ENGINEERING FOR ARCHITECTURE 1975

ARCHITECTURAL RECORD

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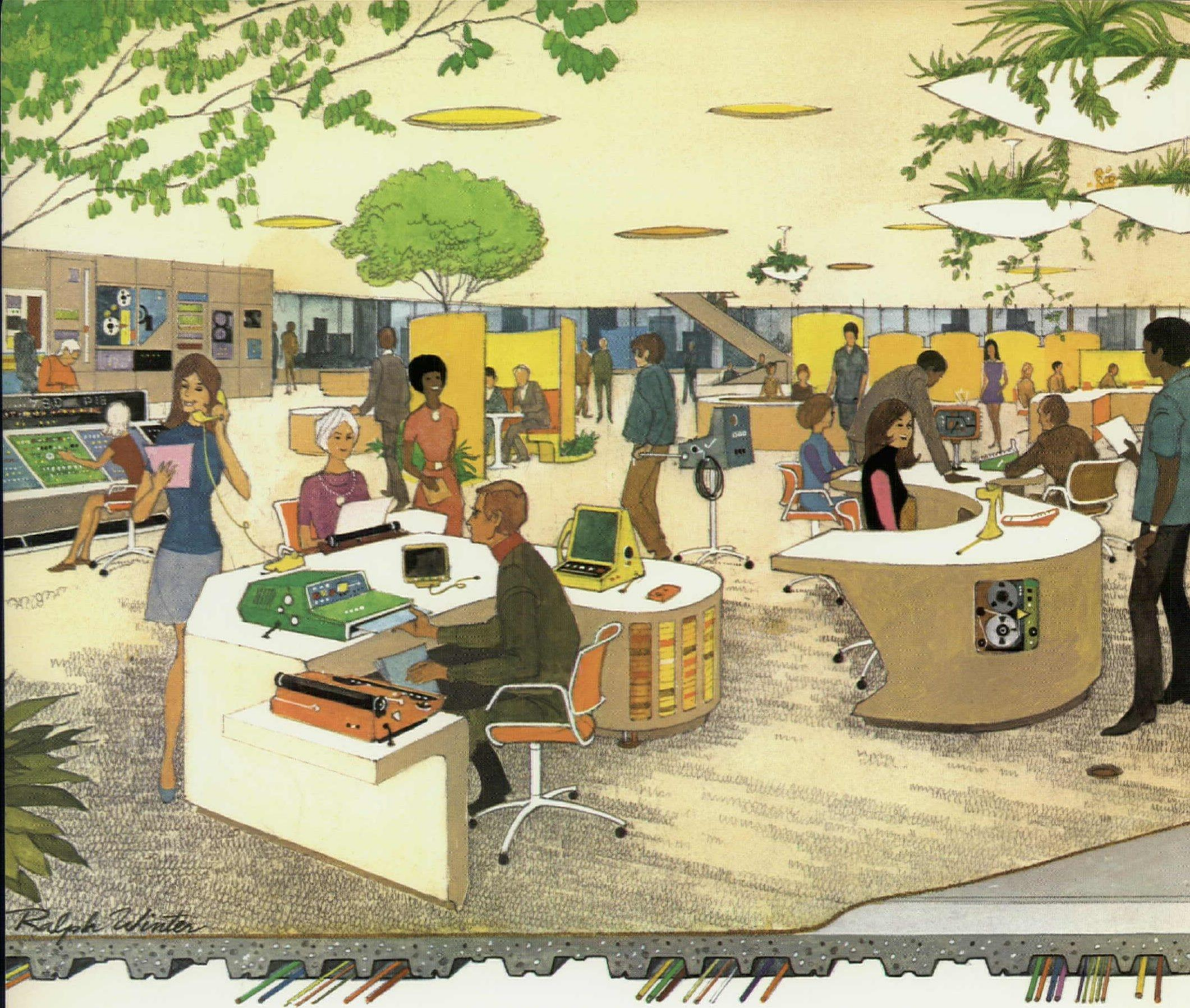

The year: 2005/The N-R-G Flor™: 1975

We're not talking about all those fancy gadgets— the technological advances we expect by the year 2005. Yes, Inryco® N-R-G-Flor—for complete energy distribution—will have adequate capacity to provide for them . . . but that's not new. Here's what is: long-term flexibility to meet changing requirements . . . economically.

Over a period of 30 years, this hypothetical office area will have seen a dozen or more major changes in its layout. Hundreds of individual work stations will have been relocated, maybe several times. And every relocation will have meant another revision in the supply pattern for power and communications services.

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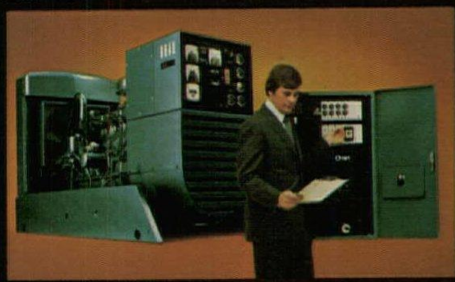

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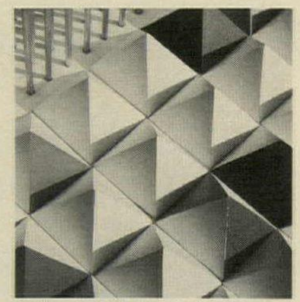
Of particular assistance to the editor in the preparation of this issue were:

Robert E. Fischer, editor-in-charge
Grace M. Anderson, associate editor
Annette K. Netburn, production
Carol Deegan, secretary
Jan White, art direction
Alex White, art production
Muriel Cuttrell, illustration
Joseph R. Wunk, production

ENGINEERING FOR ARCHITECTURE



Sculpture: Robert Strimban

THE RECORD REPORTS

ARCHITECTURAL BUSINESS

BUILDING TYPES STUDY ®479

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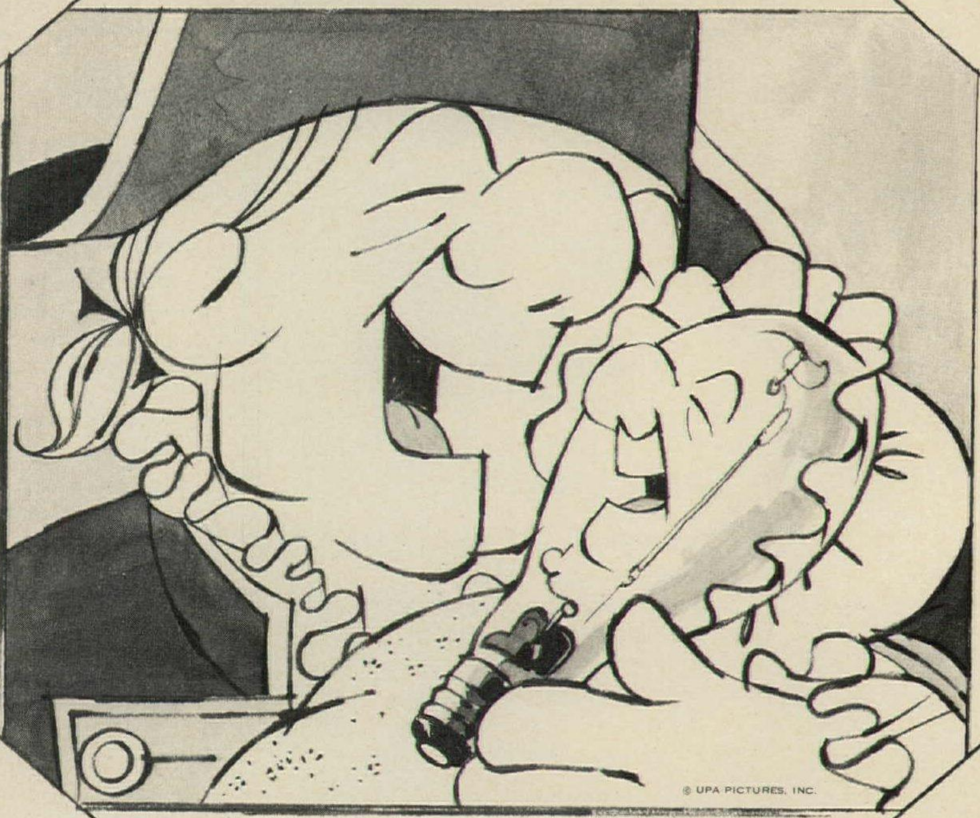

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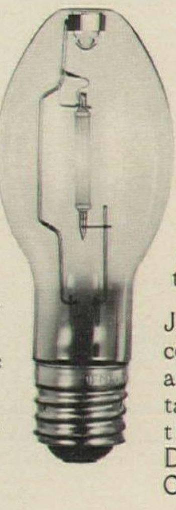

By George, this new bundle of light from the GE Lucalox high-pressure sodium family . . .

- delivers 5800 average initial lumens of light
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The Lucalox lamp family now has eight members ranging in wattages of 70, 100, 150, 250, 400 and 1000 . . . the most complete high-pressure sodium lighting line in the world.

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The most revolutionary thing in sight . . . *efficient* light

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Engineering for architecture: there's nothing to it but people

Said architect Lew Davis at our Round Table on energy conservation: "It's become so easy to be a good architect. All you need is good clients—and good consultants. We rely on our consulting engineers, and when new forms are required [as for energy conservation] we will rely on them to come with us and produce the new forms."

Well, Lew, who with his partners tackles some awfully tough jobs, does make it look easy—as many top-rank architects do. He also makes a point: The best architects know how to make the best use of their consultant engineers, and they know how to turn those engineers on so they do their very best work. I'd bet anything that on a Davis-Brody job the working arrangement is not between an architect and an engineer, but between Lew and Sam (Brody) and their friends/engineers Marvin (Mass), Jim (Leon), Bob (Rosenwasser), Dave (Geiger), and Art (Zigas).

Sure there's a contract—there's also a mutual commitment to give the client the best job that the architects and engineers working together know how to design.

Enthusiasm works! In his introduction to the article (page 100) on the work of KKBNA, engineers in Denver, senior editor Bob Fischer wrote: "In the course of reportorial conversations, the editors were struck by the energy and perceptiveness seemingly common to all members of the firm, and their unmistakable enthusiasm for their work. Our curiosity prompted us . . . to interview the firm's partners and associates, and some of their clients, to find out what accounts for the high quality of their work—and just why they have so much fun doing it." There's a chicken and an egg there!

In another introduction—to the case study section beginning on page 66—associate editor Grace Anderson wrote: "What becomes evident as one reviews the projects on the following pages is that there are a lot of people around with a sizable store of technical expertise—not only architects and engineers, but contractors and manufacturers as well. Talking with contributors to this section," Grace writes, "the editors also noticed the sheer enjoyment these experts take in tackling a knotty problem, whether it's big or little, and the great satisfaction they find in helping to make a building look more beautiful, or work more efficiently, or go together more simply, or cost less money."

I just finished reading—and making a few editor's hen-tracks on—the article on Frank Bridgers' work on solar energy. Having read more than my share of articles—in the popular and professional press alike—on the geewhizzeries of solar energy I approached my first reading of this article, even if Bob Fischer did write it, with a certain amount of . . . well, nervousness. Well, when I finished I had the feeling that I'd heard from an expert—that Frank Bridgers really *knows!*

Well, enough examples to make the point. As I wrote on this page for our first "Engineering for Architecture" issue just a year ago: "We wanted to do this issue because we think the place to search for solutions to our problems in this industry—problems like cost and energy conservation and new scale—is with people." This issue, like our first effort a year ago, demonstrates once again the enormous technical resources that we have available to solve whatever building or design problem comes up, and reinforces the unique relationships of architects to engineers that exists throughout the industry.

Finally, as it was last year, this issue is intended to honor the best work of the best engineers—to give recognition to engineers in building for their absolutely essential and all-too-often unrecognized inventiveness and resourcefulness in working with architects to achieve economical and rational and beautiful buildings. —*Walter F. Wagner Jr.*

▪ Some "essential and all-too-often unrecognized inventiveness" takes place in producing an issue like this, and—as I did last year—I'd like to give a little credit where credit is due. The editor-in-charge of this issue is Senior Editor Robert E. Fischer—the chief worrier, the chief gatherer of information, the chief writer on the issue, and (see photo credits everywhere) its chief photographer. Grace Anderson did such a fine job of assisting Bob last year that we managed to put her on the staff, so she is now Associate Editor Anderson and the assistant chief worrier, etc, etc.

One-time Associate Editor Peggy Gaskie (who moved to Denver just because she got married, for Pete's sake) wrote the KKBNA article for us with the style to which we were long accustomed. Production editor Annette Netburn managed to handle this issue with an extra arm she found somewhere, while her regular two arms produced the August and September issues. Muriel Cuttrell worked over and above on most of the handsome drawings in this issue. The issue was designed—I think with great style—by Jan White; and art production was handled by his Son the Design Student, Alex White.—*W. W.*

More great lines from the Round Table: an evocative potpourri

As you have probably seen already, beginning on page 92, is a report on RECORD's Round Table: Towards a Rational Policy on Energy Use in Building. One of an editor's frustrations in editing such an article is the enormous amount of thoughtful comment which gets edited. The transcript of the day-long meeting was 269 pages long, double-spaced; and clearly much worth hearing had to be left—as the film-makers say—on the cutting room floor. Herewith, with no attempt at organization, some of the most evocative comments:

. . . Paul Greiner of EEI on utility problems: "The problems are serious. We are a highly capital intensive industry, and with the cost of money going up and the scarcity of capital increasing the problems get more and more serious. Add to that the evironmental constraints we have to deal with—the siting problems. And then there is the problem of shortages and choice of fuels.

"ASHRAE has now set up a source-evaluation committee—better known as 'the hole-in-the-ground committee'—to study the whole problem [of where the energy is to come from]. . . . We are studying the availability of fuels, the various environmental impacts, the economic impacts, the mix of various fuels at various times, and finally the mix of usage in buildings. . . .

"In the absence of a true national energy policy, we have an energy conflict and we are all seeing it."

And Mr. Greiner pointed out that different utilities have different problems: "You take the load profile on any particular utility company and it will be very different from another utility . . . Most of the major metropolitan utilities are summer-peaking—even in the northern climates. Some still have winter peaks. I will say that the industry is looking at peak-load pricing to try and level off those peaks and fill in the valleys. Inverse rates to penalize the heavy-user? Probably just for residences."

. . . Arthur Diemer of CC&F Property Management on developing a sense of urgency among users: "My problem as an owner-manager is to translate the urgency and seriousness of energy conservation to our tenants. At the peak of the energy crisis, practically everyone adhered faithfully to the 55-mph limit. But it took only four months before everyone started to change back to 65. . . . There was a noticeable reduction in energy consumption in buildings during the gasoline shortage, but our records for late last year and this year show consumption climbing again."

. . . Charles Ince of FEA on the need for public commitment and education: "Our concern is that the public really believe there is an energy crisis. In Washington, when the embargo was on, the growth rate was four per cent. It is already up to eight per cent again.

"I am not convinced that an energy-conserving system has to cost more. The technology exists. It is a matter of understanding that the technology must be used, of getting incentives or disincentives. . . . The Federal policy in the building field is absolute conservation. It is cutting back the consumption of energy used in the construction of buildings and in the operation of buildings. We have been looking and will continue to look at long-term programs that will have a significant impact. Here I am not talking about standards, but about an informational, educational program. And that is clearly needed because at your 1971 Round Table you were debating many of the same issues that we have today."

. . . Dr. Maxine Savitz of HUD on government and the private sector working together: "This era of more expensive energy and lower energy availability gives us an opportunity for new solutions to problems.

"The architect, the engineer, and the building owner will have to work together to develop the best design and best systems.

"It is an opportunity for government and the private sector to work together to make sure that whatever is developed is technically sound and reasonable to implement. . . . There is not going to be one solution to using energy more efficiently in buildings. There are new buildings and old buildings, and very different building types. These will have to be addressed separately, and by separate means. The government will offer some solutions. The private sector can do a lot on its own—not just with education, but with fee structures and ways of financing.

"There are lots of problems, but lots of opportunities that can be looked at from a positive point of view."

. . . Frank Coda of IES on a subject dear to the hearts of architects and engineers: "The biggest problem for architects and engineers is that they don't get adequately paid for the kind of work involved in a really careful energy analysis. If we are going to have energy conservation, we are going to have to start treating professionals as professionals and pay them for the work that needs to be done."

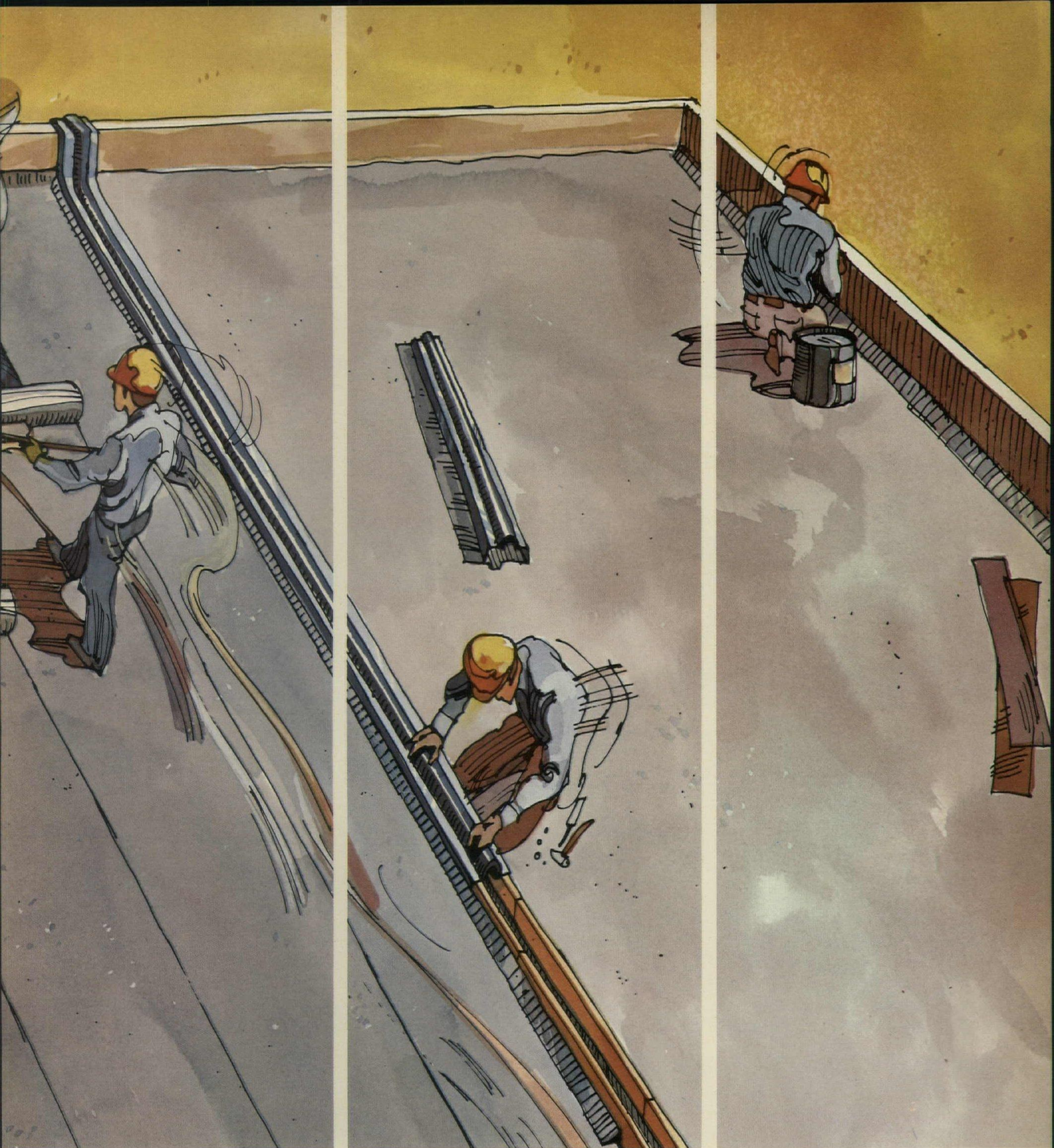
A promotional-type word about RECORD's "Resources 76" seminar in October

In this issue with its special emphasis on engineering, permit me this special message to engineers on RESOURCES 76—the crash course on getting work in today's climate—which RECORD is holding Monday through Thursday, October 27th through 30th, at the Center for Continuing Education of the University of Chicago. As I said in an earlier editorial: "This is going to be a workshop—perhaps even a sweatshop. The program starts every morning at 8 o'clock and continues after dinner. We think this concentration of work is entirely appropriate. We're asking you to spend a fair amount of money and time—and no one has much spare money or time to spend these days." The tuition will be $400.

What do we offer worth $400? Please take the time to dig back into your July issue and look at the mammoth fold-out on page 65. It gives you in far more detail than I can here exactly what we think is worth your $400 and your time. Bill Marlin, ex-competitor and now compatriot who's done the organization for the conference, has assembled a truly extraordinary roster of speakers and panelists to tackle the subjects that are closest to the heart of the business problem of every engineer and architect—business outlook, legislation, cost control, office efficiency (for small and large firms alike), changing lender attitudes, new market opportunities, and on and on.

I hope you will, despite these troubled times, seriously consider attending. There's a coupon for registration in the July issue; and—since you're a reader—you should have gotten another promotion piece in the mail. If you can't find it, call me (at 212/997-4565) or Bill Marlin (at 212/997-4242).

—W.W.



