
LEONARD K. EATON
Associate Professor of Architecture
University of Michigan
Ann Arbor, Michigan

Sullivan the Thinker

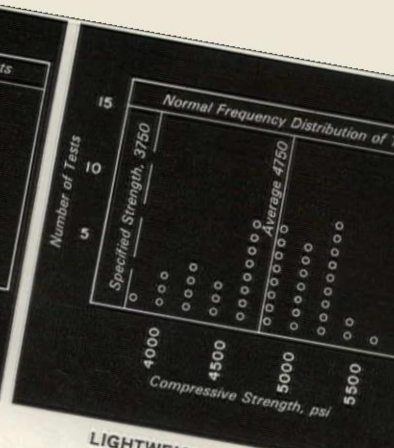
LOUIS SULLIVAN: AN ARCHITECT IN AMERICAN THOUGHT *by Sherman Paul. Published by Spectrum Books, Div. of Prentice-Hall, Inc., Englewood Cliffs, N.J. (1962, 176 pp. clothbound: $4.50 paperbound: $1.95)*

The classic phrase "slim volume" applies to this small book on Sullivan, which

Continued on page 246



STANDARD WEIGHT CONCRETE



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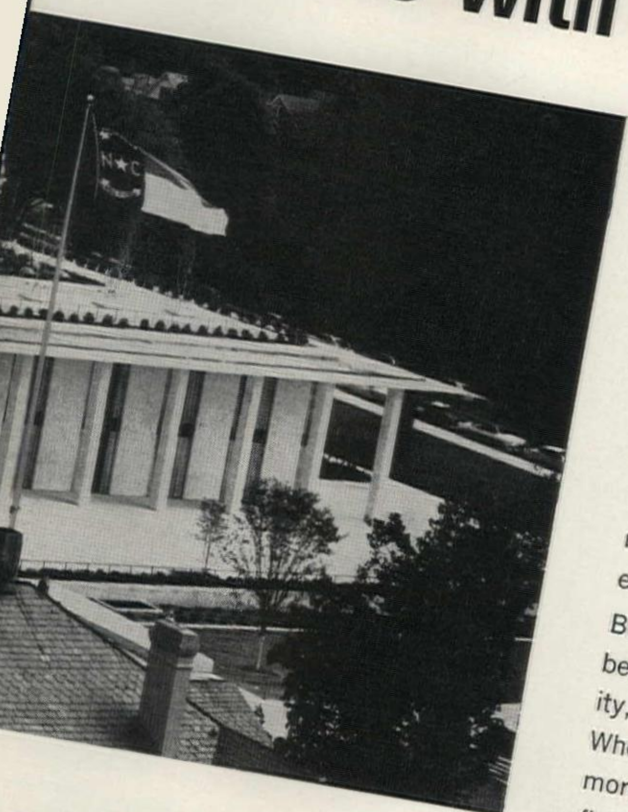

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For more information, turn to Reader Service card, circle No. 371

Continued from page 238

the author, in his Introduction, modestly calls an essay. Naturally, the prospective reader, if he picks it up casually, will ask himself, "How much information about Sullivan does it contain?" If he is a *cognoscente*, he will ask himself, "What does it add that I don't already know?"

The book's subtitle, "An Architect in American Thought," is, of course, the key to the author's intention. He is going to present Sullivan to us as an American thinker who not only writes what he thinks but builds it, too. It is, in my opinion, a very ambitious project. If successful it should become another landmark in the presentation of Sullivan to the American public. We might say that the first landmark was Professor Morrison's scholarly work on Sullivan the architect; that the second was Connoly's work on Sullivan the man; and that the third might logically be Paul's work on Sullivan the thinker.

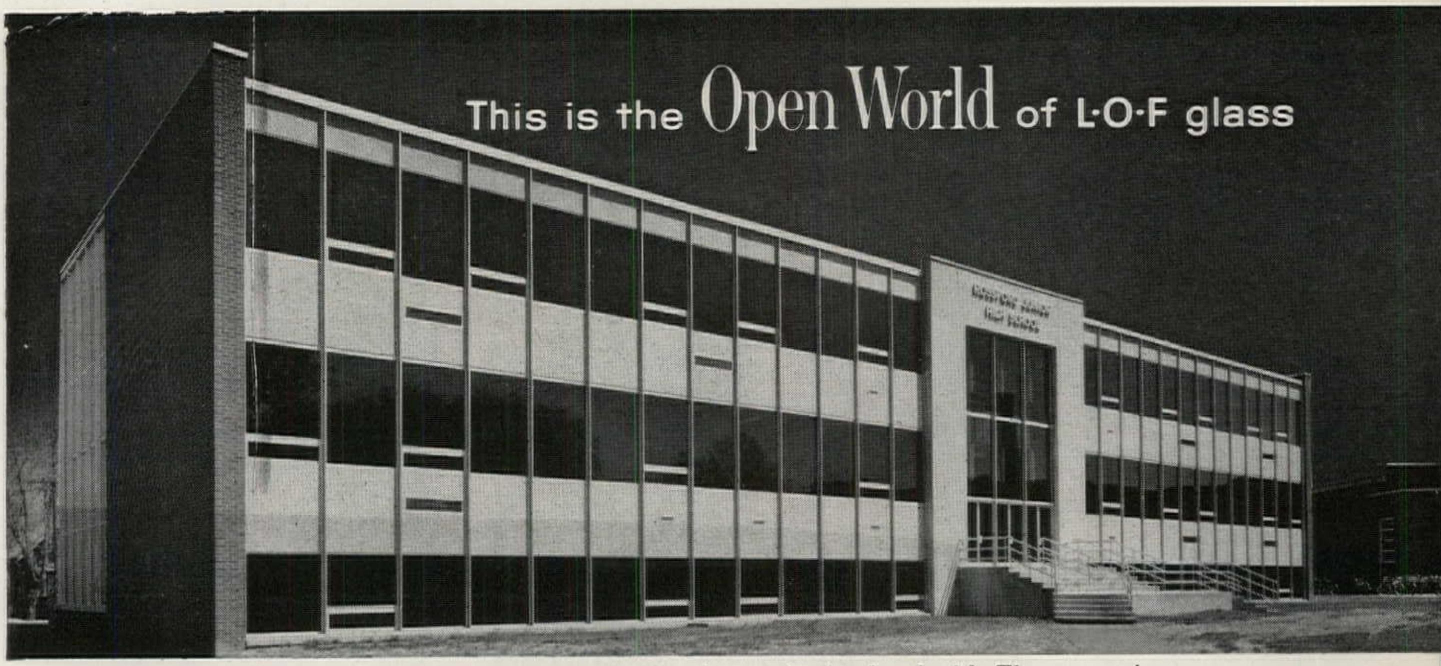
Professor Morrison's book is a landmark because it was the first but also because it is a reliable, developmental account of the course of Sullivan's architecture. Connoly's book, the work of a journalist, concentrated upon Sullivan's life and added to the legend a good deal of original material drawn from family archives previously unavailable. Now we have another professor—Sherman Paul —concentrating upon Sullivan the writer, and it is worth more than passing notice that Professor Paul teaches American literature at the University of Illinois. It is all very appropriate. Professor Paul, in his desire to link Sullivan with Emerson, Whitman, Veblen, Dreiser, and other exponents of the old American way of thinking, must have recourse primarily to Sullivan's writings. His book becomes, therefore, a sort of exegesis of these, with running commentary. Like the prototype —exegesis of Scripture—it must assume a thorough knowledge of the source on the reader's part, plus an equally thorough knowledge of the work of the writers with whom Sullivan is compared. The resultant method can be both confusing and frustrating, for an average paragraph consists of snatches of quotation interspersed with lengths of commentary in a sort of tumbling relationship. It is already clear that we have come upon the answer to our first hypothetical question: Professor Paul's book is not for the uninitiated.

The first part of the book, in which the author lays the foundation for the latter by setting forth Sullivan's early

Continued on page 252

1072F with oiled walnut top, one of the 1000 SERIES models as used in the new American Baptist Convention office building at Valley Forge, Pennsylvania.

For more information, turn to Reader Service card, circle No. 344



Rossford Junior High School, Rossford, Ohio, is completely glazed with *Thermopane* insulating glass with grey plate glass in outer pane. Architects: Hoke & Nickerson, Toledo.