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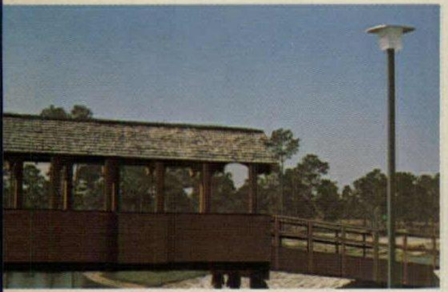

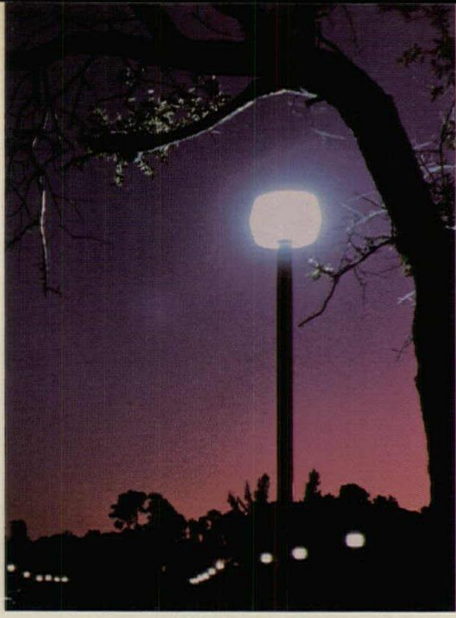

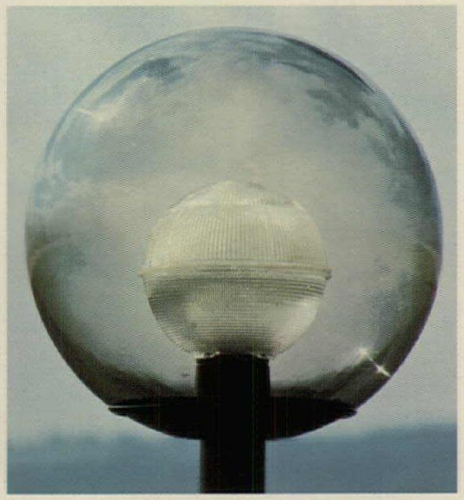

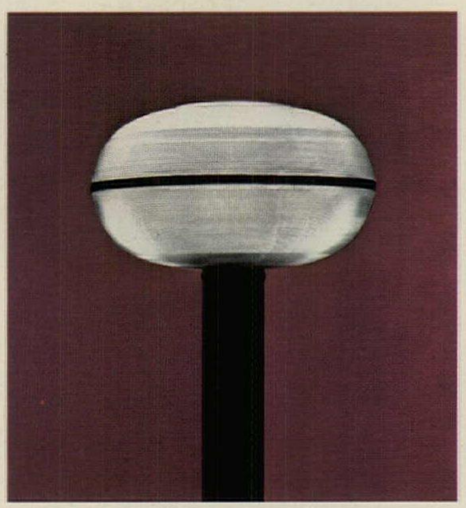

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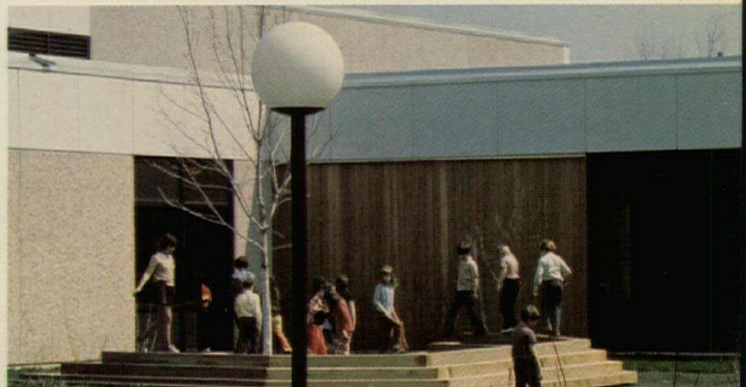

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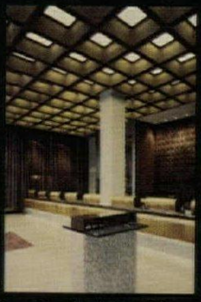

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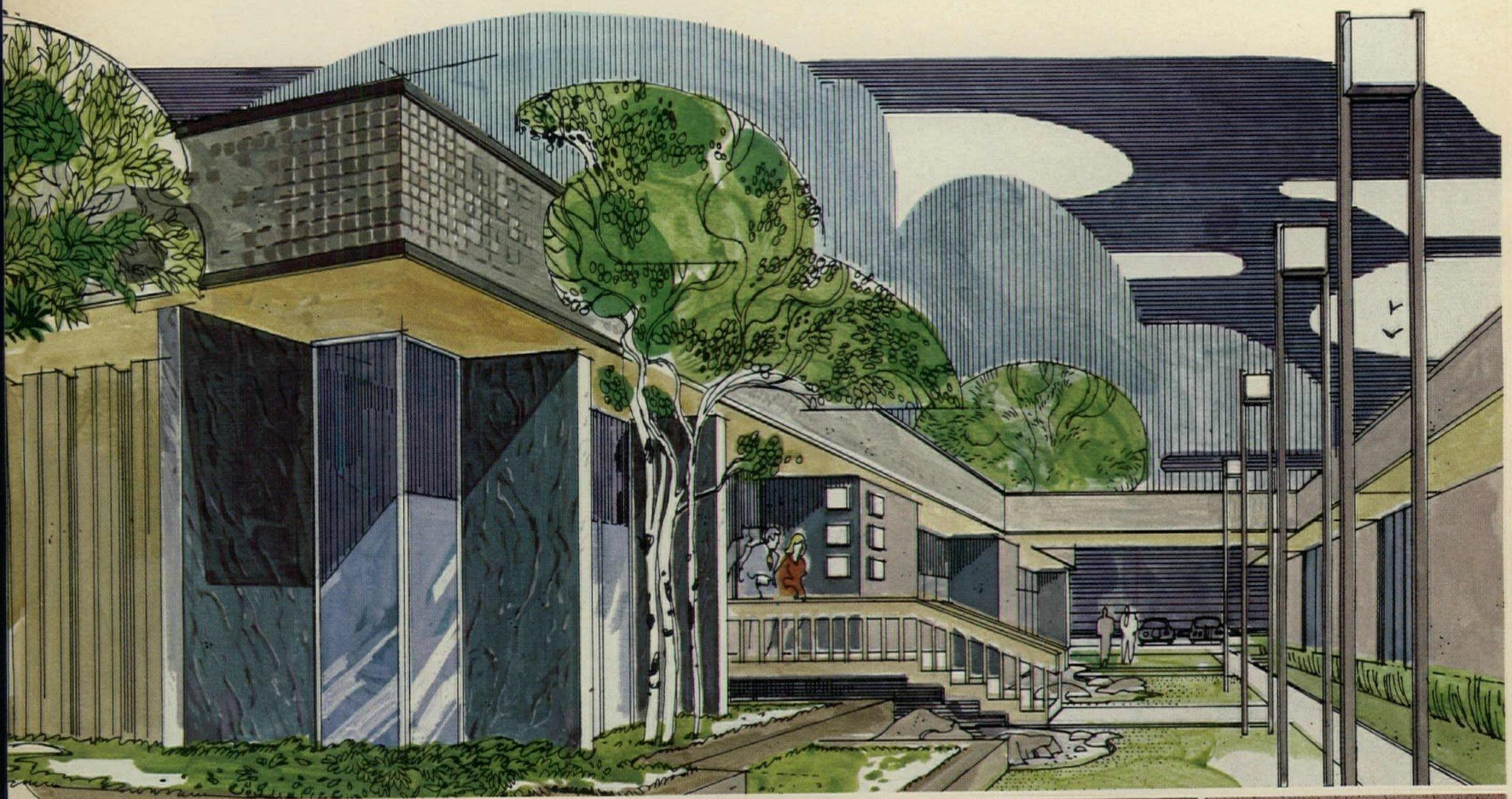

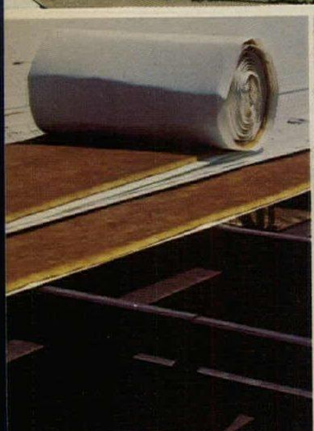

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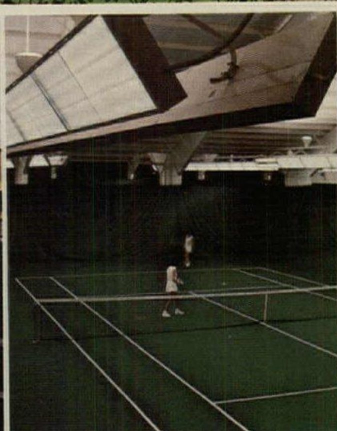

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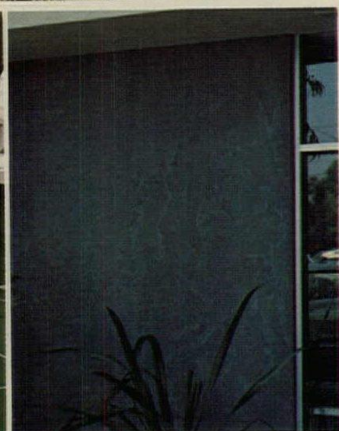

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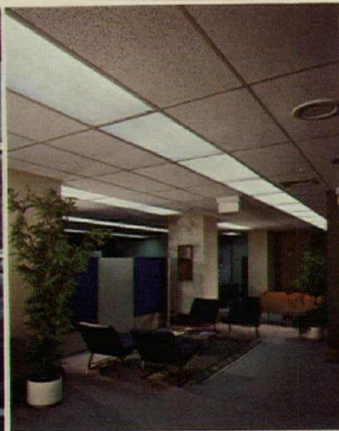

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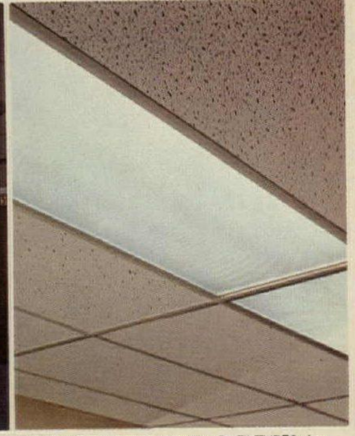

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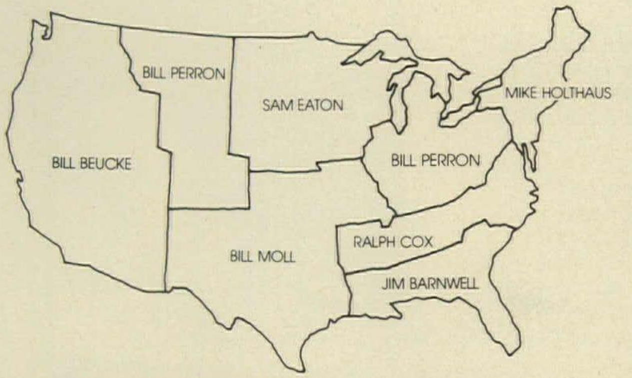

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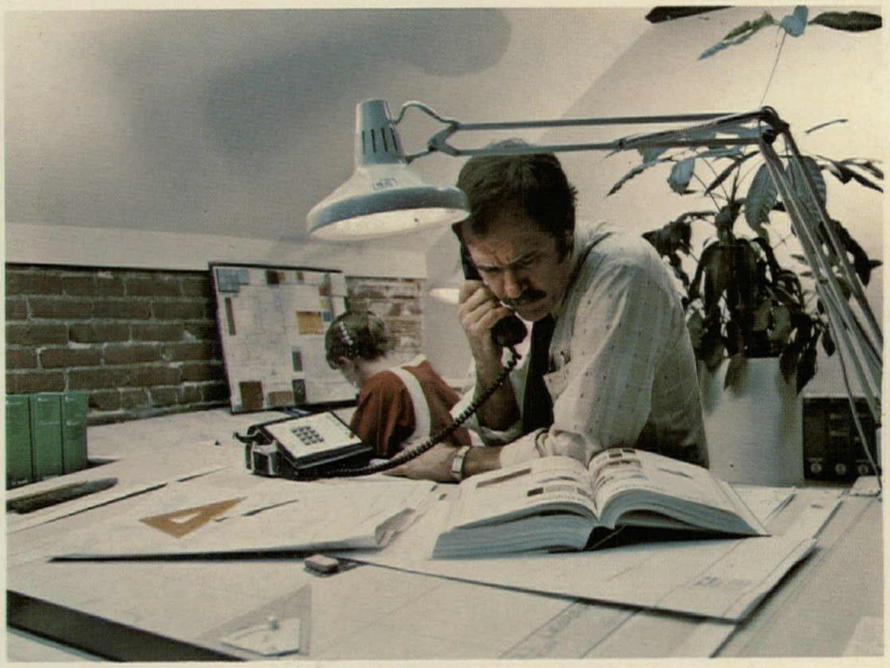
For information about J-M products, reach for a Sweet's. For <u>more</u> information, reach for a phone.

We know how much you rely on Sweet's Architectural Catalog File for detailed product information.

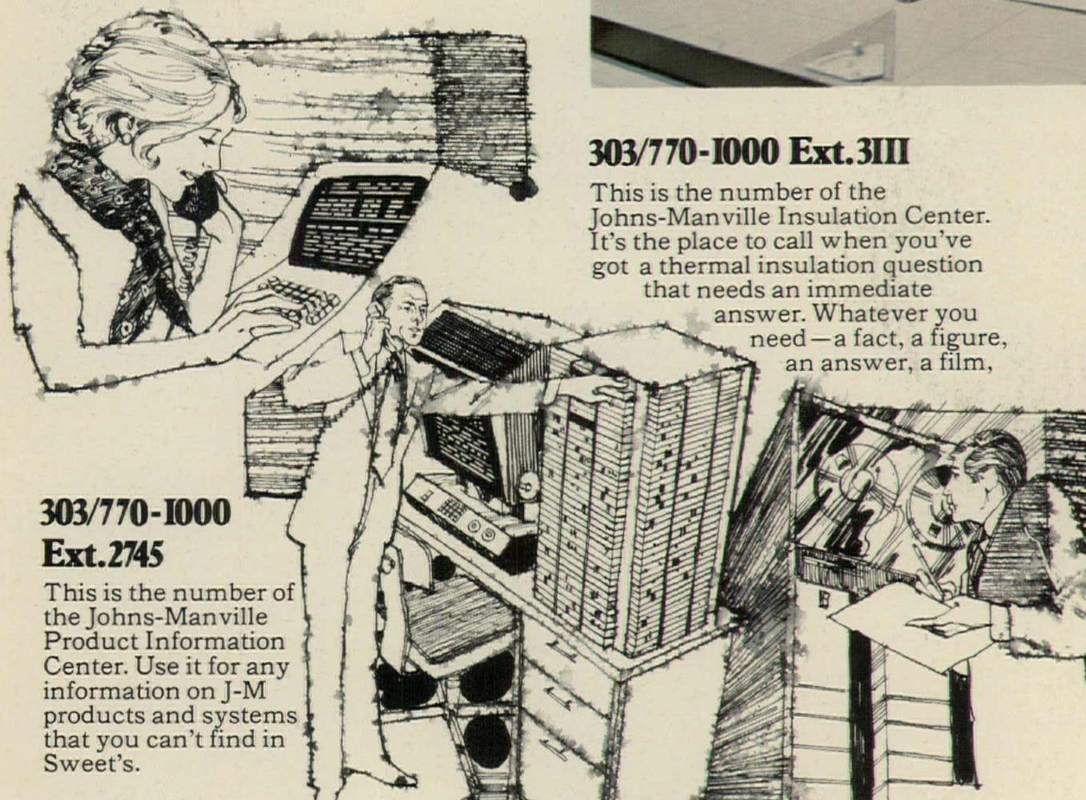
That's why we've expanded our representation in the 1975 Sweet's File to 17 catalogs with 256 pages of information about Johns-Manville architectural building products and systems.

But even 256 pages may not supply all the answers to all your questions.

When that happens, just pick up your phone. And dial one of these numbers:



BUYLINE This is the name of Sweet's new *toll-free telephone inquiry service.* The BUYLINE number appears on Sweet's Catalog File volumes. Use it when you want to know the name of the nearest J-M sales representative. Or a close source for a particular J-M product.



303/770-1000 Ext. 3111

This is the number of the Johns-Manville Insulation Center. It's the place to call when you've got a thermal insulation question that needs an immediate answer. Whatever you need—a fact, a figure, an answer, a film, data, design criteria, application know-how—the Insulation Center can supply it.

We've gone a long way to give you the information you need.

So you won't have to go a long way to get it.

303/770-1000 Ext. 2745

This is the number of the Johns-Manville Product Information Center. Use it for any information on J-M products and systems that you can't find in Sweet's.

J-M Catalog Name	Sweet's Index No.
Built-up Roofs	7.1/Jo
Blue Chip Built-up Roofing Systems	7.1/Joh
Expand-O-Flash	7.3/Joh
Corrugated & Flat Transite	7.4/Joh
Stonehenge Architectural Panels	7.5/Jo
Colorlith Architectural Panels	7.5/Joh
Splitwood Architectural Panels	7.5/Jom
Permatone "S" Flexboard	7.5/Jon
Facespan/Corspan	7.5/Jos
Shingles	7.7/Jo
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Sheer math power. Log and trig and hyperbolics and functions of x. The SR-51A has these and also statistical functions. Like mean, variance and standard deviation. Factorials, permutations, slope and intercept. Trend line analysis. And there's a random number generator. Plus 20 preprogrammed conversions and inverses. Check this list for a closer look at the real math power you can get in both the SR-51A and the SR-50A:

FUNCTION	SR-51A	SR-50A
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Trig (sin, cos, tan INV)	yes	yes
Hyperbolic (sinh, cosh, tanh, INV)	yes	yes
Degree-radian conversion	yes	yes
Deg/rad mode selection switch	yes	yes
Decimal degrees to deg.min.sec.	yes	no
Polar-rectangular conversion	yes	no
y^x	yes	yes
e^x	yes	yes
10^x	yes	no
x^2	yes	yes
$\sqrt{x}$	yes	yes
$\sqrt[x]{y}$	yes	yes
1/x	yes	yes
x!	yes	yes
Exchange x with y	yes	yes
Exchange x with memory	yes	no
% and Δ %	yes	no
Mean, variance and standard deviation	yes	no
Linear regression	yes	no
Trend line analysis	yes	no
Slope and intercept	yes	no
Store and sum to memory	yes	yes
Recall from memory	yes	yes
Product to memory	yes	no
Random number generator	yes	no
Automatic permutation	yes	no
Preprogrammed conversions	20	1
Digits accuracy	13	13
Algebraic notation (sum of products)	yes	yes
Memories	3	1
Fixed decimal option	yes	no
Keys	40	40
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Constant mode operation	yes	no

Performance, accuracy and efficiency.
Both the SR-50A and SR-51A deliver answers you can trust. Quickly and efficiently. To problems ranging from simple arithmetic to highly complex calculations. You don't have to learn special entry methods or difficult-to-master key sequences. There's a better way – TI's algebraic entry system lets you key your problem just the way you would say it. Naturally. You don't worry about losing data in stacks, or keeping track of what is in each stack, or remembering if the stack is full. The way you learned math is the way it's done. On both the SR-50A and SR-51A – you can command tremendous math power with confidence – from the beginning. Power and accuracy you can really put to work.

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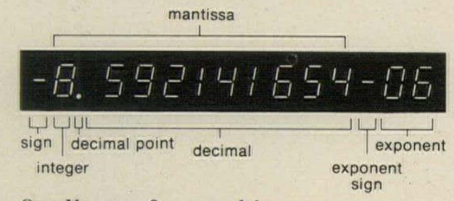

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Quality – it's built in right from the start. Texas Instruments designs and manufactures every critical component. From high-purity silicon semiconductor materials to integrated circuits to light-emitting-diode displays to circuit boards to keyboards. So, we design-in and control quality – not just monitor it – at every level: Materials. Components. The complete system.

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Technological leadership and quality craftsmanship are why Texas Instruments can offer so much value at low prices. And now, with new price tags, the SR-50A and SR-51A are better values than ever before: $99.95 for the SR-50A. $149.95 for the SR-51A.

SR-51A Preprogrammed Conversions

FROM	TO
mils	microns
inches	centimeters
feet	meters
yards	meters
miles	kilometers
miles	nautical miles
acres	square feet
fluid ounces	cubic centimeters
fluid ounces	liters
gallons	liters
ounces	grams
pounds	kilograms
short ton	metric ton
BTU	calories, gram
degrees	gradients
degrees	radians
°Fahrenheit	°Celsius
deg.min.sec.	decimal degrees
polar	rectangular
voltage ratio	decibels

See them at your nearest TI calculator retailer. Or, send for our new fact-filled color brochure. It details the outstanding capability of both the SR-50A and SR-51A with full feature descriptions, sample problems, entry-method considerations and more. Write, Texas Instruments, M/S358, P.O. Box 22013, Dallas, Texas 75222

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Sylvania Lighting Center, Danvers, Massachusetts 01923.

Lumalux and Unalux lamps. High-pressure sodium lamps: just about the most efficient light sources you can buy. Our Lumalux lamps come in several wattages, and deliver up to 125 lumens per watt. 150- and 360-watt Unalux lamps operate on many existing 175- and 400-watt mercury systems without change of fixtures, ballasts or wiring; and save up to 14% on energy while they produce up to 70% more light.

SuperSaver Excel incandescent lamps. These lower-wattage lamps (34, 54, 69, 93 and 143 watts) give the same light output and 2500-hour life as the extended-service lamps they replace (40, 60, 75, 100 and 150 watts). They also reduce energy demand by 5-15%.

SuperSaver fluorescent lamps. These low-wattage 35-, 60- and 100-watt lamps replace standard 40-watt, 75-watt Slimline and 110-watt HO fluorescents. They deliver more lumens per watt; up to 20% energy saving on typical two-lamp systems, and only 12-18% less light.