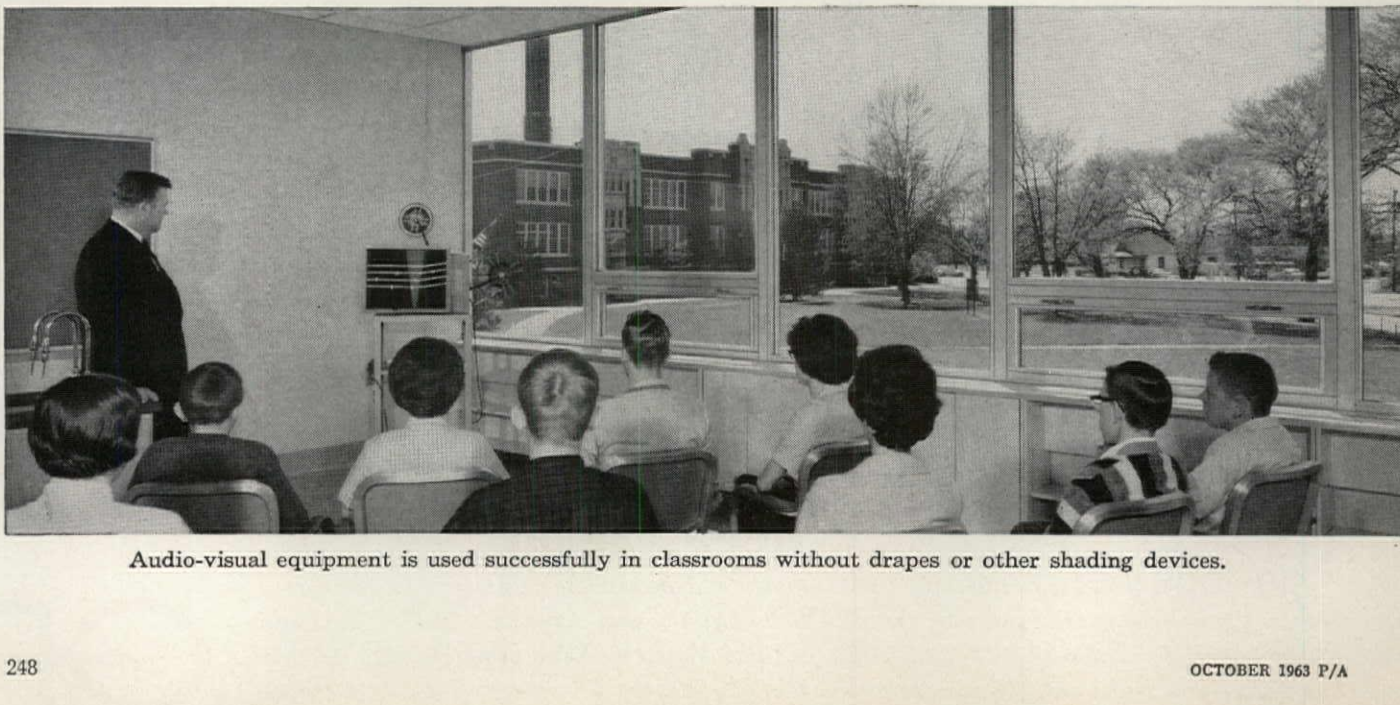
An air-conditioned school

*** This figure includes all construction costs, including heating and air-conditioning equipment. Cost of site and incidental equipment (such as desks) not included. A $600,000 bargain, with a capacity for 450 students, that compares most favorably with the cost of non-air-conditioned schools in this high-cost construction area.**

The Rossford (Ohio) Board of Education envisioned a Junior High School that could be extensively used year 'round. They wanted the comfort of air conditioning combined with the environmental benefits of sunshine and view provided by large window areas. The answer to this dual requirement was found in *Thermopane*® insulating glass, with grey plate as the outer pane. The extra cost of the double glazing (as compared to single glass) was offset by reduction in size of central heating and air-conditioning units . . . and their cost of operation. For maximum comfort and economy, the building was divided into six zones. Each can be heated or air conditioned independently.

How has the building worked out? "Wonderfully," says Dr. William L. Ramsey, Superintendent of Schools. "We first occupied it on January 21, 1963. Since then we've weathered one of the worst winters in history. Temperatures dropped as low as 18° and 20° below zero. The building was comfortable. There were no down drafts near the windows. Our heating costs were most economical.

"We like the big, open views through



Audio-visual equipment is used successfully in classrooms without drapes or other shading devices.

Soft, glare-free daylight permits science class to view X rays without eyestrain.

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our windows. They're never marred by frost or fogging—even in the locker room. The building is oriented from N. E. to S. W.; and with the grey plate glass, we don't have a glare problem. In fact, we don't have any drapes or shading devices. We don't need them, not even when using audio-visual equipment."

Noise never disturbs us

The principal, Mr. Alton Gladieux, had this to add: "These buildings, the old high school and the new junior high, are located between a busy highway and the athletic field. In the old building the windows rattled, had to be opened for ventilation. It made for a noisy school. Here, outdoor noise never disturbs us."

The public reaction to the new building has been gratifying. Visiting school administrators have praised the school's compactness, and have admired the "Open World" campus-like view. "I have yet to hear any criticism," says Dr. Ramsey. "But most important of all, is the students' reaction. They're better behaved, and absenteeism has declined."

For technical information on *Thermopane* insulating glass, call your L·O·F distributor or dealer (listed under "Glass" in the Yellow Pages), or write to L·O·F, 3103 Libbey · Owens · Ford Building, Toledo 2, Ohio.

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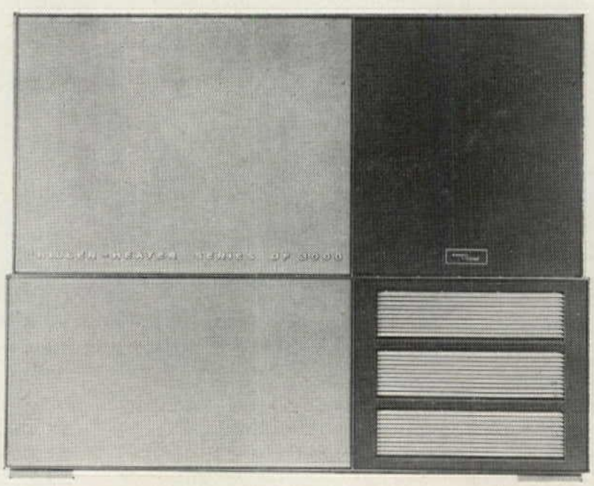
Teachers' lounge draws faculty members from the high school seen in distance. They prefer it to their own dimly daylighted retreat.

Stair wells at both ends of building are glazed also with *Thermopane* insulating glass for heating and air-conditioning economy. Grey plate glass in outer pane reduces sun heat and glare.

For more information, turn to Reader Service card, circle No. 364

The Courtland Medical Center, Milwaukee, Wisconsin · Architects: Maynard W. Meyer Associates · Mechanical Engineers: Ring and DuChateau

Medical Center heated by Gas...




COURTLAND MEDICAL CENTER

Continued from page 246

life in Massachusetts, Philadelphia, Europe, and Chicago (before the fateful meeting with Adler), relies almost entirely upon the *Autobiography*. There is nothing new here, other than the author's interlarded commentary. There is, of course, the special point of view, which is interesting. Paul emphasizes those passages, such as the days on the farm with Grandfather List, which can be construed into a mystic love of the soul and of the natural man that conjures a vision of Whitman. Later on, we are in the world of *Kindergarten Chats* and those somewhat contentious outpourings of Sullivan's which reveal him as having something less than the lyric strength of Whitman. Here again, the point of view taken by the author is that we see Sullivan, now like Veblen, Dewey, and Dreiser, battling for native American values against European clichés. The uniqueness in this aspect of Sullivan's life is that, unlike the others with whom he is continually compared, he has two strings to his bow: while he writes, he builds (or, to be accurate, has built—for many of his best-known literary efforts postdate the time when he was an active builder). If this uniqueness cannot be demonstrated, then the case for Sullivan as a great American thinker falls a little flat since, in his writings, he so often appears querulous rather than decisive.

It must surely have been Professor Paul's idea to link Sullivan's architecture with his writings and to make one the counterpart of the other so that, together, they make a powerful argument. There are references to Sullivan's buildings, and about half a dozen are illustrated. There are allusions to the "maleness" of the Auditorium (a Whitmanesque touch, but with due credit given to Richardson's Marshall Field Wholesale Building), and a photograph of the Guaranty Building carries beneath it the phrase "mobile equilibrium." But somehow, for this reader, the magic trick of integration, which could be so truly exciting, does not come off. The book leaves me with a sense of irresolution: Sullivan still exists, for me, as an architect who, like many others, writes, too. And finally, there is the question of Sullivan's ornament; it emerges from Professor Paul's brief handling undefeated as one of the major mysteries of the story of American genius.

Now we come to the answer to my second hypothetical question. What does the book offer to the *cognoscente?* It offers a sort of review of the known writings of

. . . speed, economy, flexibilty

Insurance in steel

It isn't hard to understand why designers chose steel for the new 23-story home of Continental National Insurance Group in Chicago's Loop.

For one thing, they wanted to make the most efficient use of available space. Using USS MAN-TEN (A440) Steel for the 20 columns, they were able to achieve 42 x 42-foot unobstructed bays. The high strength of MAN-TEN steel meant more useable floor space because the columns are leaner. Further economies were realized by the duplication of beams and girders which permitted the fabrication of hundreds of identical floor members. Floor-to-floor heights were kept to 12 feet by running mechanical ductwork through reinforced openings in floor beams and girders.

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United States Steel

Der Liebe Meister, in context not so much with 19th-Century American literature as a whole, as with the writings of the Chicago School, which Professor Paul very refreshingly interprets as the total product of Chicago in its days of glory.

GRANT MANSON
Professor of Architecture and Fine Arts
University of Southern California
Los Angeles, Calif.

Congratulations and Thanks

FACE OF THE METROPOLIS *by Martin Meyerson, with Jacqueline Tyrwhitt, Brian Falk, and Patricia Sekler. Sponsored by ACTION, The National Council for Good Cities. Published by Random House, 457 Madison Ave., New York 22, N.Y. (1963, 249 pp., illus. clothbound: $7.50; paperbound: $2.95)*

This sensible book, although written "to stimulate a wider and more sophisticated public interest in urban design and architecture," nevertheless speaks a language that all professionals will understand and respect.

In documenting the new forms of the urban landscape, the authors have a number of refreshing points of view. Some 70 examples of "design from urban areas" have been assembled—selected, as Meyerson's preface states, not because "we regard all as excellent, [but because] in all cases there are lessons to be learned, and we try to point them out by interpreting both the strengths and weaknesses of the designs."

A selective group of this size will not be complete by any means, but this one is excellently representative—of cities, countries, schools of thought, and architectural philosophies. The examples are grouped by location—center city, middle city, and outer city—which makes for a valid organization in its context and an interesting departure from usual practice. Among the examples are a few old favorites—Roehampton, Tivoli Gardens, Vällingby, Baldwin Hills Village, and the GM Technical Center—mixed with a diversity of newcomers that includes the House of Seagram, Lincoln Center, Philadelphia's Eastwick, Chicago's Marina City, and the Connecticut General Building by SOM. Making an unexpected but very proper appearance are Greater Boston's Route 128, the Charles River Basin, New York's East River Drive, and the Toronto subway.

It is in the treatment of these 70-odd examples that the book's every page is stimulating. The authors do not simply describe; they are critical in the best

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41-47 DICKERSON STREET, NEWARK 3, NEW JERSEY sense of the word—evaluating the project's achievement in terms of what it was attempting and what limitations it had to work with (or chose to set up). For instance, on the Unité d'Habitation in Marseilles:

". . . although the experiment has now been under way for almost ten years, the results of it have not been analyzed. This calls attention to one of the great needs of urban design; the appraisal, after the glamour of novelty has faded, of new forms of living and how they function, how they withstand the attritions of use, how they answer the needs of the people they house. The Unité is a prime example of a design experiment which is a triumph in aesthetics, yet far less of a social and economic success."