Architectural Precast and PRESTRESSED CONCRETE

Conserves energy five ways.

About 15 percent of the nation's annual energy consumption is spent in the operation of commercial buildings. The building's envelope is an important first line of defense against energy consumption. If designed with energy conservation in mind, the "building envelope" — its walls, floors, and roof — can help conserve energy at least five ways:

1. Reduced Fenestration: A prestressed concrete building with reduced window area can help stabilize the building's thermal requirements by controlling heat transmission.

2. Thermal Storage: The stored heat in the exterior walls, roof, and floors constructed of precast and prestressed concrete can be an energy conservation tool... absorbing part of the heat and releasing it later when other heat gains have diminished. This reduces air-conditioning loads in summer and heating loads in winter. Concrete walls reach peak thermal loads three to four hours later than other wall materials (wood and metal) measured under like conditions.

3. Improved Insulation: Precast concrete panels of sandwich construction combine weatherproof exterior, effective insulation, and finished interior surface in one unit... all installed by one contractor, one supplier, and only one or two trades for the entire wall.

4. Decreased Building Volume: For decreased building volume, prestressed hollow-core floors and roofs take less space than a truss system of comparable strength. This reduces total building volume — and its energy requirements.

5. Sun Shades: Properly designed architectural precast and prestressed concrete shading devices minimize solar heat gains without reducing natural light and view. These devices include window walls, vertical or horizontal "fins," various sculptured shapes, and prestressed concrete double tees, single tees, and hollow-core units that also can be cantilevered beyond wall lines.

Prestressed concrete has many uses in conserving energy. If you'd like to know more, consult your local architectural precast or prestressed concrete producer.

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STRUCTURAL PCI PRESTRESSED CONCRETE INSTITUTE®

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If we tried to solve all your material-handling problems with a single system, it would be like trying to fit square pegs into round holes. So we developed a wide range of systems, to fill the needs of virtually any hospital.

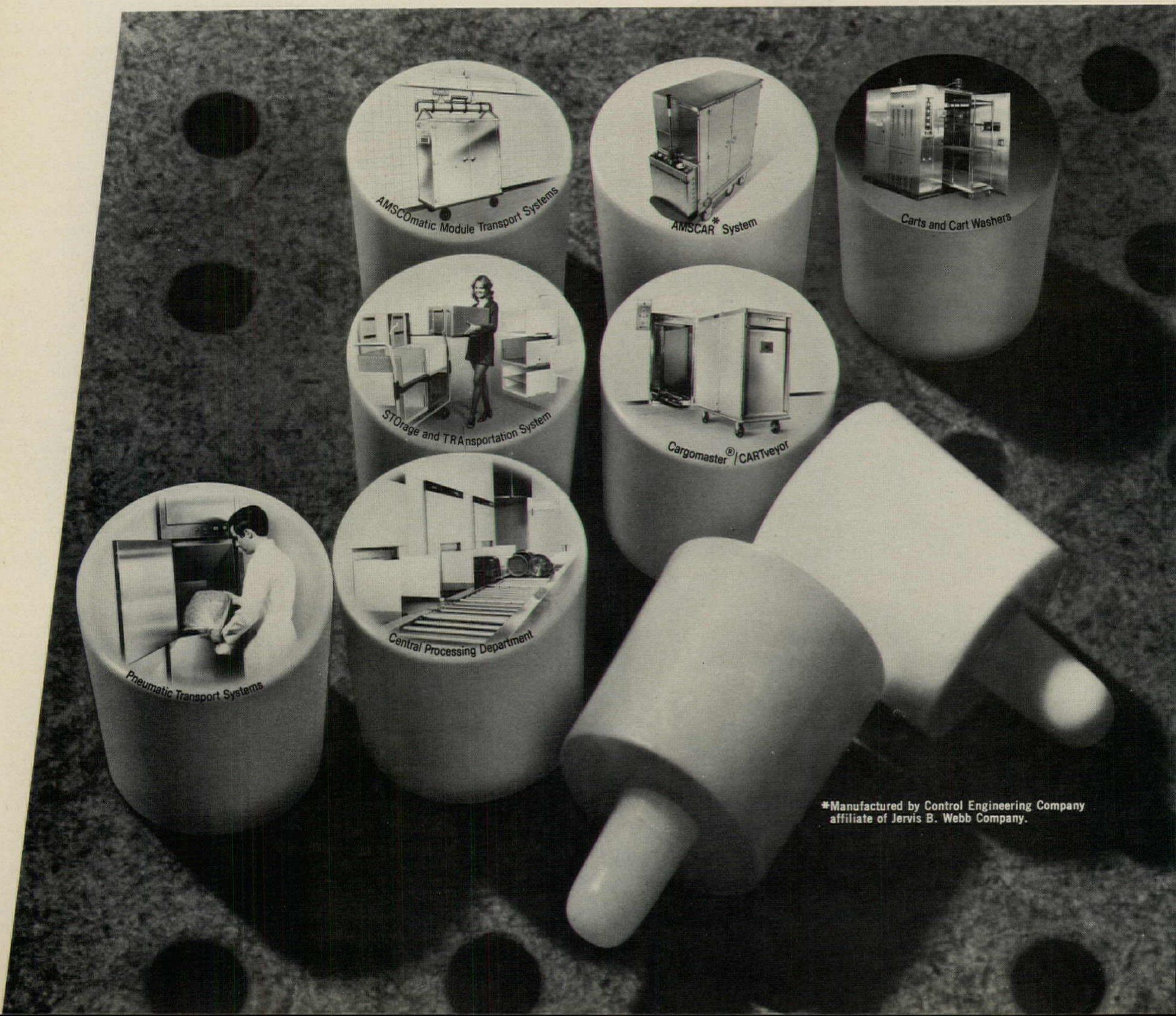
And we back our products with expertise that helps us tailor our material-handling equipment to your building instead of requiring that you plan your building to fit our systems.

We work with you to determine the best system or combination of systems for the job you want done. We gather facts and figures on costs and cost-savings. We design the system down to the last nut and bolt — and can even employ computer simulation to prove that our plans will work as well in actuality as they promised to on the drawing board.

We provide full installation if required . . . train hospital personnel in proper and efficient use of the system . . . and remain on hand during start-up and operation to make sure all the bugs are out. To assure that they stay out, AMSCO offers you a nationwide network of service technicians for preventive maintenance or repair.

When it comes to material handling for hospitals, we may not have all the answers. But we're working on them.

keep hospital materials



The New AMSCAR System — with shuttle and power-assisted load/unload capabilities — now provides even greater benefits to both new and existing hospitals! Using the automated shuttle technique, hospitals can achieve cost effective horizontal movement. New load/unload capability adds an even higher degree of cost-saving automation. Result? An even greater quantity of supplies are now distributed by AMSCAR — and distributed more efficiently . . . distribution life-cycle costs are even further reduced . . . personnel are freed for their most important job: improved patient care.

AMSCO SYSTEMS

Division of American Sterilizer Company

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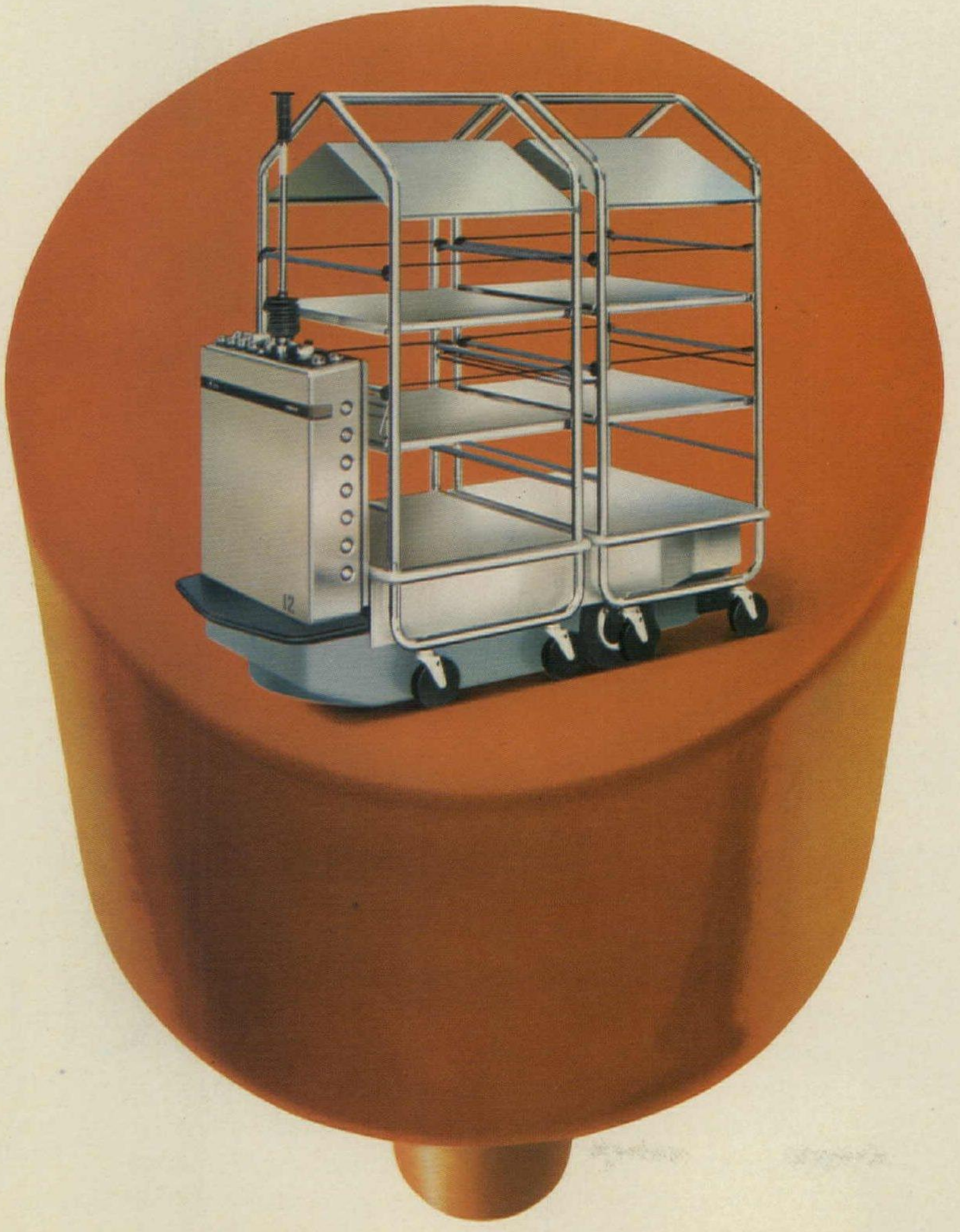
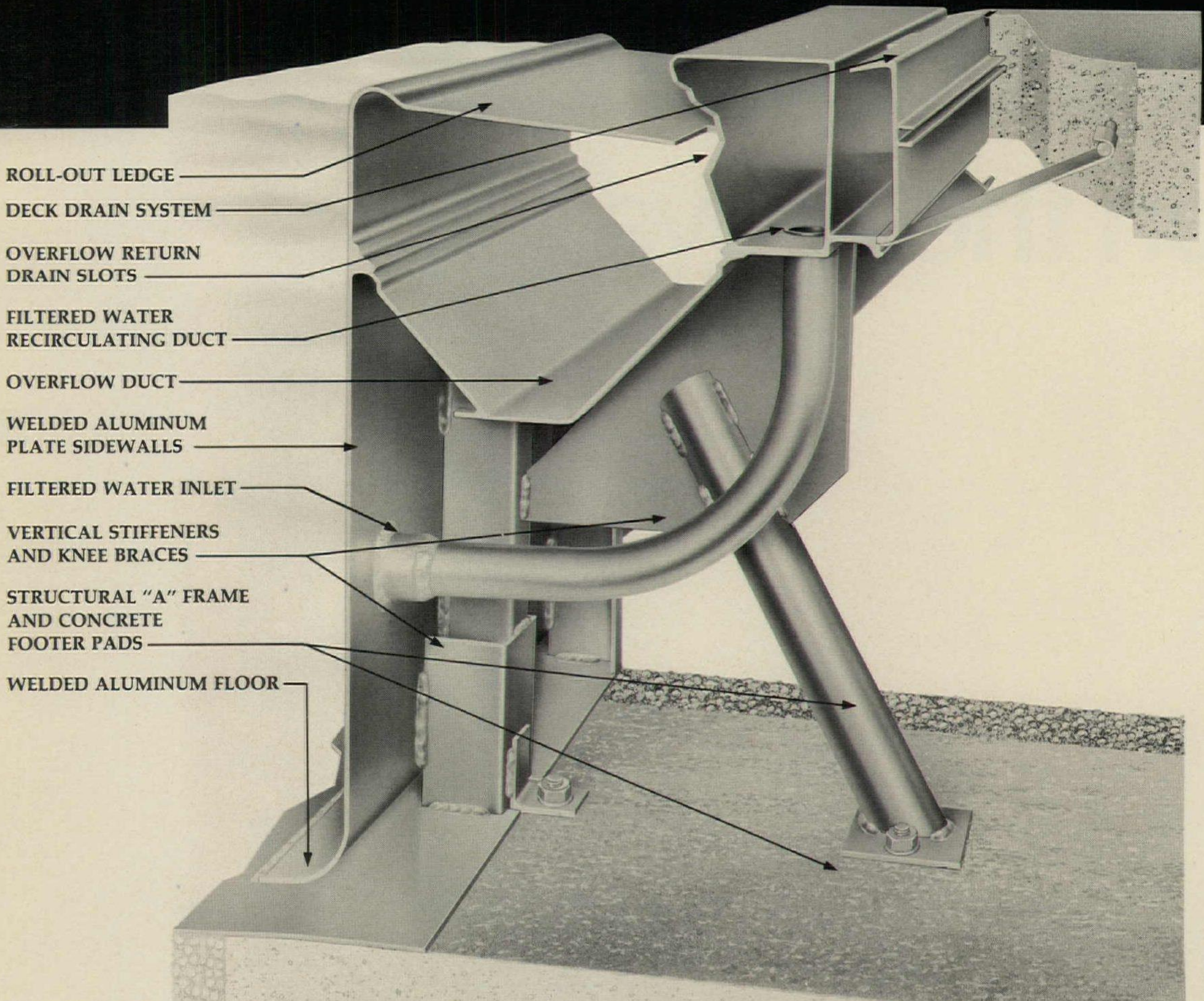
on the move



CHESTER POOL SYSTEMS BEGIN HERE

the same place your pool problems end



The Chester pool wall. Self-supporting. Structurally stable. Incorporating an extrusion forming all circulation and overflow ducts. The beginning of a totally engineered pool system, low in maintenance, free of repair. The Chester system — pool, filtration tank, piping between. All aluminum. Chester . . . the single source, single responsibility pool package . . . designed, fabricated, and constructed by the builders with over 20 years of proven performance . . . backed by a comprehensive 5 year warranty. See Sweets architectural file 13.22 Ch. Case histories are available for study which may parallel your present situation.

CHESTER
POOL SYSTEMS
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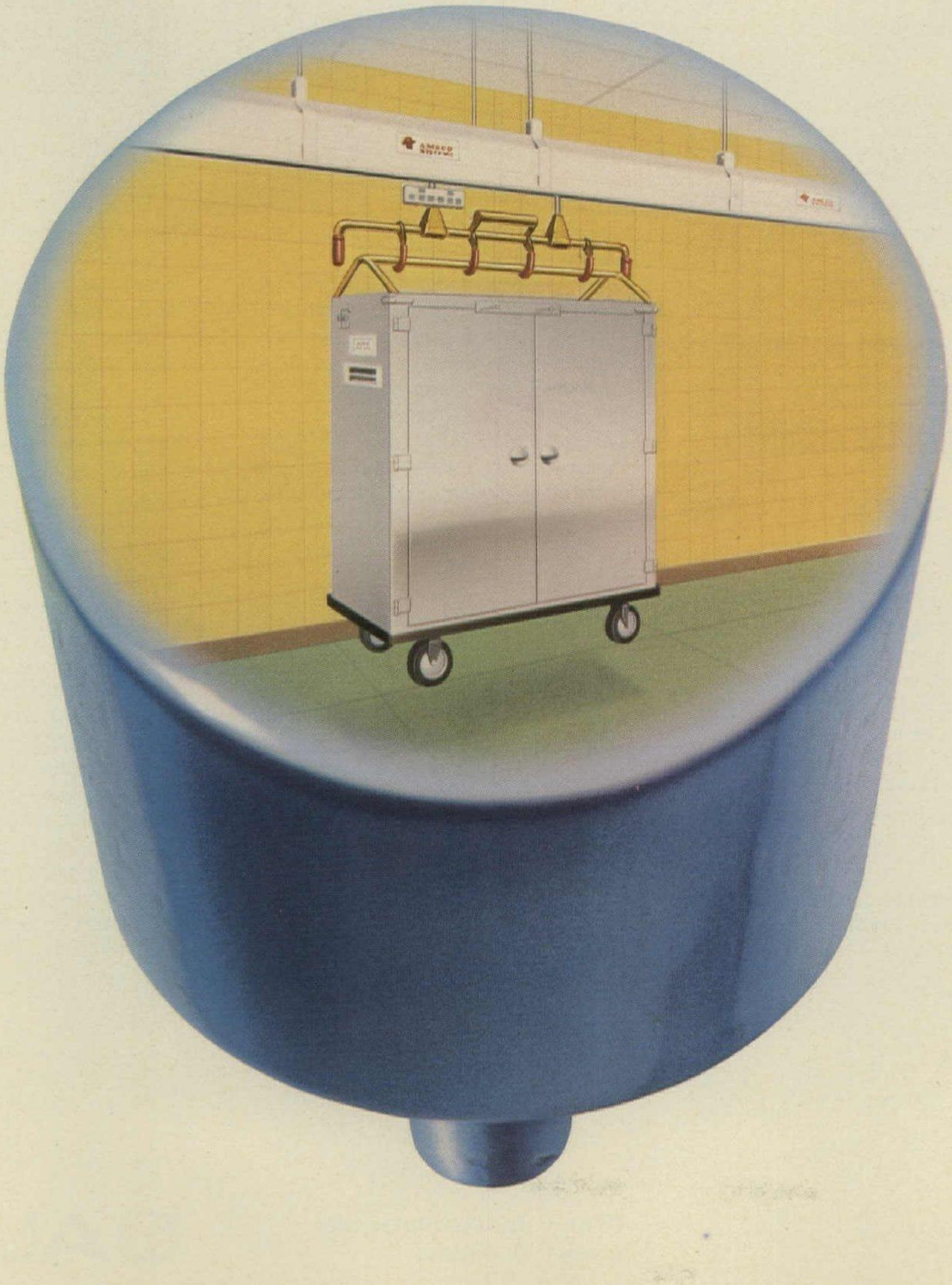


Project: Keen College Academic Building, Union, N. J. Architect: Robert Hillier, Princeton, N. J. Curtain Wall Erector: Whelan Mfg. Co., Trenton, N. J.

Versatile Alcoa Alply wall systems offer custom design flexibility.

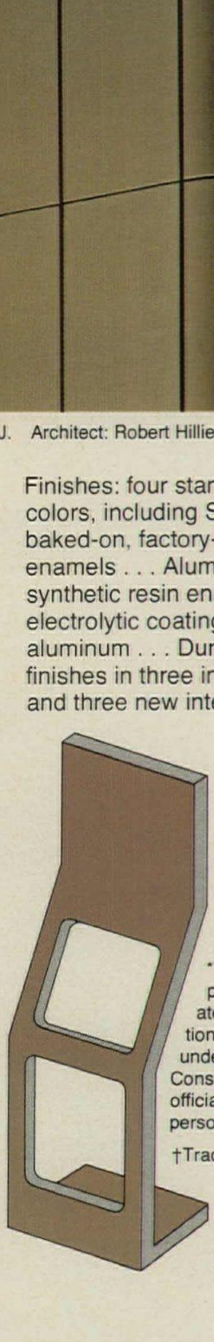
Why settle for less?

You can design your own Alcoa Alply® wall system. Then work through an Alcoa-authorized wall system contractor who offers you single-source responsibility — everything from engineering to the completed wall system, in place, with integral fenestration, interior and exterior finish and thermal insulation.

No other modular wall system offers all these choices for low- to middle-rise buildings:

Exterior and interior skins: aluminum, stainless steel, hardboard, plywood, cement-asbestos — you name it.

Finishes: four standard finishes and 18 colors, including Super Alumalure® baked-on, factory-applied fluoropolymer enamels . . . Alumalure baked-on synthetic resin enamels . . . Alumilite† electrolytic coatings in natural aluminum . . . Duranodic† hard-coat finishes in three integral bronze shades and three new integral gray shades.



*The use of polyurethane, polystyrene and isocyanurate cores in these applications may present a fire hazard under certain circumstances. Consultation with building code officials and insurance agency personnel is recommended.

†Trade Name

Panel cores: polystyrene, polyurethane, isocyanurate* or other materials, depending upon project requirements.

Wide range of panel sizes: up to five feet wide, 18 feet long.

Variety of shapes: panels can be shop-formed to almost any three-dimensional shape desired.

Choice of joining systems: Alcoa's patented Snug Seam®, caulking, splines, battens or frames.

Variety of cutouts possible: to accommodate windows, doors, sloping grade lines, walkways, difficult contours, parapets.

Whatever you're designing, let Alcoa and its wall system contractors help. We know a great deal about wall systems, finishes, industrial roofing and siding and other low- and middle-rise construction problems. We can make things easier. Especially if you involve us early. For further information, write: Commercial Building Systems, Aluminum Company of America, 1090-V Alcoa Building, Pittsburgh, PA 15219.