And on Philadelphia's Penn Center:

". . . however brilliant the urban design principles, the execution and the detail are also important. The fine concept is there. The circulation is effective. The Chinese Wall is no more. City Hall has a new visual setting. But there is only a little of the aesthetic gratification that Philadelphia's city planner, Edmund Bacon, sought to create."

The book concludes with a forcefully stated epilogue entitled "Constraints and Possibilities." In this discussion of the realities of life, it is refreshing to find that the architects and planners are not the primary villains, nor are they potentially cast as the primary heroes.

"Whether we like it or not, ours is a world characterized by technology, a verbal culture, mobility, impermanence, and quick economic returns. Great architects (and even good ones) can work within these limitations and produce beautiful buildings. But these constraints have a depressing effect on aesthetics in general when building is in the hands of lesser talents."

Further on:

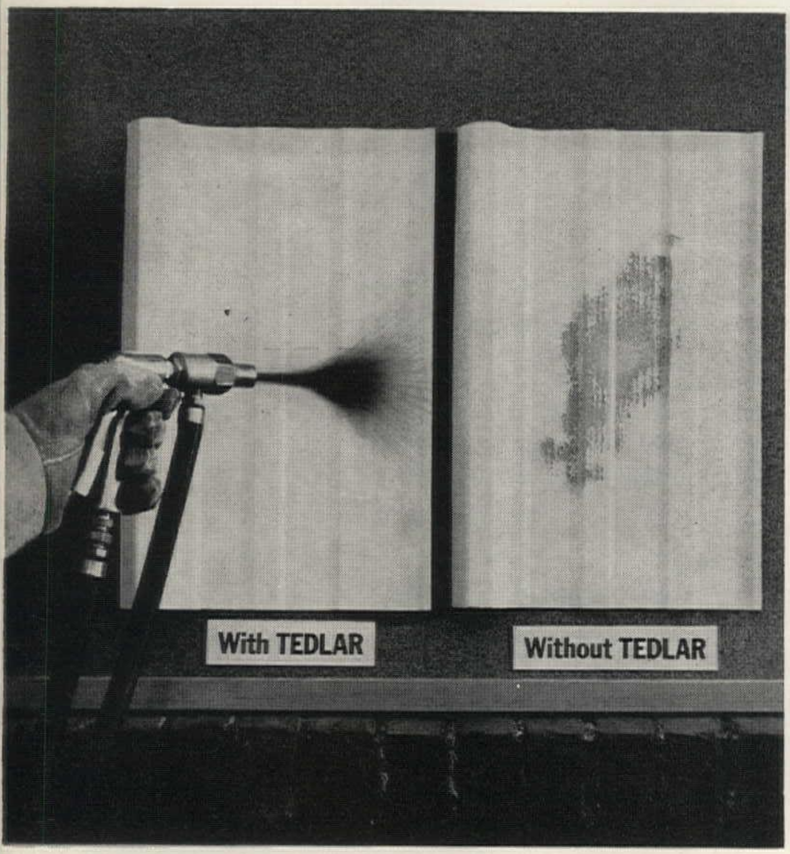
"It is not possible to turn back the forces which shape architecture and urban design today. We are unable to prevent, for example, large-scale residential, commercial, institutional or industrial developments. The problem is not so much in how to avoid these projects as how to design them with more livability, flexibility and attractiveness than they have had in the past."

The authors then discuss the possibilities of "positive government action"—various incentives to business firms and private developers such as reimbursement for providing "an outdoor gallery at which architecture is displayed without charge." Another intriguing suggestion: inducements to clients for selecting, "as much as possible, the most gifted designers."

Ultimately, then, it is the public which is (at least to a significant degree) at the bottom of things. They must become aware of what is now lacking in

Continued on page 262

siding looking new for up to 25 years.



Sandblasting tests prove durability

The siding on the left, surfaced with TEDLAR, was subjected to a punishing sandblasting test—and came through unharmed. The same test ripped apart the conventional finish on the other siding. This durability of TEDLAR makes it virtually impervious to heat, cold and ultraviolet light. Weather, good or bad, doesn't affect it.

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Stays new-looking without refinishing

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BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Continued from page 256

their cities and must want these things strongly enough to fight for them and pay for them. They must care or be made to care about what is happening to their cities.

"It is upon an alliance between good taste and public-spirited leadership that the future of urban design depends."

For helping to enlighten and stir up the citizenry, those responsible for this book deserve both congratulations and thanks. They are Martin Meyerson, Director of the MIT-Harvard Joint Center for Urban Studies; Jacqueline Tyrwhitt, Associate Professor of City Planning at Harvard; Brian Falk and Patricia Sekler, also connected with Harvard's Graduate School of Design; ACTION, who sponsored the book; and the Ford Foundation, who supported the project. E.P.

Builders of Civilization

ANCIENT ENGINEERS *by L. Sprague de Camp. Published by Doubleday & Co., Inc., 575 Madison Ave., New York 22, N.Y. (1963, 408 pp., illus. $4.95)*

According to the author, this book is devoted to all those neglected early engineers who, much more than the soldiers, politicians, prophets, and priests, have built civilization. Be that as it may, the author reviews in a popularized manner the role of technology in the development of historic civilization, from early Egypt, approximately 3000 B.C., to the advent of modern scientific technology in the 17th Century. In addition to the ancient technologies of Egypt, Greece, Rome, and Northern Europe, he includes chapters on areas generally passed over by other writers—Mesopotamia and the Orient.