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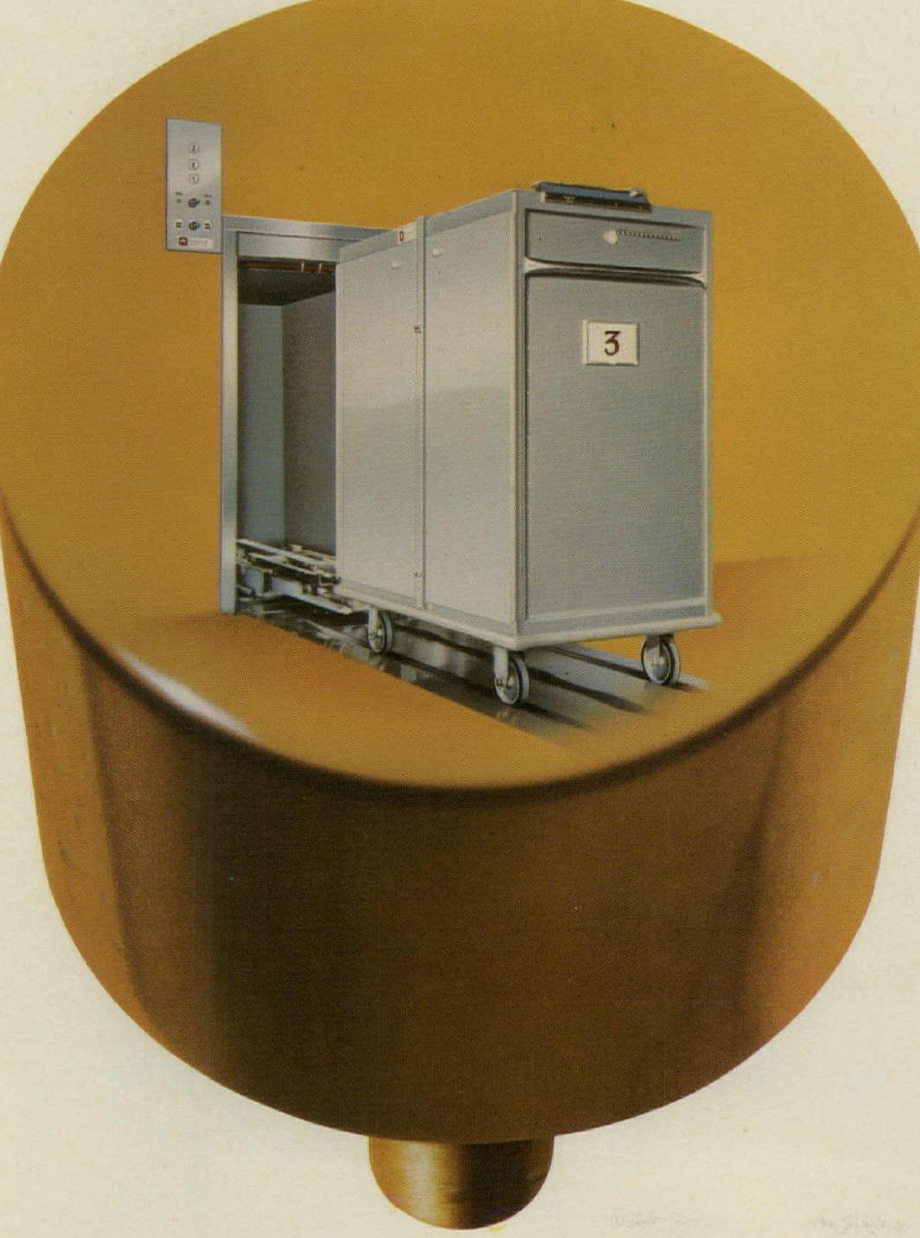
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398

For more data, circle 21 on inquiry card

Administration of the $18 billion water pollution construction program may be hampered by manpower inadequacies at the regional level, according to a recent report from the Environmental Protection Agency. The report states that unless EPA changes procedures for administering the sewage treatment facilities building program, the Agency may have trouble obligating the remaining $12.8 billion of the $18 billion authorized by Congress for use by September 1977. Increased staffing by EPA is recommended to assure that projects on the State Priority Lists result in a steady flow of approvable grant applications.

The Environmental Protection Agency is modifying demands for pre-construction review of certain buildings and structures. Because state and local governments would not help in the review process—and Congress does not require them to do so—EPA is backing away from earlier demands to review parking lots, sports stadiums and shopping centers. EPA's concern stems from knowledge that automobiles drawn to these facilities can cause air pollution, and under the review plan approvals would have been granted only to those projects minimizing that potential problem.

Meeting with President Ford in July, AGC officials expressed opposition to secondary boycotts in the construction industry. James M. Sprouse, executive director of the Associated General Contractors of America said following his meeting with the President that he is convinced that Mr. Ford will veto the measure if it reaches his desk, unless accompanied by "new, comprehensive and badly needed construction labor reform legislation." The bill—HR 5900—now in Congress would permit, if passed, any union to force a general contractor off the project by picketing everyone on the site, even those not involved with a particular dispute. The bill is discussed on page 36 of RECORD, July 1975.

Underwriters' Laboratories has released its report on flammability of cellular plastics in finishes. Entitled "Flammability Studies of Cellular Plastics and Other Building Materials Used for Interior Finishes," the report covers comparative full-scale fire tests and laboratory-scale tests on 31 interior finishing materials, including 18 types of cellular plastics used as building materials. The 235-page report is available from UL for $22.50 per copy, and orders should be directed to: Underwriters' Laboratories Inc., 333 Pfingsten Road, Northbrook, Ill. 60062.

The American Institute of Architects has announced a proposed tax incentive program for energy conservation. Testifying before the Senate Committee on Finance in July, AIA executive vice president William L. Slayton presented the Institute's tax incentive proposal as an alternative to the insulation and solar equipment incentives contained in HR 6860, the Energy Conservation and Conversion Act of 1975. The tax incentive program, said Slayton, would stimulate between two and three million jobs in the depressed construction industry, and would make possible energy savings of up to 4.65 billion barrels of petroleum in the first five years.

A "New Techniques for Life and Fire Safety in Buildings" seminar will be held by ASHRAE this year. Covered in the two-day seminars will be: codes and standards; testing of new concepts; requisites for upgrading buildings; suppression and communications systems; and new design team concepts. The dates and cities for the seminars are: September 17-18, Chicago; October 7-8, New York City; October 22-23, Los Angeles; November 6-7, Atlanta; and December 4-5, Washington, D.C. For further information, contact: Management Concepts International, Inc., 505 Park Avenue, New York, New York 10022. Telephone (212) 582-0337.

Energy conservation, fires, multi-use and security were discussed at the June 26 BOMA conference in Toronto. Six hundred members attended the annual meeting of the Building Owners and Managers Association International, at which Eugene A. Barbles was elected president. A BOMA policy statement issued at the meeting called for support of land use planning, and government aid to rapid transit. BOMA's stand on fire safety was to recommend that government jurisdictions work more closely with local building owners and managers and other informed persons in the private sector to improve safety devices, codes and procedures. Also, OSHA regulations in their present form were labeled wasteful and nonproductive in non-critical industries.

The AIA has completed the first volume of its "Energy Opportunities Notebook," a continuing service to be offered on a subscription basis. It contains information on design and engineering opportunities for achieving an energy efficient building environment, and current proposed legislation concerning energy conservation issues. The notebook will be updated on a quarterly basis.

Vincent G. Kling of Philadelphia will be consulting architect to the Metropolitan Atlanta Rapid Transit Authority Board of Directors. Kling's selection concludes six months of searching by the MARTA Board, and his responsibilities will include monitoring and reviewing architectural design progress on all 39 of the transit system's rapid rail stations. His contract will run for 24 months, on an "as needed" basis.

Hugh A. Stubbins, Cambridge, Mass., has been awarded the Tau Sigma Delta Gold Medal for Distinction in Design. The national honor fraternity for architecture and the allied arts presented the award to Mr. Stubbins at the AIA convention in Atlanta on May 20. Current projects of Mr. Stubbins include the Citicorp Center under construction in New York City, and the Federal Reserve Bank of Boston.

CRSI design awards go to six buildings

Six architect/engineer/owner teams won equal honors in the 1974 Concrete Reinforcing Steel Institute Design Awards competition for reinforced concrete structures. Creative achievement in esthetics, engineering, functional excellence and economy were judged in all entries.

The winners in the first annual contest and their buildings are:

Gruzen & Partners, New York City, architects; Farkas, Barron & Partners, New York City, structural engineers; and City of New York, owner, for One Police Plaza, a 10-story office tower (see photo 1).

George Matsumoto & Associates, San Francisco, architects; Hirsch and Gray, San Francisco, structural engineers; and Regents of the University of California, San Francisco, owner, for the School of Nursing Building, University of California Medical Center, a six-story office and classroom building (see photo 2).

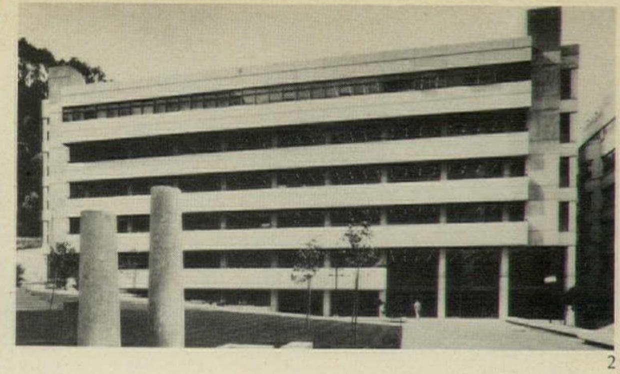
I.M. Pei & Partners & Araldo Cossutta Associated Architects, New York City, architects; Weiskopf & Pickworth, New York City, structural engineers; and the Christian Science Church, owners, for the Christian Science Center, which includes a 28-story administration building, a colonnade building, a three-story Sunday School and an underground garage (see photo 3).

Allen & Miller, Santa Ana, Cal., architects; Martin, Tranberger & Associates, Newport Beach, Cal., structural engineers; and Santa Ana Unified School District, Santa Ana, owner, for the Fremont Elementary School, a single-story recessed building with rooftop play area (see photo 4).

Reid & Tarics Associates, San Francisco, architects and structural engineers; and University of California, San Francisco Medical Center, owner, for the Clinics Expansion and Parking Structure, an 11-story health-care facility combined with a multi-level garage (see photo 5).

Hamon Cooling Tower Division, Research-Cottrell, Bound Brook, N.J., designers and builders; United Engineers and Constructors, Philadelphia, architects/engineers; and Atlantic City Electric Company, Atlantic City, owner, for the B.L. England Station, Salt Water Natural Draft Cooling Tower, a 208-foot tall structure which is the first such tower in the U.S. that uses circulating sea water (see photo 6).


1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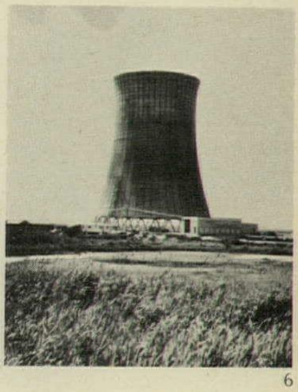

6

Sault Ste. Marie landmark opens

Standing on Sault Ste. Marie's waterfront is a 21-story concrete structure in the form of a triple observation tower, designed by George Rafferty of Progressive Design Associates, St. Paul, Minn.

The towers are in the shape of three vertical trapezoid columns, topped by five cantilevered viewing platforms. The interior of two columns contains a stairway, and the third column contains an elevator.

The structure is used as an observation tower with a view of the St. Mary's River, the Soo locks, and both the Canadian and Michigan cities of Sault Ste. Marie.

Research credits elevators in high-rise safety

Many lives can be saved from fire or explosion in high-rise buildings if evacuees are allowed to use elevators, a University of California architecture research team at Berkeley has concluded.

Vladimir Bazjanac, lecturer in architecture who heads the research team, points out that virtually every city's building code requires "grounding" of all passenger elevators in emergency operations.

"With proper evacuation strategies and proper operation of elevators, all the people can be removed from the floor in danger, as well as from the floors immediately above and below, within five minutes. In case of fire, you might be able to take everyone out of danger even before the fire department gets to the scene," said Bazjanac.

The Berkeley project's conclusions result from nearly three years of work by the four-member research group. The researchers used data from several high-rise buildings in San Francisco.

"Experiments with our simulator disprove the widely held notion that elevators cannot provide adequate service to the building population in an emergency, and that they should not be used," Bazjanac said.

"In most emergencies in modern high-rise buildings, elevators will not fail during the initial phase of emergency. There is ample time to remove people from areas in danger using elevators, and elevators can usually accomplish the task much faster than people can escape on foot through stairwells."

Specific evacuation strategies suggested by the U.C. study include sending elevators to floors just above and below the emergency zone. Other possibilities: people could be taken to safe refuge areas within the building; elevators could be sent simultaneously to the same floor; only part of the building's population might be transported; or the building could be totally evacuated.

This research has been funded by the National Science Foundation. The simulator is also used to test elevators.

Energy conservation stressed in ERDA game plan

The Energy Research and Development Administration has come out with a broad-scale plan for meeting the nation's energy needs through the year 2000. ERDA stresses no single technology at the expense of others and promises development of new conservation techniques.

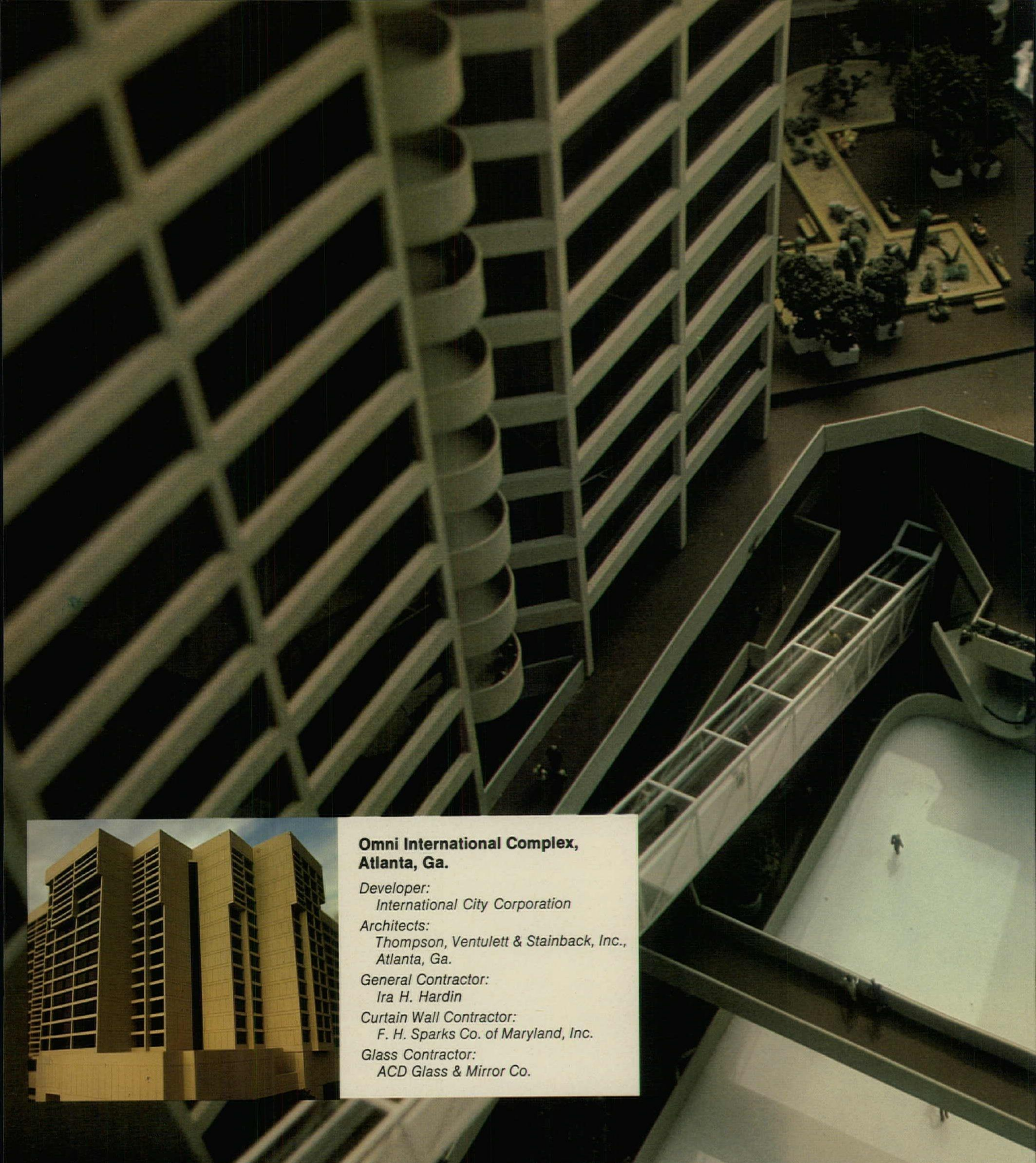
In general, ERDA hopes to rely on extensive new energy technologies to shift the U.S. away from its 75 per cent dependence on oil and gas while at the same time maintaining about 2 per cent energy consumption growth rate.

In the near term (1975-1985), the top priorities will be to expand use of coal and nuclear reactors, increase domestic oil and gas recovery, and increase the efficiency of energy use. In the mid-term (1985-1995), ERDA intends to accelerate development of synthetic fuels from coal and shale, and to increase the use of geothermal, solar heating and cooling, and waste heat recovery. The long-term scenario stresses nuclear breeders, fusion and solar electric power.

But ERDA assigns one of its highest priorities to conservation—in buildings. ERDA intends to develop model building codes and performance and design standards, conduct research development to establish thermal performance standards for new buildings, and encourage large-scale adoption through Federal incentives and development of innovative financing.

Another short-term goal is development of heat management technologies in industry, leading to the demonstration of a waste heat pump by 1982 and advanced thermal storage by 1983.

A secondary objective is development of solar heating and cooling for buildings. ERDA forecasts that it will be a significant factor by 2000, however, contributing 9 quadrillion Btu's to an estimated total demand of 125 quadrillion Btu's. The near-term emphasis will be on heating and cooling of residential and commercial buildings, leading to demonstrations by 1979.—*Roger Smith, World News, Washington.*



Omni International Complex, Atlanta, Ga.

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International City Corporation

Architects:
Thompson, Ventulett & Stainback, Inc., Atlanta, Ga.

General Contractor:
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6 Amarlite products specified for Omni International Megastructure

Omni International is a city within a city. Located on 5½ acres, the megastructure covers approximately 2,000,000 square feet devoted to work, sports, leisure, corporate offices, business facilities, retail shopping, dining, exhibitions, international banking, sculpture, hotel space (500 rooms), cinema and world trade.