De Camp has a way, however, of stretching the proper meaning of engineering to encompass gadgeteering—such items as locks, clocks, pipe organs, printing presses, eye glasses, and even holy-water dispensers. Certainly anyone who builds a mousetrap is not an engineer, any more than a person who builds a woodshed is an architect. But although his definition of engineering is misleading, such extensions and numerous legends do make the book more readable. Twenty-four pages of notes and bibliography attest to the author's attempt at historical accuracy.

One particularly amusing and moralistic tale (unverified, of course) is about the architect-engineer Sostratos who built the Lighthouse of Alexandria, one of the classic Seven Wonders of the World. It seems that the king wanted only his own name inscribed on the monument, but the crafty Sostratos first had *his* name chiseled into the stone of the tower, then covered this with a layer of plaster on which was scribed the proper royal inscription. In time, the plaster peeled off, removing the king's name and leaving only the architect's. The final joke was played by nature, which decided to blow the whole darn lighthouse down.

WILLIAM ZUK
Professor of Civil Engineering
Charlottesville, Va.

Caught in the Drafting

PEN AND INK, INC. *Written and Published by Edwin Bateman Morris, 5517 Grosvenor Lane, Bethesda 14, Md. 193 pp., illus. $3*

Architects attending AIA national conventions over the past—how many?—years are familiar with the diverting exegeses Edwin Bateman Morris used to issue for the Tile Council of America, interlarded with his facile sketches of old and new architecture in the host city. These essays now have been collected between two covers. Morris' witty text holds up very well on rereading; he is an expert collector of informative minutiae, the "I never-knew-that-before-and-I-don't-need-to-know-it-now-but-I'm-glad-I-do" kind of data.

J.T.B., Jr.

OTHER BOOKS TO BE NOTED

Ideas and Integrities: A Spontaneous Autobiographical Disclosure. Buckminster Fuller. Edited by Robert W. Marks. Prentice-Hall, Inc., Englewood Cliffs, N.J., 1963. 318 pp., illus. $6.95

To be reviewed.

Living and Activity Patterns of the Aged. Glenn H. Beyer and Margaret E. Woods. Center for Housing and Environmental Studies, Cornell University, Ithaca, N.Y., 1963. 29 pp. $2 (paperbound)

The implications of daily activities on housing for the aging. Thorough statistics form the basis for conclusions: (1) Desire for "things to do" indicates independent living for most. (2) Public or voluntary nursing for the infirm should be provided within the home. (3) Institutional living is only for the very infirm.

Landscaping of Motorways. Alwin Seifert, R. W. Rose, and Gilmore D. Clarke. British Road Federation, 26 Manchester Square, London W. 1, England, 1963. 63 pp., illus. 10s 6d (paperbound)

Excellent report documenting the first British conference (held May 1962) on this subject. The three papers are entitled "The Landscape Architect as the Collaborator on Motorway Alignment and Design," "Landscape Engineering," and "The Design of the Motorway."

Manual of Steel Construction (Sixth Edition). American Institute of Steel Construction, Inc., 101 Park Ave., New York 17, N.Y., 1963. 650 pp., tables. $7

Seven thumb-indexed sections contain latest comprehensive information on the design aspects of steel.

Michelangelo's Models. Ludwig Goldscheider. Phaidon Art Books, New York Graphic Society, Greenwich, Conn., 1963. 54 pp., illus. $6

Survey, including historical notes, of extant wax and clay models for Michelangelo's sculptures.

New Architecture in Africa. Udo Kultermann. Universe Books, Inc., 381 Park Avenue South, New York 16, N.Y., 1963. 180 pp., illus. $12.95

To be reviewed.

Pioneers of Modern Art in America: The Decade of the Armory Show: 1910-1920. Lloyd Goodrich. Whitney Museum of American Art. Distributed by Frederick A. Praeger, 64 University Place, New York 3, N.Y., 1963. 96 pp., illus. $6

Well-illustrated coverage of the first decade of modern art in the U.S.—its pivot, the 1913 Armory Show; the preceding struggles of American modernists abroad, and the resulting revolution in American thought. Various U.S. schools are contrasted with European modernism. Author is Director of the Whitney Museum of Modern Art.

Precision Perspective Drawing. T.O. McCartney. McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N.Y., 1963. 239 pp., illus. $11

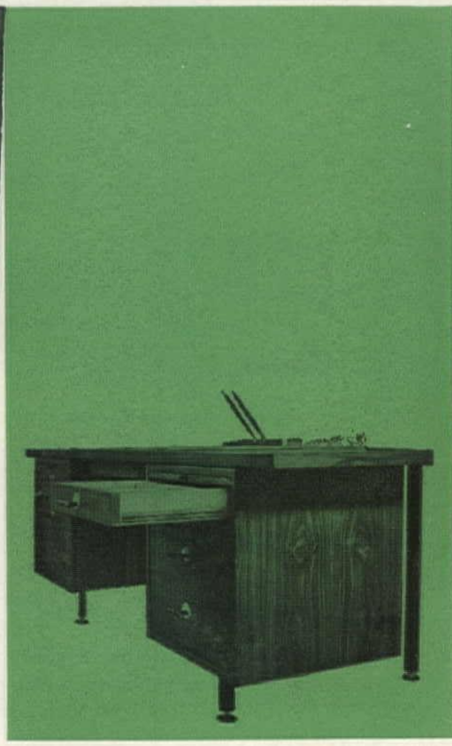
System for three-point perspective drawing based on mathematical tables emphasizes both visual and mechanical accuracy. The author clarifies the concepts of infinity, vanishing points and horizons; reviews traditional mechanical drawing methods; then introduces his simplified mathematical tables and discusses wide-angle perspective.

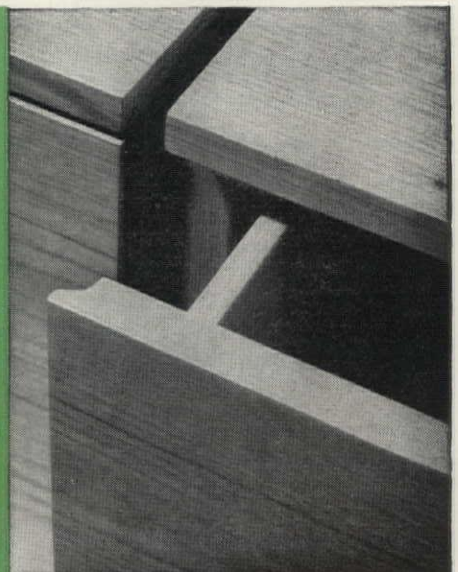
School Maintenance and Operation. Joseph J. Baker and Jon S. Peters. Interstate Printers and Publishers, Inc., 19–27 N. Jackson St., Danville, Ill., 1963. 278 pp., illus. $5.25

All aspects of school maintenance and operation programs are covered for the administrator.

A System of Architectural Ornament. (Facsimile edition). Louis H. Sullivan. W. R. Hasbrouck, AIA, The Prairie School Press, 117 Fir St., Park Forest, Ill., 1963. 12 pp., illus. with 20 plates. $15

To be reviewed.





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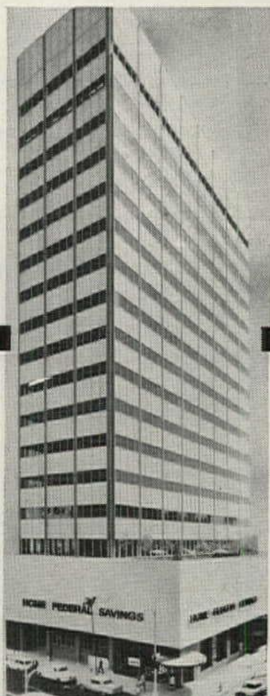

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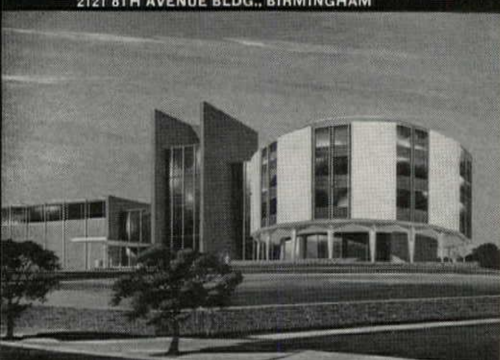

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Continued from page 212

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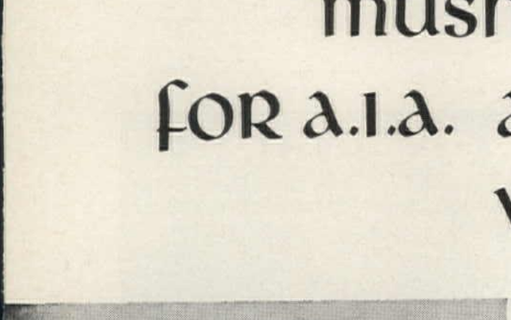

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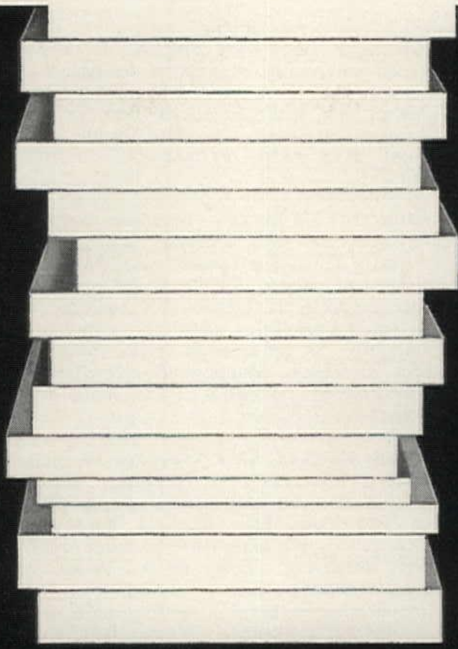

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ABOUT THE AUTHORS

NOVERRE MUSSON has practiced architecture for 17 years as a member of the firm Tibbals-Crumley-Musson in Columbus, Ohio. He is a one time member of the Frank Lloyd Wright Taliesin Fellowship. Mr. Musson has a unique background as a journalist as well. He has lectured and been author of many articles which have prompted the public to take greater interest in architectural projects of many kinds.