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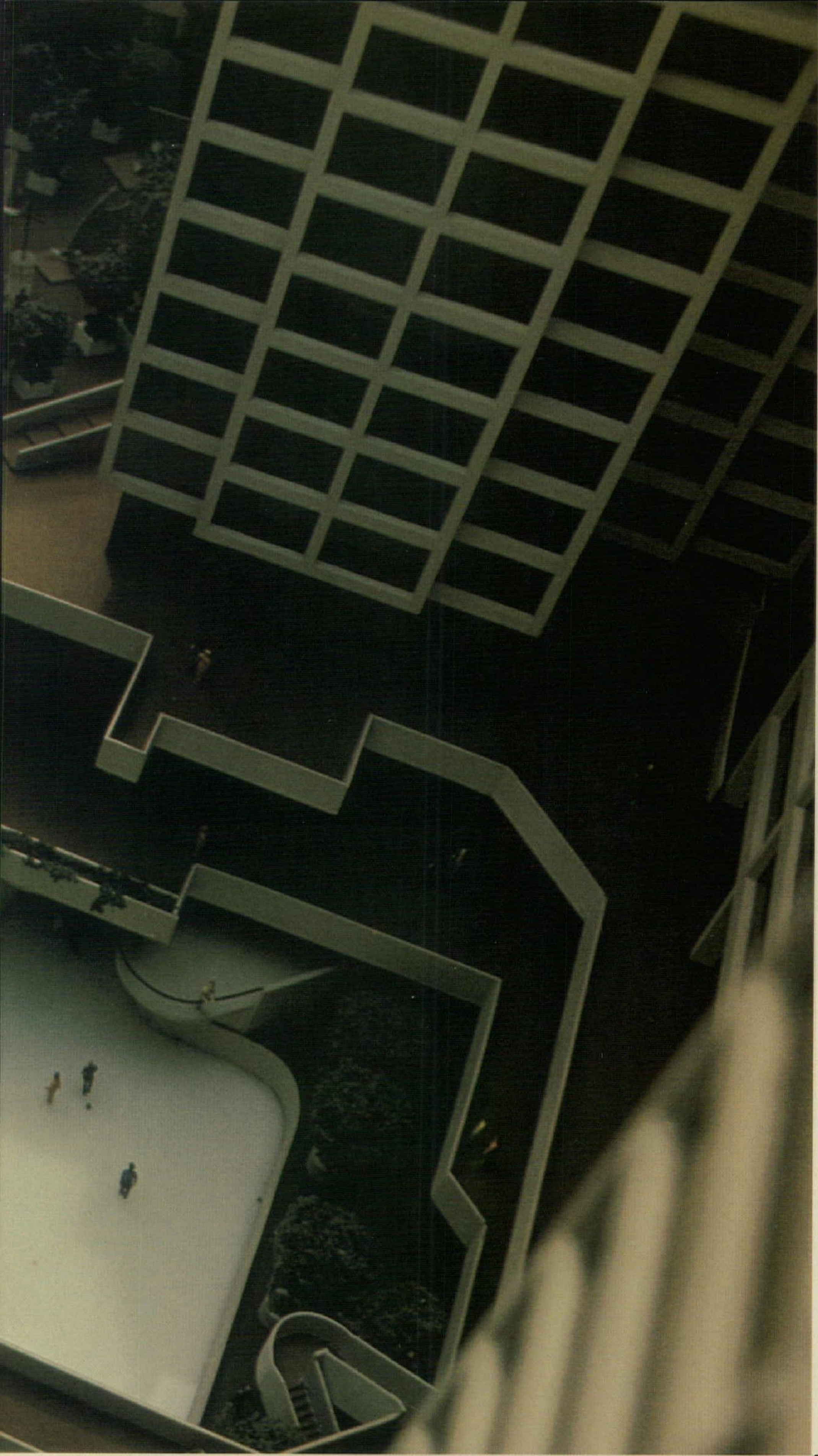

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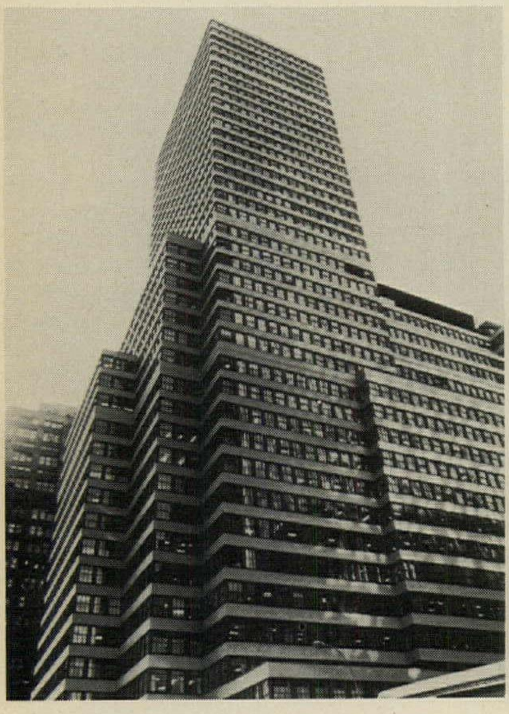
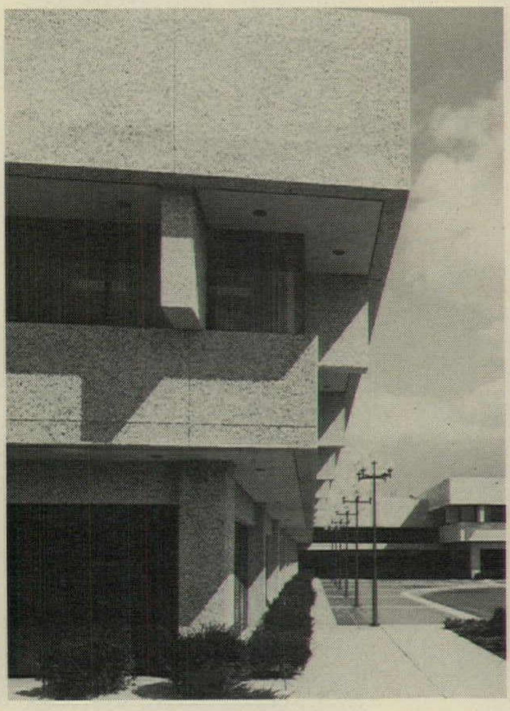
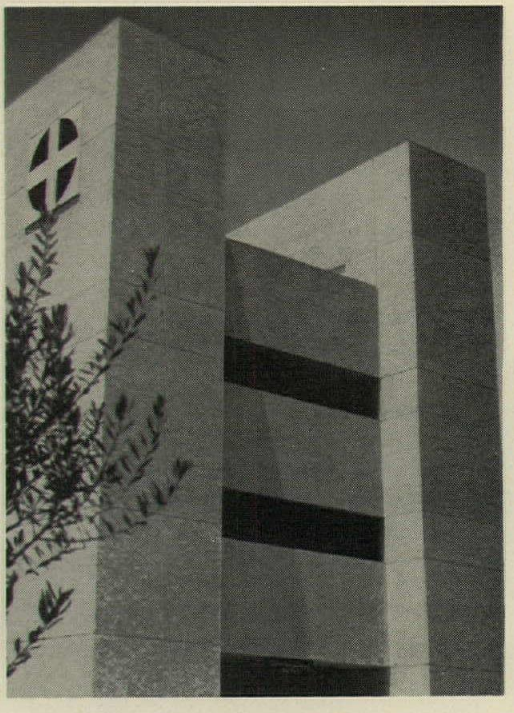


This 44-story office structure was built in 1950. Honeywell central control now saves its management $16,400 on energy and $27,000 on manpower costs. Says Leslie Hill, Superintendent, "We're enjoying the best operational cost savings in the history of this building."



Energy consumption at corporate headquarters in Woodcliff Lake, New Jersey is managed over leased lines by a Honeywell owned and operated BOSS control center—located 40 miles away. "Last year we cut our natural gas volume by 22% and electrical usage by 31%," according to Vice President Bill Grant. I-R shares the cost of control center operations with many other on-line building owners.



"Without our Honeywell central control system, we'd need twice the maintenance staff just to keep our building running," states Merlin Vincent, Director of Plant Services at Desert Samaritan Hospital and Health Center, Mesa, Arizona. "Even then, we couldn't run it as well or as cost-effectively as we do now. In terms of cost-avoidance, our system paid for itself in its first year."

These are but six of over 2000 successful Honeywell central control installations in buildings old, new, large and small.

If your building is over 150,000 square feet, Honeywell can "fine tune" it to run better, more efficiently — for a lot less money. Our Delta central control system ties together your heating, cooling, ventilating, lighting, security and fire safety equipment into a *single* system.

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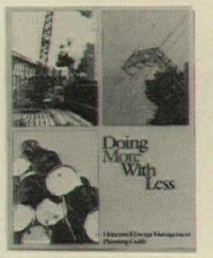

1. For exact cost-saving figures, based on a professional survey of your building, contact your area Commercial Division office today.

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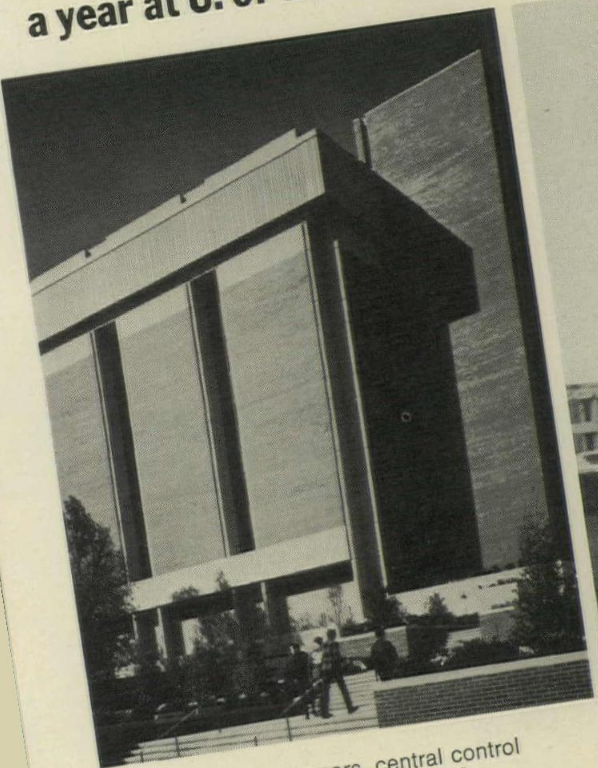

"In its first two years, central control saved us $242,820 on coal and electricity. We anticipate even greater savings as energy prices rise. Even when you deduct the salary of our operator and a few hours a week of our technician's time, that is a substantial savings," explains George Moore, Director of Physical Plant. "It's amazing how much you can save when you turn off unneeded heating and cooling systems. Until we installed Honeywell central control, we couldn't do this . . . we just didn't have the manpower."

"That's on top of providing a high level of security and fire safety," reports William d m Snell, Building Superintendent and Chief Engineer at Kemper Insurance Companies, Long Grove, Illinois. "Without Alpha 3000 we would incur additional manpower costs of $85,000 per year. It's also helped us cut annual electricity consumption by 8 million KWH, saving over $115,460 in electric bills." That works out to combined savings of 40¢ per sq. ft. on the half million sq. ft. facility.

With 60 buildings spread around Denver, Mountain Bell recognizes that the enormous cost of operating and maintaining facilities can be contained by tighter management control. So they turned to centralized control on a metro area basis. Their single Honeywell system will save enough in energy, labor, and equipment replacement costs to pay for itself in about two years. And, the system's fire, security and equipment monitoring functions will help them protect customer phone service.

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Steel framing brings this inverted pyramid in at reasonable cost

Located amid Stamford's 130-acre, $280-million downtown revitalization, GTE building rises over a 3-story, 1,300-car above-ground garage, whose roof also serves as a 4-acre plaza. Design of building also allows for construction of an addition atop garage when more office space is required. This provision was the reason for treating the inverted pyramid and garage base as separate structural elements.

General Telephone & Electronics' new world headquarters in Stamford, Conn., was designed with floors of different areas to accommodate varying departmental space requirements. One of the primary requisites was the elimination of view-obstructing columns, normally located along window walls. But the inverted pyramid design, while valid both practically and architecturally, did pose some problems.

Structural engineer Werner Jensen, of Werner Jensen and Adams, used sound engineering principles to solve them. He explained, "The slope was the most economical way of transferring the load to the foundation." And the cantilever design eliminated the need for windowwall columns.

Steel selected for economy, strength, speed of erection. Since each successive floor of this structure cantilevers beyond its column supports, steel was chosen to provide the necessary tensile strength. Moreover, the flexibility of steel framing gave the architect freedom to design an unusual structure at a reasonable cost.

An enclosed arboretum, containing a circular reflecting pool, rises 50 ft from the building's ninth floor. It passes through the penthouse mechanical level to an unusual roof—a group of 76 plexiglass domes supported by joists and cross-framing which span 80 ft.

To frame both the building and its garage base, the fabricator used 1,500 tons of ASTM A572 Grade 50 and 4,300 tons of ASTM A36 structural shapes supplied by Bethlehem. The A572 grade is used in areas of high stress in both office building and garage. Speed of erection was another reason for steel framing.

In all, the building provides approximately 480,000 gross sq feet of office space. The bottom of the 6-step inverted pyramid measures 180 ft square. In four steps it reaches the maximum dimension of 230 ft square. The sixth and top step is smaller than the one below it, resulting in a penthouse design with a 10-ft-wide surrounding terrace.

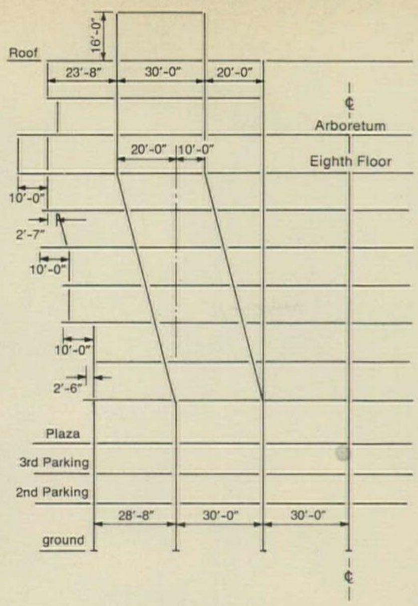
Sloping columns are critical. In elevation, 14-in. wide-flange interior columns rise vertically to the second floor, where they bend to a

15-degree off-plumb angle. Twelve of the sloping columns stem from four 3-prong, 12-ton weldments located in each of the building's corners. These were shop fabricated from 3-in. steel plates.

According to the fabricator-erector, the slanting columns caused no major problems. To hold them in place before bolting, they used temporary bracing rods tied to floor beams. The ease of erection was said to be due to careful shop fabrication. When exterior columns were plumbed, everything lined up.

The second directional change occurs at the eighth floor, where the sloping columns again straighten to support the floors above. Here the floor beams become a tension ring. Gusset plates are bolted top and bottom to hold continuity of tension members.

Sloping columns bend to a 15-degree off-plumb angle at second floor. Design permitted cantilevering of different levels and column-free walls.



Cross section through center line of structure includes three parking levels beneath 10-story building. Sloping columns begin on second floor and end at the eighth.

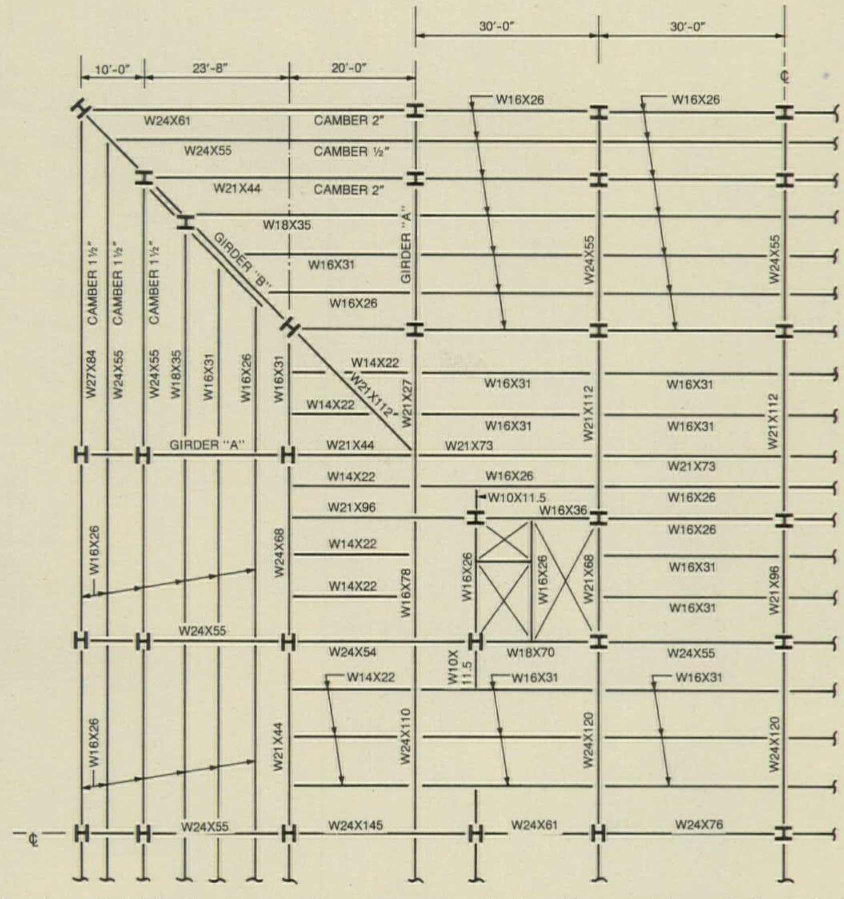
Ten-story height is visually foreshortened. Horizontal bands of reflective glass, which enclose one floor and two spandrel panels at a time, give the GTE building the appearance of a 5-story structure. (Vision panels of tinted gray glass separate the reflective glass bands.) This also produces the floating effect the architect was trying to achieve. Floor-to-ceiling height is a constant 12 ft 8 in., although the cantilevering of each 17-ft-high band causes floor heights to appear different.

Connection techniques are varied. Vertical loads from the four weldments are transferred directly to the columns below, while the horizontal components are transferred through fillet welds. In this way, critical tension welds are eliminated. On the second floor, the sloping columns act as a compression diaphragm in resisting forces acting in two directions. Full penetration butt welds connect these members.

In addition to both shop- and field-welding, ASTM A325 and A490 bolts were used for field connections.

Deck and fireproofing. The floor system of the office structure is a 4¾-in. concrete slab over a 1½-in. composite floor deck. The deck itself is cellular to allow for electrification, which is blended approximately 45-55 percent. Fireproofing was sprayed on the structural members.

Eccentric forces eliminated. Engineer Werner Jensen says, "Since the building is symmetrical in both directions, there are no 'oddball' forces." Wind bracing at each corner near stairwells and elevator shafts



Plan view of eighth-floor corner shows arrangement of cantilever girders which eliminate the view-obstructing columns from the building's perimeter.

bear on footings that are tied together to counteract lift.

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The crisis: not energy; not ignorance; but inaction

Do you have a sense of *déjà vu* in all those oh-my photos of solar heat collectors, windmills, tidal energy machines and household hints about double glazing, insulation, caulking against infiltration, lower night temperatures and the like?

Echoes of Maria Telkes, Farrington Daniels and C. G. Abbott from circa 1950! (Remember the Dover solar house, RECORD March 1949?) The ancient verity of Q=UA(delta T), the great brown-coal conversions to a thousand years of Btu, total energy systems as exciting as perpetual motion, volumes and treatises of know-how at every level of science and invention—all of these have been waiting on the reference shelves for one simple event: a rise in the price of energy units to exceed the cost of simple conservation measures.

We talk to J. Karl Justin of O'Brien & Justin about such things from time to time, so he sent us a copy of the following letter, which he thought to address to *The New York Times* and other places. —*W.F.*

In Hugh Kenner's article, "Bucky Fuller and the Final Exam" (*New York Times Magazine*, Sunday, July 6, 1975), Fuller was quoted as saying "There is no energy crisis. There is a crisis of ignorance."

Some recent thinking has led me to the conclusion that in the building industry the crisis is not even one of ignorance but of *inaction* and I would like to share my observations with you.

A little casual math shows million-gallon savings are easy

It was during some recent meetings on architectural aspects of energy conservation in new buildings that a little casual arithmetic made me startingly aware of how easy it would be to make a substantial dent in our national total of annual oil consumption. In fact, the President's announced goal for reduction of a million gallons a day is a pushover for our industry alone.

To begin with, just looking at housing, it occurred to me that there are so many more existing buildings than projected ones that we might spend our effort more productively on improving the former. There already exist in the country about 75 million dwelling units of which about 50 million are single-family units. This compares to the scant one million or so that are being built new annually.

One reliable survey says that 17 million of the houses are un-insulated. Now just suppose we simply threw some insulating batts on the ceilings of those uninsulated houses (and I should say right away here that this is not a paid ad by any insulation manufacturer or association). It's an easy thing to do and does a lot of good.

I figured we would save about two Btu's per square foot for every degree day. At a low average of 1000 square feet a house and 4000 degree days; that would be 136 trillion Btu's per year. At reasonable furnace efficiency I calculate that would come out to *200 million gallons a year saved.* Staggering!

The President's one million a day goal is only 365 million a year. We could be better than half way there in a weekend's work.

If you've ever worked on the problem, you know that on the ceiling or under the roof is generally the most effective and the easiest place to put insulation. You carry the insulation blanket up into the attic, and with luck, if there are no floor boards, you just unroll it in the joist spaces. Though it helps a bit, you don't even have to staple it down—gravity does that part of the work for you.

With floor boards in the way, the insulation can be stapled between the rafters. The cost per house is small, maybe $100, some "sweat equity" and a couple of cans of beer. The benefits are about $200 a year; not a bad trade-off.

Now if intelligent efforts continue to be made in new construction too, and toward improving the other millions of already existing units, and if we go after commercial and industrial and government buildings as well, we should be able to reach the million gallon a day conservation goal with ease just in buildings; even taking into account that it takes energy to save energy (we have to run the mines, refineries, mills and factories to make all this insulation).

All this is without addressing ourselves to the other major sectors where energy is consumed and can be saved, such as transportation, power production, illumination and even air conditioning. (Our insulation would help here already) and it doesn't even consider elimination of just plain inadvertent waste.

I remember in 1950 a couple of former school chums of mine started a business selling small scale furnace dampers for large residences. The idea was, mainly in the summer time when the furnace was run only to heat the domestic water, to restrict gases from escaping the flue until they cooled to 600 degrees instead of exiting at their usual 1200. These fellows, when they made an installation, also always took the opportunity to clean the oil burner nozzle and air ports . . . with the result that the testimonial letters they got were too good to be credible; some "savings" in the first year running as high as 60 per cent. Actually, the burner cleaning was due at least half of the credit.

This kind of simple waste is probably responsible for much of the discrepancy between the U.S. and other countries in energy consumption per capita. Germany and Sweden, for instance, which have a per capita GNP about the same as ours, use 55 per cent and 39 per cent less energy per capita respectively than we. And it is, at this point, no longer because of much lower living standards and deprivation of energy consuming luxuries.

Scare tactics won't work until the pocket pinches

I suppose one factor in creating this layer of waste is that the layman doesn't have to understand even rudimentary technology and its rational base to partake of its abundance. On the other hand, in spite of this lack, the public does not respond well to technical projections of crises, the exaggeration of which it can sense if not corroborate mathematically. The public correctly senses that the problem is easily cleaned up regardless of all the talk about "crisis." But the public may just let it continue for the same reasons it allowed the problem to develop in the first place; perhaps until the pinch gets tighter.

Now as you see I am already a convert. My partner and I take all this very seriously and advise our clients to do likewise. And we already devote a significant part of our practice to "retrofitting" existing buildings for greater economy of energy and maintenance generally. Before long, we feel, matters will be well under control.

But just to put a safety catch on the solution I propose that we conscript all the unemployed new and used-car salesmen to go out and hawk this insulation, and I guarantee people who never heard of a Btu will be buying insulation.

All this is in the end a very qualitative review studded with a few key figures that I think make it unnecessary to prove the point further. Fortunately, I am only an architect with a little extra engineering background. Just think what can be accomplished when the full-time engineers get going.

—*J. Karl Justin*

GSA's mandatory computer program for CM control is not exclusive to IBM machines

At an introductory briefing on the new edition of "The GSA System for Construction Management," reported in RECORD June 1975, the impression was conveyed that the PBS computerized control system stipulated as mandatory for use by construction managers of GSA projects, was specifically developed for use with IBM equipment. It turns out that GSA is fully aware of the implications of such an "exclusive" arrangement and has adapted the equipment requirement to allow use of any manufacturer's computers that have sufficient capacity and can accommodate the PBS-CMCS logic. The following letter from Frank J. Matzke, acting assistant commissioner for construction management, explains the situation:

First I wish to express my appreciation for the fine article that appeared in the June 1975 issue of the RECORD about the GSA system for construction management. Basically, all the salient features of the new system have been accurately reported.