HELEN HEUSINKVELD is a member of The National Council on Aging, and was a participant in the 1960 White House Conference on Aging. She did extensive research for this book in Norway, Sweden, Denmark, Finland, Holland and England as well as in this country.

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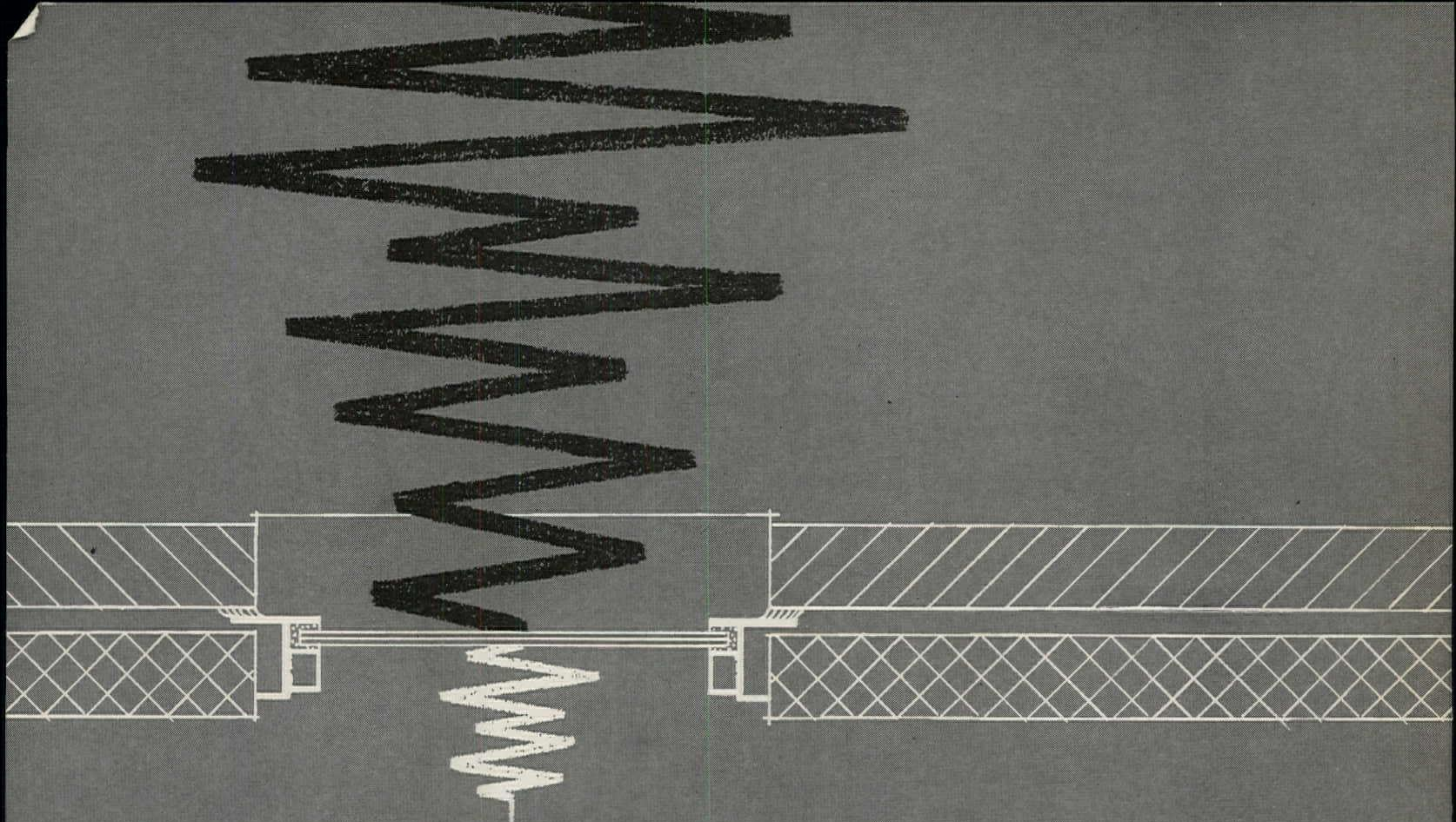

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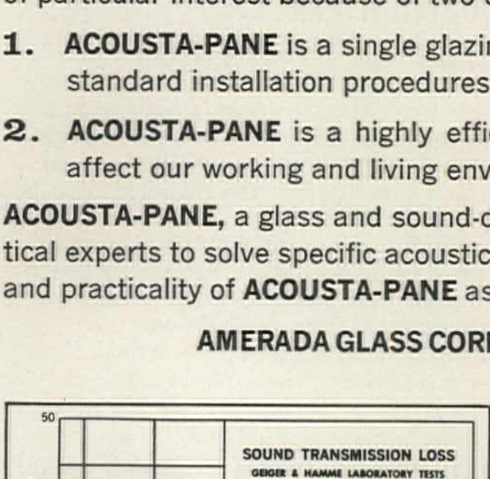

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