I do, however, wish to correct the item concerning the mandatory use of our computerized system for measuring actual performance against projected goals for schedules, costs, and finances. While it is true that our management tool called the "Construction Management Control System" has been programmed for use with the IBM 360 Computer System, Model 50 or higher model number, we are aware that other manufacturers of computer equipment can meet our needs. Accordingly, we have, prior to any solicitation under the new system, changed the computer equipment requirement to allow the Construction Manager to use any manufacture and configuation of computer equipment, which will provide sufficient capacity to meet the data processing requirements, and which will compile the CMCS FORTRAN programs with no change to system logic and no change to program coding other than minor special character conversion.

We believe that this change opens the door for firms that have an interest in providing computer services for Construction Managers doing work for GSA and should help relieve the concern expressed in the article about restraint of trade.

The interest you have shown in our building program and specifically in our new system for construction management is greatly appreciated. I feel we are on target toward our goal of securing the best design and management services the construction community can provide. —*Frank J. Matzke*

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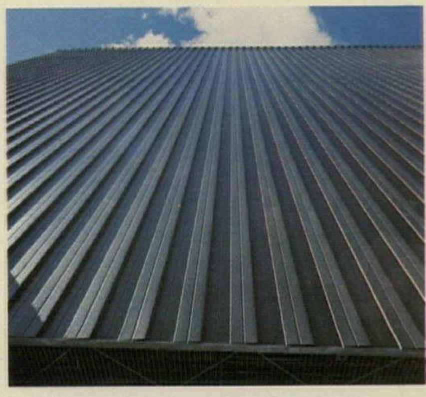

The Geysers Power Plant, Unit 11
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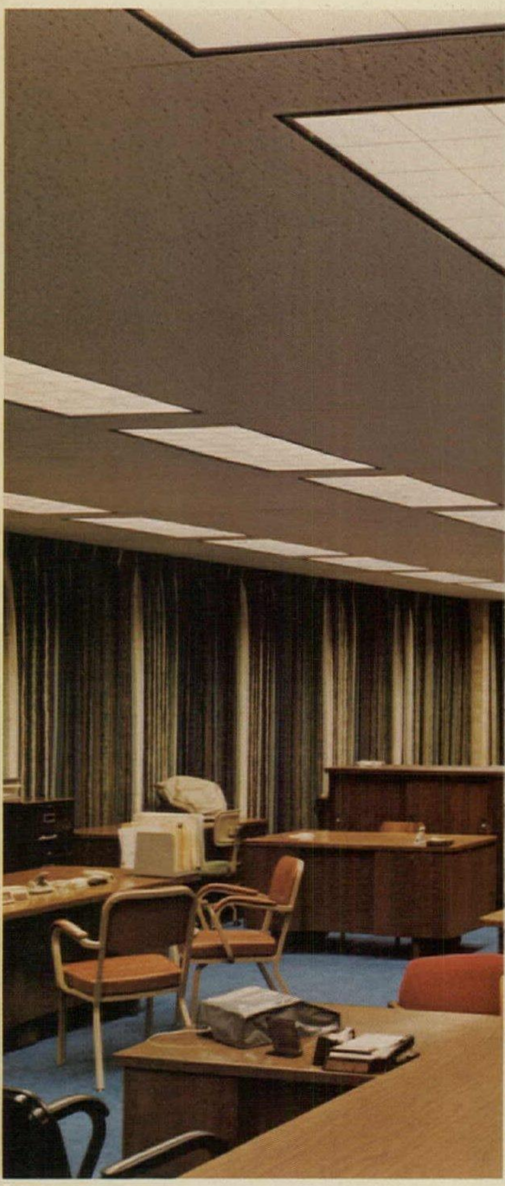
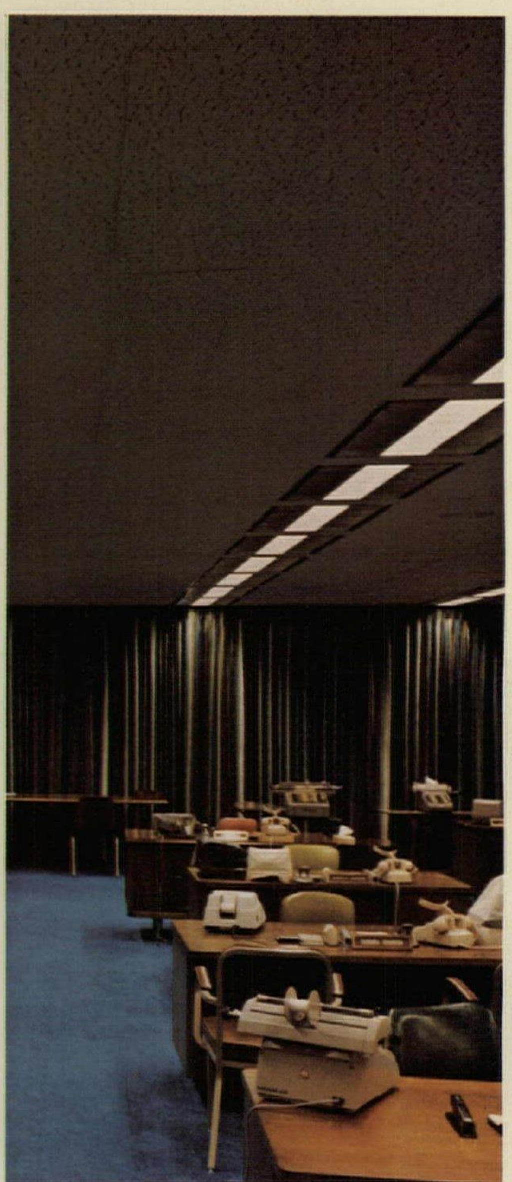


3 lamps

2 lamps



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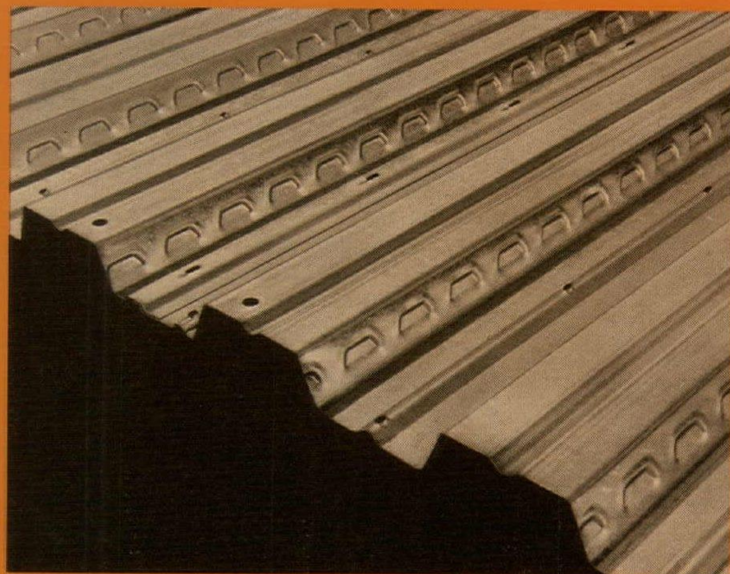
1. New deep embossed indentations bond concrete for full composite action. Structurally tested and proved one of the strongest composite action deck designs available.

2. Fewer sidelaps and faster erection with full 36" wide panels. Lengths to 45' mean fewer sheets to handle.

3. Easy, precise bay fit and line-up with new adjustable sidelap design that also eliminates lap leakage.



4. Faster welding with pre-punched slots on a 12" module.

5. Light gages are double thick at sidelap to improve fastening strength.

6. Optional ceiling hanger holes in each rib (12" o.c.) fit any ceiling grid pattern.

7. Handling holes provide easier handling and faster erection.

8. Comdek has approved UL Fire Ratings up to 3 hours.

And for greater economy, Comdek is available in both 2" and 3" depths. For complete information, see Sweet's, section 5.5, Metal Decking, composite. Or mail this coupon request for a free copy of the new Comdek brochure. Write now. Granco, P. O. Box 40526, Houston, Texas 77040.

Granco: Send the Comdek brochure fast.
☐ For my files ☐ For a job under consideration.

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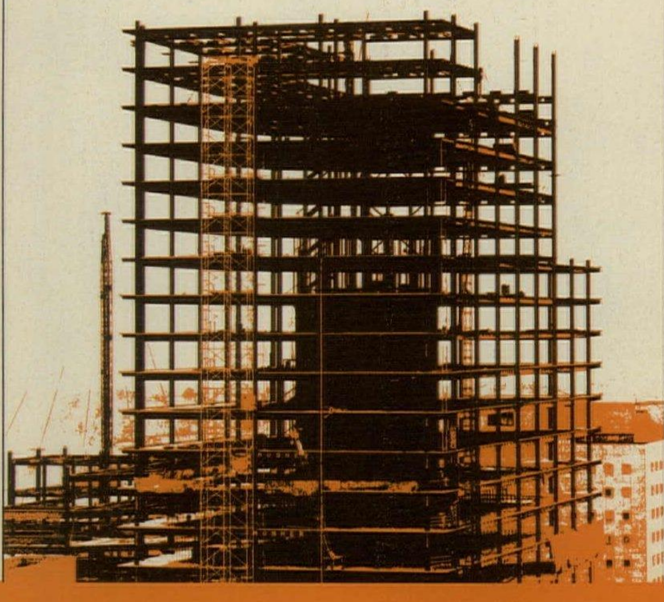

GRANCO®
Building products that perform

National Steel Products Company
Subsidiary of National Steel Corporation

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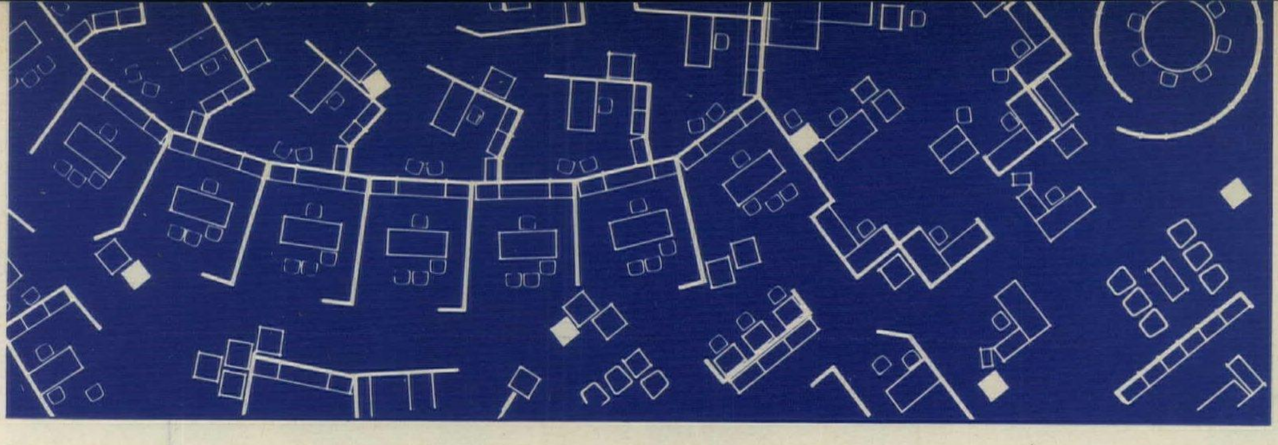
modulo 3 (un) common denominator at IBM

Upper left: one of the executive offices in the new IBM World Trade Americas/Far East Corporation headquarters, where free-standing Modulo 3 furniture and panel-hung components are combined.

Lower left: acoustical panels in the Modulo 3 System form offices, support components and establish an integrated staff area using free-standing furniture.

Upper right: free-standing, white laminate secretarial stations have recessed oak veneer work surfaces to complement the panel-hung and free-standing components of adjacent executive offices.

Lower right: in 37 sq. ft. is an efficient work station containing panel-hung desk and work surface, ample overhead storage units and mobile tub file. All communication and electrical wiring for the station is safely concealed in the Modulo 3, UL approved raceway—the only plug-in, panel-to-panel System that's UL approved.



A section of floor layout illustrating curvilinear, rectilinear and free-standing configurations.

This newest IBM facility is more than eight football fields of floor space, transformed by Modulo 3 furniture and panels into an efficient work environment for 1,100 people.

Every office and all support areas meet a common criteria for individual efficiency, uncompromising aesthetics, and adaptability to the change-dynamics that set the way of life in modern corporations.

What's not so common in office planning today is that Modulo 3 is the *only* System providing the complete spectrum of solutions: Fully integrated, free-standing Furniture; Panels; Panel Mounted Components—and unlimited combinations of all three for rectilinear and free-form configurations.

Brilliant white laminate finishes, warm oak and walnut veneers are blended in work surface and storage units throughout the building. Acoustical panels used as privacy screens and supports for components are covered in both white and buff shades of Belgian linen. The full range of utility and price in the Modulo 3 line permitted extending the same rich design statement from offices for senior officers to space for junior staff.

Product information...yours for the asking. You can apply our single-system approach to your planning—for a single work station or spaces as big as football fields. You'll find Modulo 3 contains the (un) common denominator of design for your next office plan. Write for your copy.

modulo 3

A SUBSIDIARY OF TIFFANY INDUSTRIES, INC., 100 PROGRESS PARKWAY, MARYLAND HEIGHTS, MO. 63043
TELEPHONE: (314) 878-4222, TELEX: 44-7652
SHOWROOM/MERCHANDISE MART, SUITE 1635, CHICAGO, ILLINOIS 60654 TELEPHONE: (312) 467-9437

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Pre-insulated

Inryco

1

Inryco/wall PS
Pre-insulated Sandwich Panel

30" wide, U-value: .080.

A one-piece, complete wall section that reduces field erection steps to a minimum. No wall system has fewer parts or can be installed faster. Isocyanurate insulation properties are excellent, and there is no metal-to-metal contact between inner and outer faces. Factory-installed seals at panel joints keep the weather out. Exterior appearance: attractive, flush, monolithic; eight long-life colors in Duofinish 500™ Interior: bright, reflective, flush, white surface in Duofinish 100™

Three new options for energy-saving design in wall construction

There is no single solution. The designer needs flexibility to meet the requirements of different structures. Inryco/wall's three versions help. Each type greatly increases a building's energy-conserving properties, but each permits a different approach to construction.

All Inryco/wall panels share one vital advantage over others: the excellent thermal values of foamed-in-place isocyanurate, a second generation, 93% closed-cell material that outperforms conventional, flame-retarded urethanes while equalling their strength and insulating qualities.

All Inryco/wall panels have composite strength resulting from the bond between the steel and insulation. Strength for longer spans, rigidity for easier handling and faster erection. And all Inryco/wall panels are protected by long-life, oven-cured Duofinish coatings over galvanized steel.

We've prepared information that describes these three new Inryco/wall panels in greater detail. Get yours from your local Inryco sales engineer or send in the handy coupon.

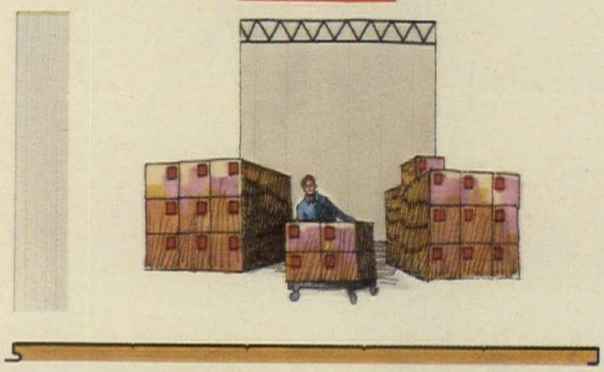
INRYCO
an **INLAND STEEL** company

Formerly Inland-Ryerson Construction Products Company

General Office, Melrose Park, Illinois

o/wall™

2

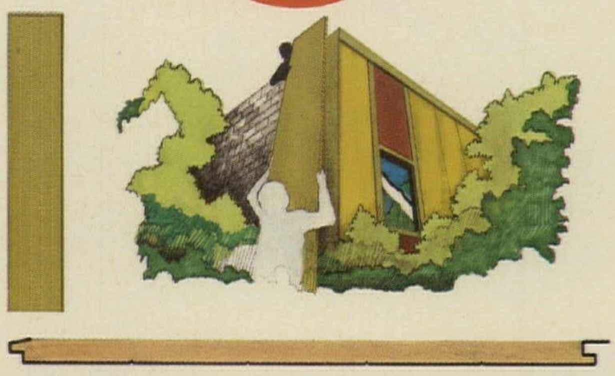


Inryco/wall PL
Pre-insulated Liner Panel

30" wide, U-value: .15.

For field assembly in combination with conventional exterior wall panels. Liner creates a flush, easy-to-clean interior wall surface with a long-life Duofinish 100™ white coating that enhances lighting levels. Erection is greatly speeded because factory-installed insulation eliminates the step of insulating in the field. Panels are strong, rigid, easy to handle. For the exterior, the designer can choose any panel from Inryco's broad line of conventional wall systems.

3



Inryco/wall PF
Pre-insulated Face Panel

30" wide, U-value: .12.

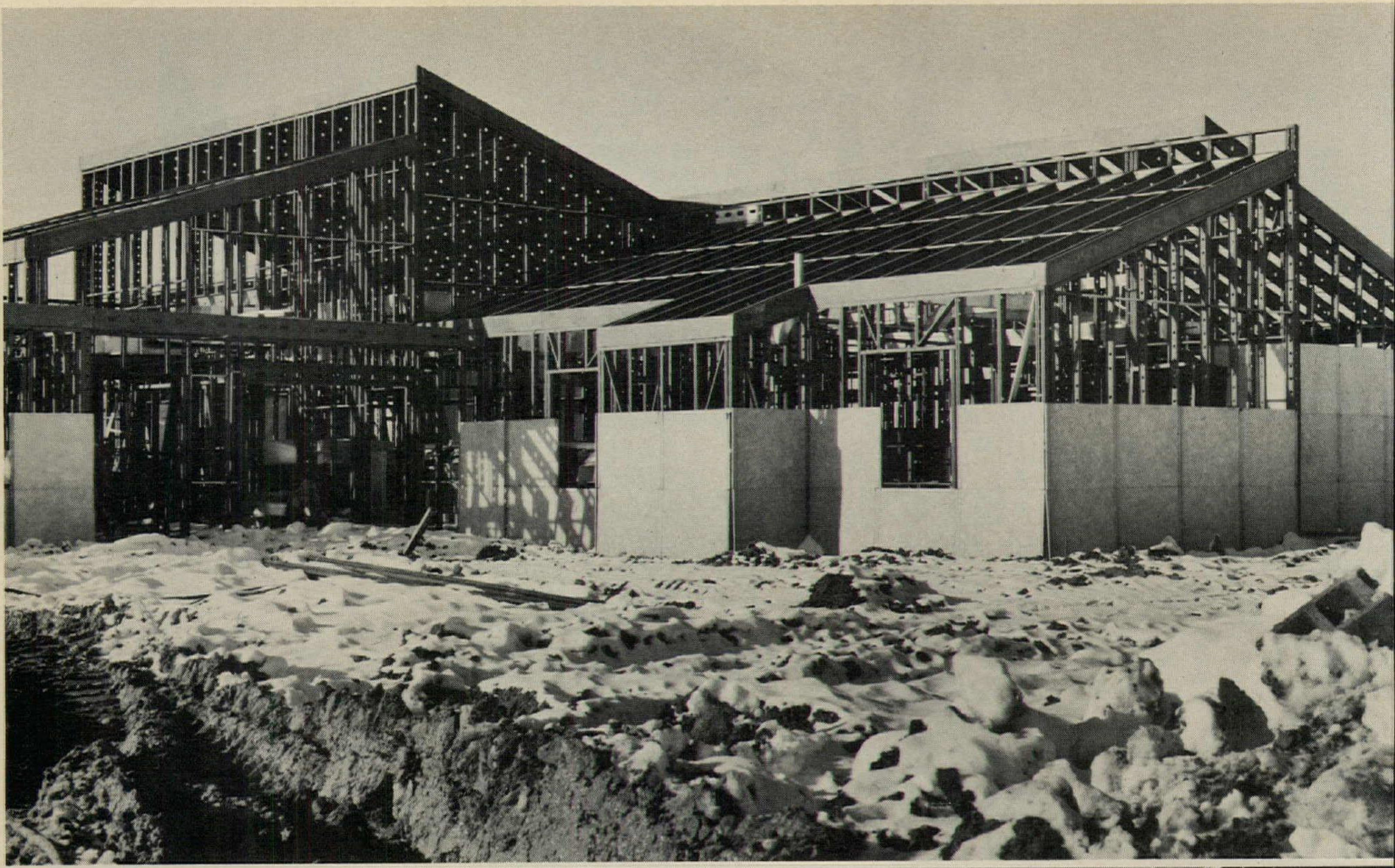
Two ways to upgrade both the appearance and the energy-saving properties of older masonry or block structures. Face panel can be used either on the exterior or interior of a building. Used outside, the panel creates a contemporary, flush look with a choice of eight long-life Duofinish 500™ colors. Used inside, it covers unsightly wall conditions with a neat, flush surface and boosts lighting levels with its Duofinish 100™ white coating.

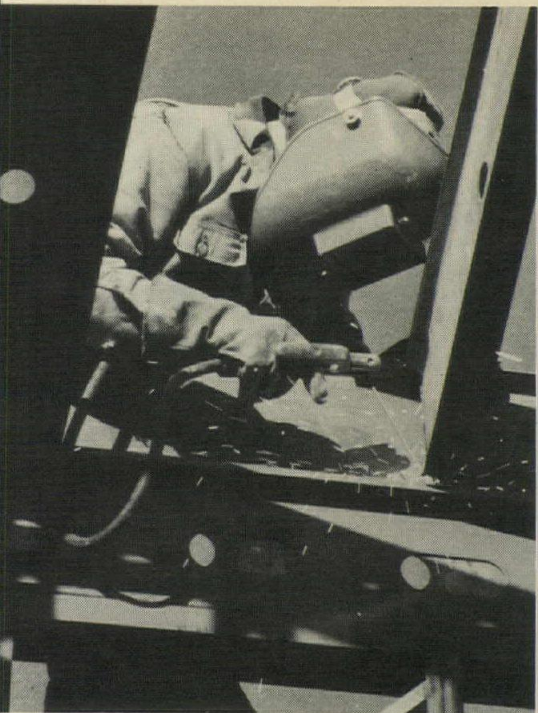
INRYCO, Inc., Dept. H, 4033 West Burnham St., Milwaukee, WI 53201

Send me the information on Pre-Insulated Inryco/wall.

Name	Title	Company		
Address	City	State	Zip	5-22-1

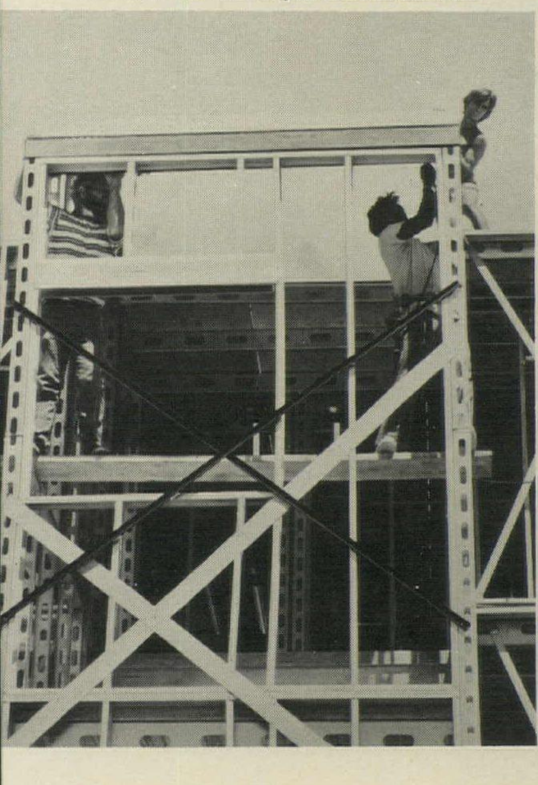
For more data, circle 31 on inquiry card





Markward & Karafilis, Inc., of Detroit is building this 85,000 sq. ft. complex for the Mental Health Department of the State of Michigan. Complex is the proper word for this residential training center. And because it is fireproof, flexible and compatible with other building materials, the architect, Eberle M. Smith Associates, chose steel as the proper framing material for the building shown (top left) and the eight other buildings involved. C & I Building Products Company of Chicago are the fabricators on the project.

Nine buildings (left) are also involved in PUU HELEAKALA, the 126 unit apartment project designed by architect, Charles R. Sutton & Associates and being built by Associated Masons Ltd., for the Ferguson Land Company and Kaiser Industries on Oahu, Hawaii. Pre-fabrication of panels by Tayler Products of Burlingame, California and Honolulu, saved on-site job time in Hawaii.



In Michigan and Hawaii they're catching the new wave: Wheeling® Steel Framing.

More and more builders are swinging to Wheeling framing systems. They're doing it because Wheeling framing systems do more for them. There's more to the Wheeling system. More gauges. More sizes. More shapes.

More gets done each day, when you use Wheeling Steel Framing. More productivity. More profitability. And most important, lower overall costs.

Wheeling Steel Framing will take any interior or exterior material. All joists and studs are pre-punched. Electrical and mechanical service lines are easily installed.

The rigidity and strength of steel is obvious. And steel framing is non-combustible. It will not shrink, swell, rot or warp.

Catch the big wave in building. The first step is to write for our brochure: WC-608. It's crammed full of load tables and many other things you want to know about steel framing.

For your copy write, Wheeling Corrugating Company, Division of Wheeling-Pittsburgh Steel Corporation, Dept. GC-17, 4 Gateway Center, Pittsburgh, PA 15230.

Wheeling® Steel Framing

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CONDITION WITH

Plexiglas acrylic plastic is a combustible thermoplastic. Observe fire precautions appropriate for comparable forms of wood. For building uses, check code approvals. Impact resistance a factor of thickness. Avoid exposure to heat or aromatic solvents. Clean with soap and water. Avoid abrasives.

PLEXIGLAS®

today, more than ever... it makes such beautiful sense.

Flat or formed. Clear or color. Strong. Light weight. Beautiful. Plexiglas brand acrylic plastic. Making sense, solving problems . . . any way you look at it. In banks where it provides transparency, security and crystal-clear beauty. In school skylights and windows where it resists breakage, controls glare and conserves energy. In homes where its formability makes small worlds larger.

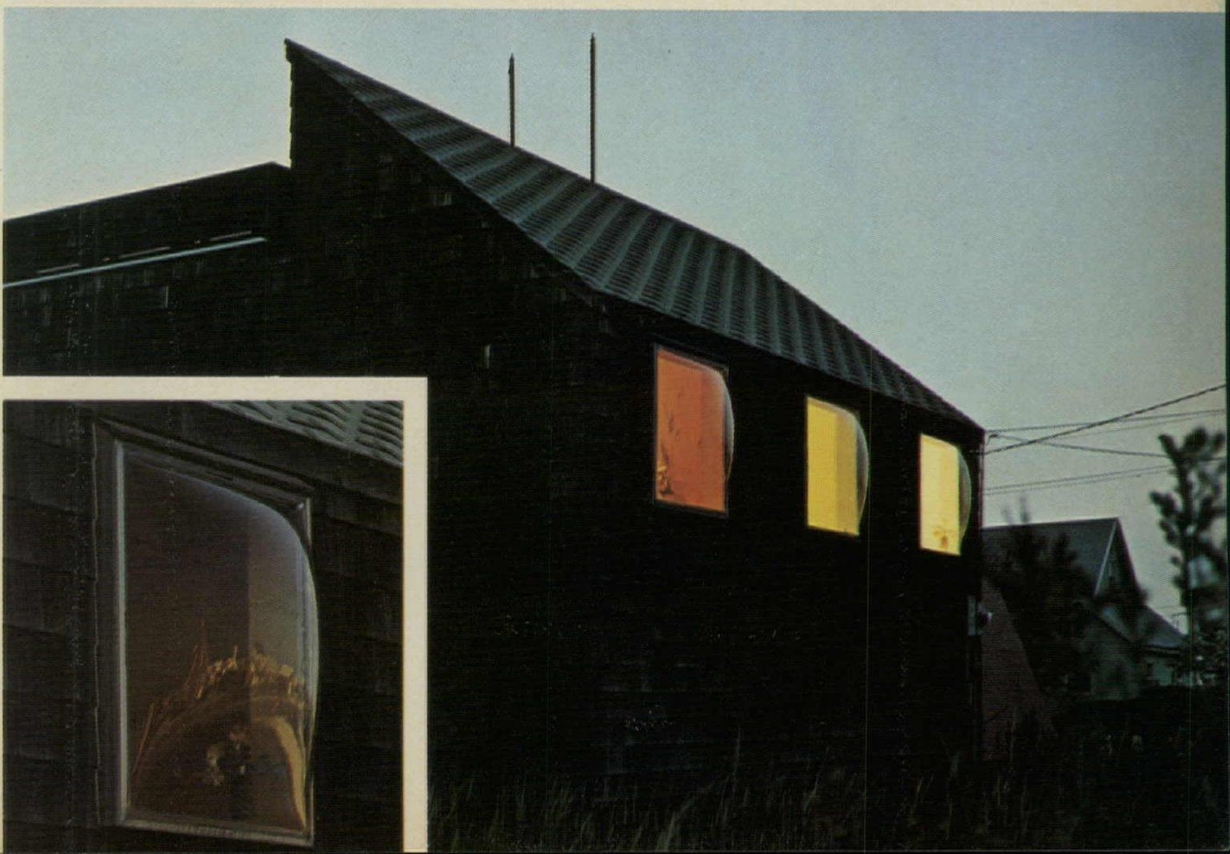
Find out more about Plexiglas by writing for our brochures and engineering data. For on-the-spot answers to specific questions write or call our Architectural Coordinator (215) 592-6799. See our catalog in Sweet's—8.26/Roh

Building codes limit areas of plastic glazing. Approvals for large-area Plexiglas enclosures must be applied for on a special permit basis. Fire safety design considerations must take into account the combustibility of Plexiglas.

Martin Luther King Elementary School
Pittsburgh, Pa. (above)
Architects: Liff, Justh and Chetlin
Pittsburgh

Suffolk Franklin Savings Bank
Boston, Mass. (left)
Architects: Bastille-Neiley
Boston

Beach Cottage, Harvey Cedars, N.J. (right)
Architects: Murphy Levy Wurman
Philadelphia, Pa.



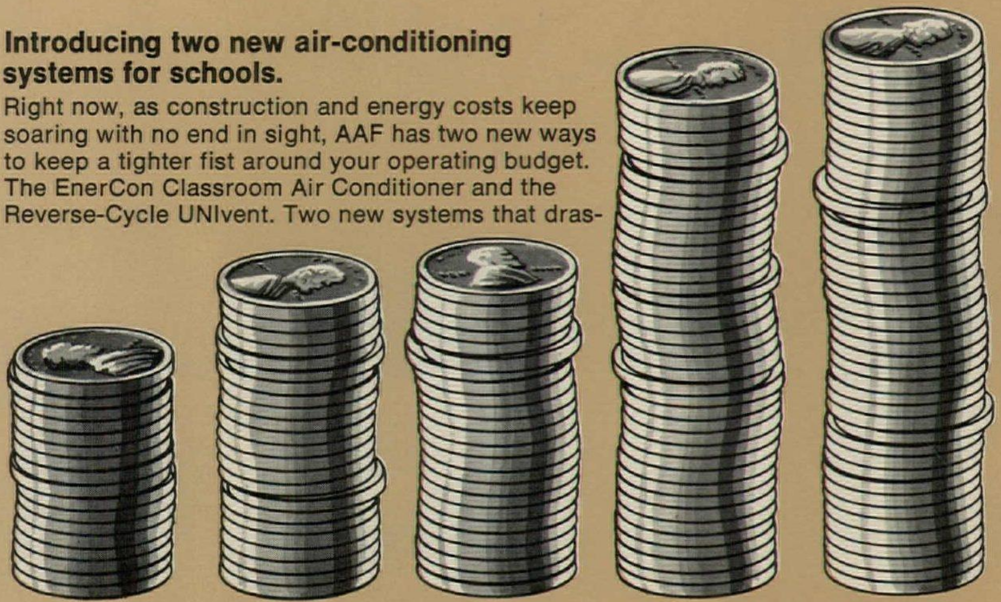
the trademark	*the company*
PLEXIGLAS	ROHM AND HAAS PHILADELPHIA, PA 19105

For more data, circle 10 on inquiry card

New EnerCon heating and air conditioning. The system that puts money

Introducing two new air-conditioning systems for schools.

Right now, as construction and energy costs keep soaring with no end in sight, AAF has two new ways to keep a tighter fist around your operating budget. The EnerCon Classroom Air Conditioner and the Reverse-Cycle UNIvent. Two new systems that drastically cut heating/cooling power costs in schools. Both recycle energy. Both save money. Both are designed for easy installation in either modernization or new building projects.



It costs less annually to heat and cool with EnerCon than with any other system. Approx. energy cost per sq. ft. per year:
EnerCon—17¢
4-Pipe Unit Ventilator—23¢
Central VAV—24¢
Roof Top—39¢
Dual Duct—42¢

Save up to 25% in energy costs.

With EnerCon. The system designed to save energy, by not wasting it.

EnerCon is a new concept in school heating and cooling. It captures and reuses energy other systems throw away.

A simple water loop makes it possible. The water loop—interconnecting each unit—recirculates energy throughout the system. Or, stores it until needed. You spend less—up to 25% less—in system operating costs.

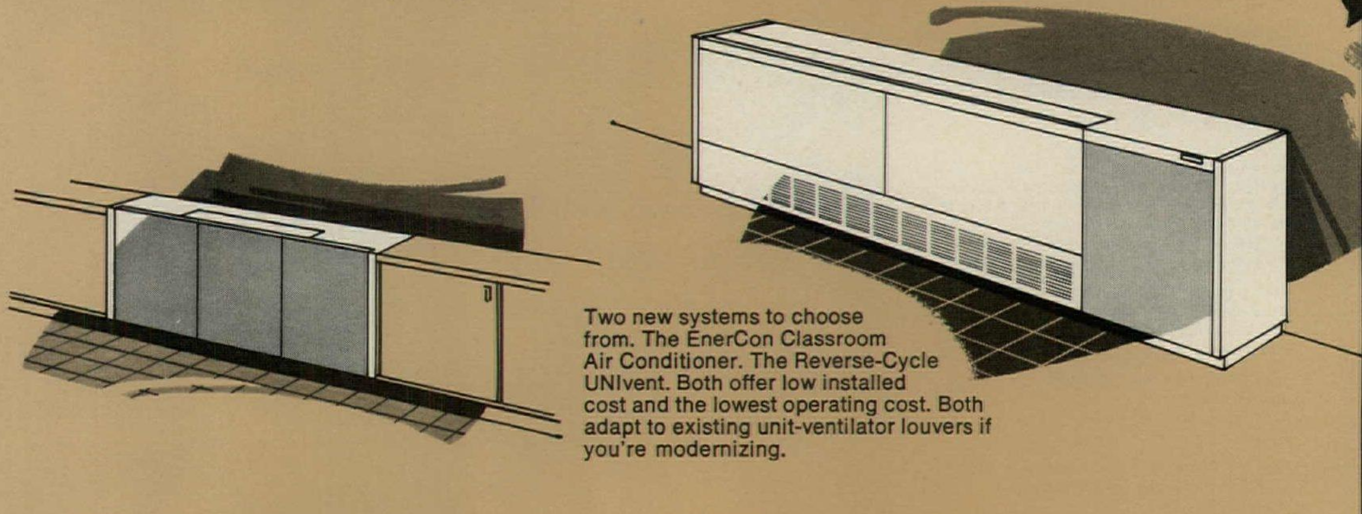
The Reverse-Cycle UNIvent System.

Where desired, the ASHRAE II ventilation cycle can be provided with AAF's new Reverse-Cycle UNIvent. With a wall louver similar to standard unit ventilators, it has 100% outside-air capability. With ASHRAE Cycle II, you have fresh air constantly, and during moderate temperatures, you can cool without operating the refrigeration circuit. So you save even more over conventional systems. You get all the operating economies of reverse-cycle air conditioning with all the benefits of a unit-ventilator system.

And the Reverse-Cycle UNIvent is a perfect solution to modernization, too. Existing "heat-only" unit ventilators are easily replaced by Reverse-Cycle UNIvents. A larger wall opening is *not* necessary, and frequently it is possible to reuse the existing hot water piping for the water loop.

The EnerCon Classroom Air Conditioner system.

This Reverse-Cycle unit also cuts power costs to the bone. EnerCon Classroom Air Conditioners can be used as an individual system or in conjunction with Reverse-Cycle UNIvents. Either way, they're the answer for offices, corridors and administrative areas where 100% fresh air isn't essential—the EnerCon



Two new systems to choose from. The EnerCon Classroom Air Conditioner. The Reverse-Cycle UNIvent. Both offer low installed cost and the lowest operating cost. Both adapt to existing unit-ventilator louvers if you're modernizing.

back into your budget.

Classroom Air Conditioner brings in up to 25% outside air.

These units also adapt to existing unit ventilator louvers if you are modernizing. And, EnerCon Classroom Air Conditioners are compatible in design and construction with all AAF cabinets and classroom accessories, including the effective, energy conserving Draft/Stop return air arrangement.

EnerCon pinpoints your heating/cooling needs.

The average school frequently calls for both cooling and heating at the same time, even during the middle of winter. For instance, heat gain from lights, equipment and people means that core areas need to be cooled whenever they are occupied. So, core areas must usually be cooled even while perimeter areas are being heated.

And during moderate weather conditions, the shifting of the sun from one side of a school to the other can make the difference as to whether you heat or cool the perimeter. Conventional systems exhaust the heat from the areas being cooled, EnerCon reuses and utilizes this energy. You get cooling or heating where you want it, quickly and efficiently, at less cost.

And, you get a lot of heating practically free of charge.

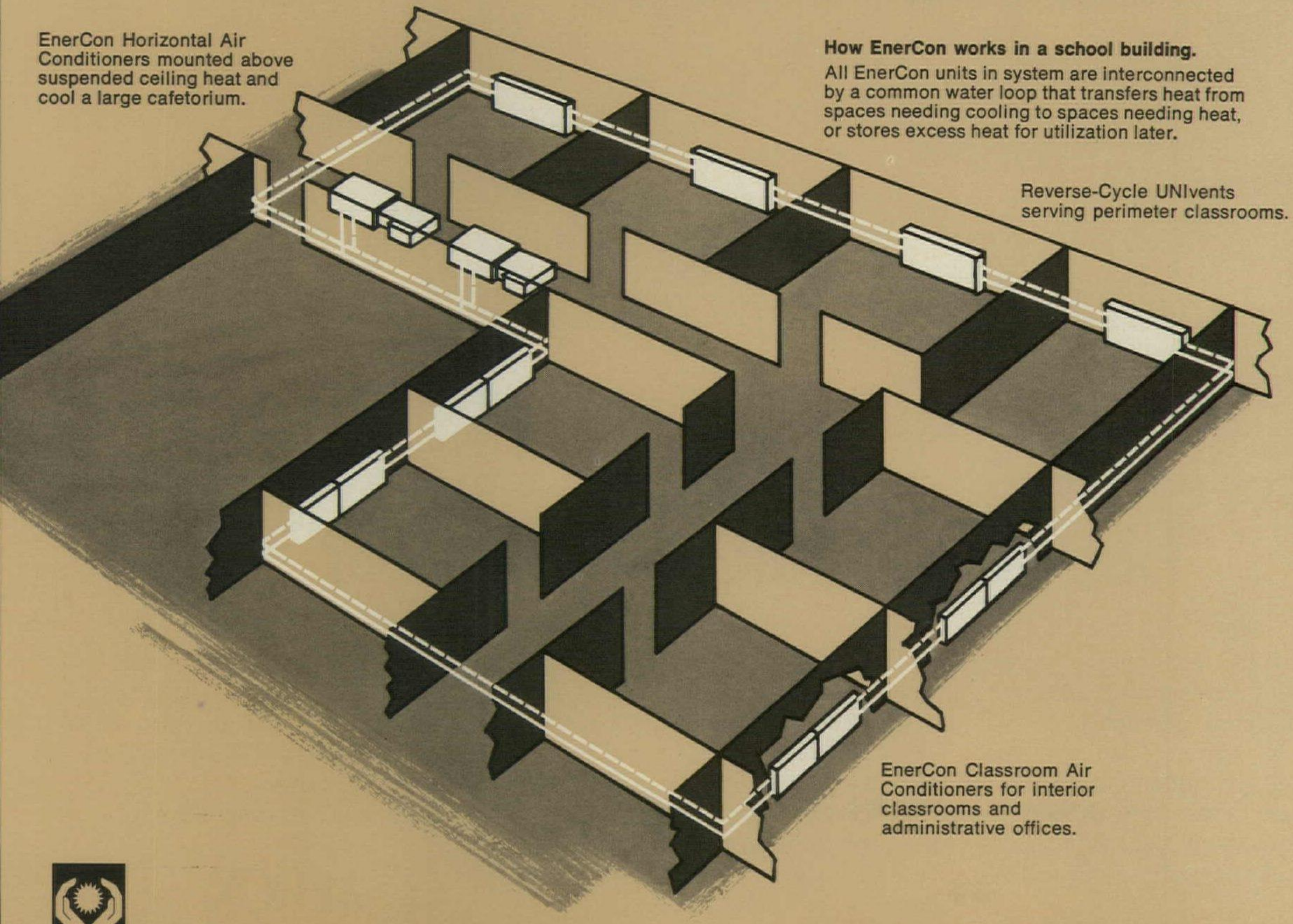
Schools frequently have excess heat available during the day when classrooms are occupied, even when it is chilly outdoors. That excess heat is transferred to the water loop raising its temperature to the maximum limit before any heat is rejected from the building. The EnerCon system can then heat the building during the night by transferring heat stored in the water loop.

EnerCon cuts costs all around.

Energy costs. Installation costs. Operating costs. They're all cut to the minimum. In fact, the annual owning cost of an EnerCon system, whether it's EnerCon Classroom Air Conditioners or Reverse-Cycle UNIvents, is especially attractive when compared to other heating/cooling systems on the market today. It's designed for today's school.

For more information, write: AAF, Dept. 131, Box 1100, Louisville, Kentucky 40201.
Better Air is our Business.

AAF American Air Filter
SCHOOL ENVIRONMENTAL SYSTEMS



How EnerCon works in a school building.
All EnerCon units in system are interconnected by a common water loop that transfers heat from spaces needing cooling to spaces needing heat, or stores excess heat for utilization later.

The Energy Savers

"The specifications for the Elm Street Project are stuck somewhere between Oak and Maple?"

When you're waiting for copies of specs, the last thing you want are delays.

And delays are about the only things Xerox duplicators don't give you.

They do give you sorted and collated copies of spec books in one completely automatic step. Right in your own office. Quickly, easily and inexpensively.

There's a Xerox duplicator that also reduces oversize originals down to a handy 8½ x 11.

Another even binds completed reports.

And of course, all Xerox copiers and duplicators can turn out crisp, clear copies on a wide variety of stocks. And any color bond. So spec books can be as color-coded as the rainbow.

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If he doesn't get caught in traffic.

XEROX

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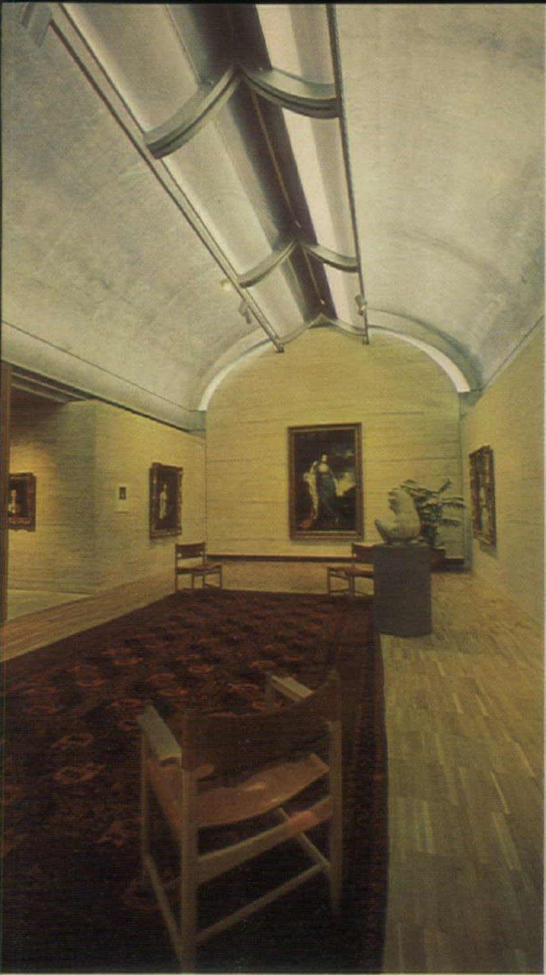

Kimbell Art Museum
Fort Worth, Texas

Southlake Mall
Merrillville, Indiana

Midway Motor Lodge
Milwaukee, Wisconsin

Saving energy can be beautiful with Skylights by Naturalite®.

Flattering, natural light was the obvious complement for the masterpieces on display at Fort Worth's Kimbell Art Museum. Naturalite Skylights provided the efficient, beautiful answer. The American Institute of Architects and the Illuminating Engineering Society provided the awards. (The museum won the AIA's coveted Honor Award in 1975 and received the Lumen Award from the IES in 1973.)

Should the day come when power is rationed, the Southlake Mall in Merrillville, Indiana, will go right on doing business as usual. Because this beautiful facility lets the sun do the work of expensive lighting fixtures — thanks to Naturalite Skylights.

Swimming is a year 'round affair at the Midway Motor Lodge in Milwaukee, Wisconsin. Skylights by Naturalite provide a striking, practical domed enclosure that allows the Lodge's guests to sun and swim any time, all the time.

Other Naturalite installations in schools, warehouses and residences throughout the country are doing equally beautiful jobs of saving energy by using *free* natural light.

For a closer look at how others have discovered beautiful results using Naturalite products, write for our free color brochure. Better yet, let one of our Architectural or Engineering Consultants demonstrate how you can incorporate innovative energy saving skylight designs into the structures you're now planning. Call collect or write.

NATURALITE,® INC.

P.O. Box 28636 Dallas, Texas 75228 214/278-1354

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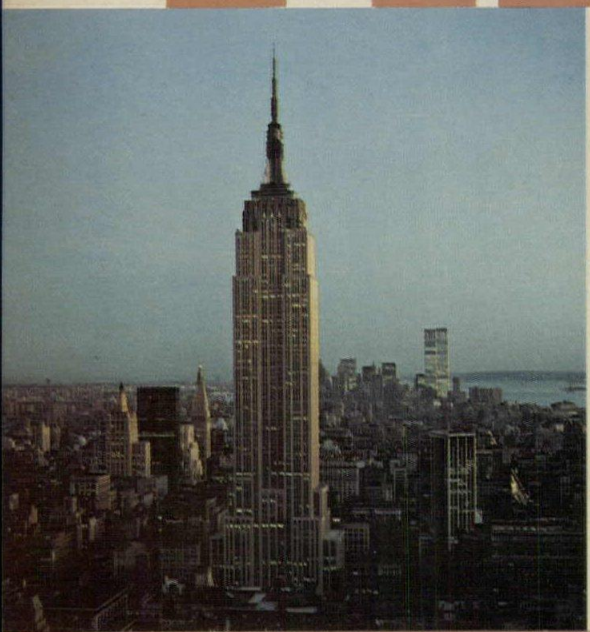
More than just stainless

Timeles



In 1924, Republic first began producing a new chrome-nickel high alloy steel. It soon was named "stainless steel." Republic ENDURO® stainless steel.

We quickly learned that what we had was a lot more than simply a "stainless" steel. It was, among other things, destined to become the foremost of architectural metals. In buildings, it is, literally, *timeless.*

Timeless/stainless steel. Uncompromising in its stubborn resistance to corrosion. Strong, tough, durable. High strength-to-weight ratio. Resistant to abrasion and denting. Takes the hard knocks of heavy traffic. Dimensionally stable at high and low temperatures. Easy to clean and to keep clean. Practically self-cleaning in rain.

New York's Empire State Building became its most prominent architectural showcase. Builders protected the world's then-loftiest building and made it handsome with lavish use of timeless/stainless steel.

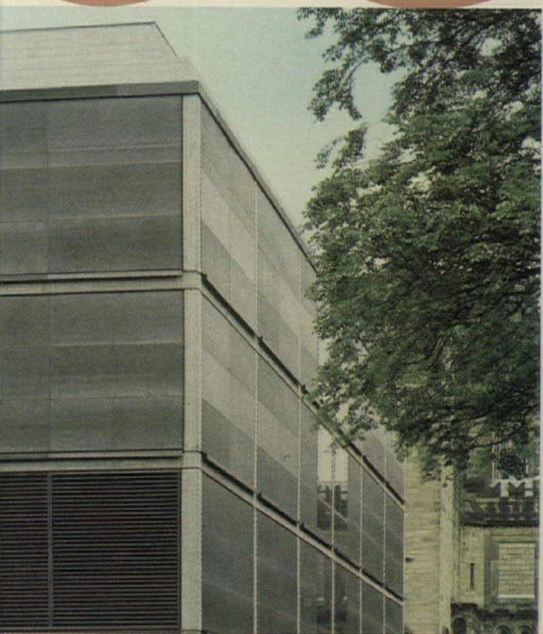
Since the roaring twenties, timeless/stainless steel has been making architectural history. Each application tends to be more spectacular than the one before. In the lobbies of the World Trade Center, architect Minoru Yamasaki used 35,000 square feet of matched panels of ENDURO type 304 for walls that rise a breathtaking 70 feet high. Not a ripple or a fastener shows in the bright #8 architectural mirror-finish surface.

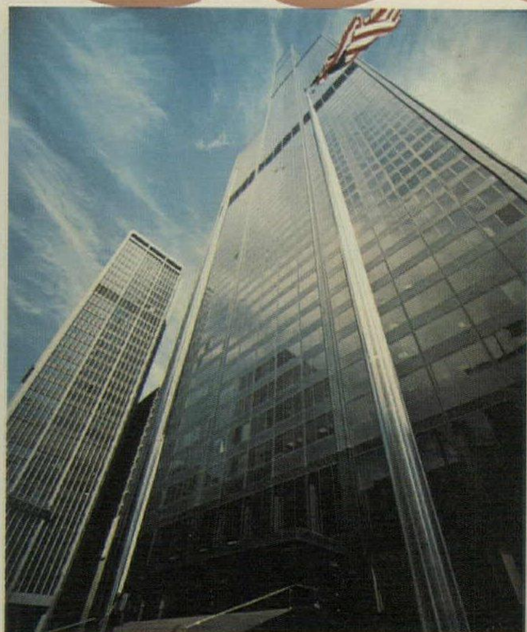
Other interior elements—curved floor gratings, flashing, railings, revolving doors, escalators and elevators—all are timeless/stainless steel.

While the Empire State Building was showcasing timeless/stainless steel at 34th Street, the equally imposing Chrysler Building was being topped out at 42nd Street. It, too, was topped with ENDURO, including gargoyles high up at each corner. Forty years later, those gargoyles still grimace over Manhattan, still shining, still resistant to atmospheric corrosion and the effect of New York weather.

Member Steel Service Center Institute

s Steel





An industry first—timeless/stainless steel in new "pewter" finish. Unlike ordinary finishes which are silvery, pewter is an uneven gray resembling cold rolled stainless plate. New from Republic.

Architect Louis Kahn wanted this look for his new special art museum currently under construction.

Trio Industries fabricated the 12- and 16-gage type 304 timeless/stainless in pewter finish for exterior walls, interior panels, and railings of the museum.

Sears Tower—world's tallest building—rising 110 stories into the Chicago sky. Building team member Flour City Architectural Metals, Minneapolis, fabricated and installed ENDURO architectural metal products inside and out.

Timeless/stainless steel adds special luster to virtually any building, any type of construction. It can be thin and light enough for curtain wall, strong enough to be load bearing. Always cleanable, durable, beautiful.

Outside railings and flagpoles of Sears Tower are timeless/stainless steel. Inside, Flour City Architectural Metals fabricated and installed glass framing of ENDURO with a mill pre-buffed finish. Wall and door panels are embossed in subtle texture design or supplied in 2-BN finish.

Committed to our customer's requirements, we produce a wide variety of stainless grades, types, and sizes in one of the country's largest production facilities.

Republic produces the only 60-inch-wide continuous cold rolled stainless steel sheets made in America. Distributed through the country's leading Steel Service Centers, coast to coast.

And, we offer the unique expertise of a full fifty years of timeless/stainless steel manufacturing, metallurgy, and marketing. Fifty years of dependability in product, performance, and people.

Write for a handsome souvenir of our first fifty years of timeless/stainless steel production, plus any specific information you may need.
Republic Steel Corporation,
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Republicsteel

Fifty years of new ways to help people

Certain things you can depend on.

Mom and Rover are pretty reliable. So is the inevitability of taxes. You can also put your faith in a few, very select mechanical devices.

One of them, that a lot of architects have depended on for years, is a Halsey Taylor water cooler.

Exclusive design features

It's no accident that our coolers deliver years of reliable service with very little maintenance. We've designed a lot of extras into them. Such as our exclusive automatic regulating valve that maintains a constant stream height regardless of varying line pressures; heavy-duty start capacitors that assure compressor start-up, everytime; and our efficient pre-cooler that boosts cooling capacity by 60 percent.

We balance the complete cooling system for longer service and lower life cycle cost. And happier customers.

Color and textural harmony

Each of our welded unitized cabinets is topped by a buffed stainless steel receptor and Halsey Taylor's unique anti-squirt twin-stream bubbler. To harmonize with virtually any interior, we offer cabinets in satin finish stainless steel, PATINA bronze tone stainless, eight different Polychrome colors and a choice of vinyl clad steels. We also offer the widest selection of water coolers in the industry.

Halsey Taylor water coolers. Not a big item in your specs but something you can honestly depend on. We'd like you to have our new catalog. Write to Halsey Taylor Division, 1554 Thomas Road, Warren, Ohio 44481.

Halsey Taylor®
KING-SEELEY KST THERMOS CO.

For more data, circle 37 on inquiry card

Glen Lochen Marketplace, Glastonbury, Conn. Architects: Callister, Payne & Bischoff

Looks expensive, but it isn't!

GLULAM—Structural Glued Laminated Timber—

has been a competitive structural framing material for 40 years, but there are still many architects who think that just because wood is beautiful, projects warmth, and offers unlimited design opportunities, it must be expensive. This simply isn't true.

Glulam prices have remained relatively stable during the past year.

Exposed glulam systems, engineered to exact specifications, are readily available, reducing costly delays at the job site.

For your next building design, whatever its application, think of glulam. We know you'll be surprised at how cost efficient it really is.

Glulam—engineered for any design. For information contact:

American Institute of Timber Construction
333 West Hampden Avenue
Englewood, Colorado 80110
Call **800/525-1625**—Toll Free!

Sweet's Architectural and Industrial Construction Files/Spec Data: Prefabricated Structural Wood

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ENGINEERING FOR ARCHITECTURE

... An Introduction

This issue is our second annual mid-August issue on Engineering for Architecture. Like all our issues, it is about design—and what makes design work. The only thing that is different is the emphasis. Our regular issues emphasize the work from the architects' point of view—though the engineering contribution is always there. This issue emphasizes the work from the engineer's point of view—but the architects' contribution is always there. This difference in emphasis comes easy—for it is always the same story. Any fine building is a collaborative effort by closely related disciplines—two allied professions with the same goal: The best possible building for the client within his budget. Members of both professions are designers; they simply use different tools.

And in this issue—as we hope we did last year—you will find an emphasis not just on ideas—but on people. For we cannot be reminded too often that expertise does not rest in a profession—expertise rests with individuals—individual engineers and individual architects. Showing through every page of this issue is a breathtaking breadth of individual knowledge—assurance that within the design profession there must be few problems, technical or esthetic, that cannot be solved.

All kinds of expertise are catalogued on the pages that follow. On the next 26 pages we show some of the most innovative engineering work of this or any other year. Beginning on page 96 is a Round Table discussion focusing on the most controversial yet most pressing technical problem of the day: What policies will best assure a reduction in our profligate use of energy? Beginning on page 100 is a profile of the work of KKBNA—a Denver structural engineering firm whose work, we feel, typifies not only the great competence of the best of the profession, but exhibits a vitality and zest for problem-solving that is especially worth study. On page 112 is an article we feel brings some sense of balance and order to the battle of better lighting vs. lower energy usage. Solar energy is much talked-about—but mostly in gee-whiz terms; and the article on page 128 is intended to shed some common sense and to offer some hard technical information.

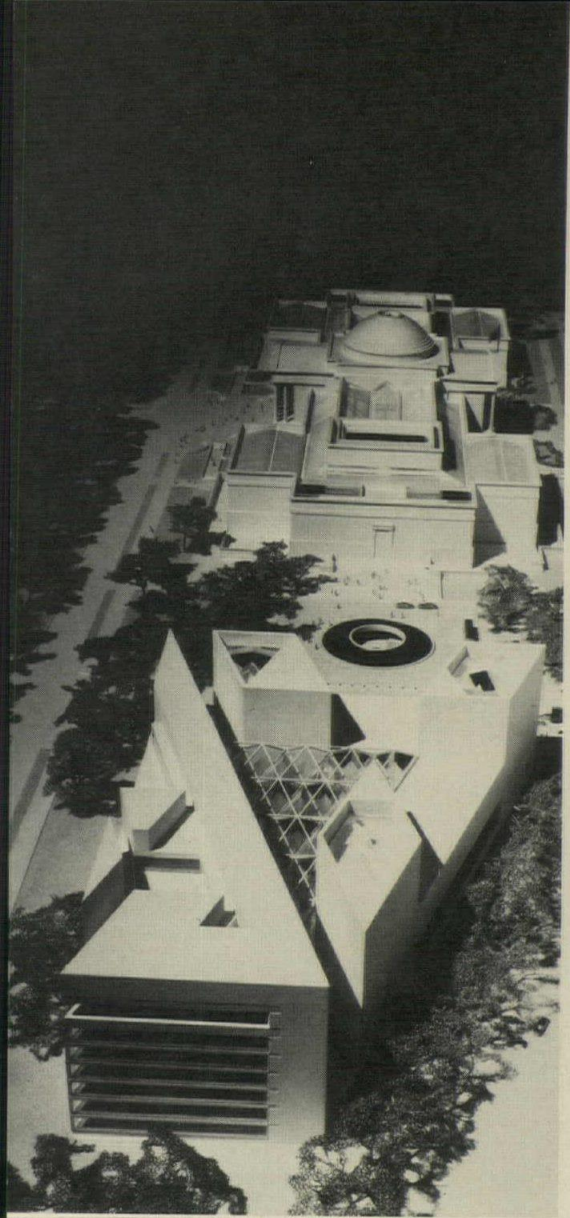
This is an issue about engineers—but it is for architects and engineers and all those who share in the work—and the joy—of building great buildings.—*W.W.*

12 EXAMPLES

OF EFFECTIVE ARCHITECT-ENGINEER COLLABORATION

What becomes evident as one reviews the projects on the following pages is that there are a lot of people around with a sizable store of technical expertise—not only architects and engineers, but contractors and manufacturers as well. Talking with contributors to this section, the editors also noticed with interest the sheer enjoyment these experts take in attacking a knotty problem, whether it's big or little, and the great satisfaction they find in helping to make a building look more beautiful, or work more efficiently, or go together more simply, or cost less money. These examples range from a potential landmark—a one-of-a-kind commission with one-of-a-kind technical problems—to more common problems uncommonly well solved, such as two thoughtfully detailed curtain walls and a tightly reasoned mechanical system for a Colorado high school with a serious fuel shortage.

LANDMARK IN THE MAKING: "PEOPLE WORK HARD TO MAKE THINGS LOOK SIMPLE"



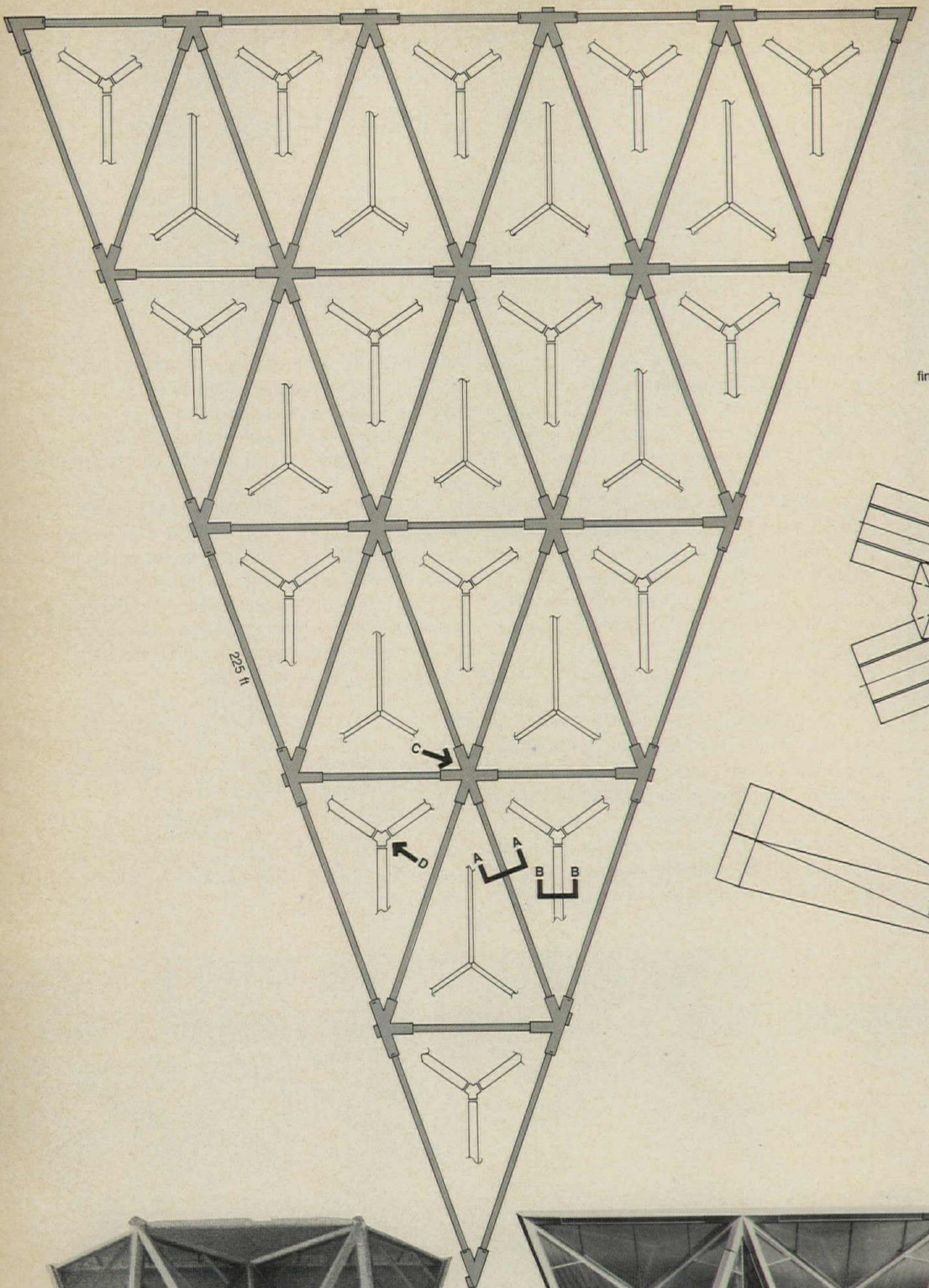
Superb execution is as important to a finished work of art as inspired design, a principle that is always reflected in the work emanating from the office of I.M. Pei & Partners. This principle is stretched very nearly to its limits at the National Gallery of Art, where extensive additions are presently under construction. The building contains more than a few technical tours de force, among them a space frame measuring 150 by 225 ft with supporting members weighing as much as 5 tons, a 135-ft concrete girder only 4 ft deep, and cast-in-place concrete of extraordinary beauty.

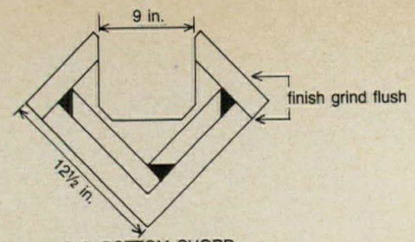
The new building's triangular plan derives from its trapezoidal site at the intersection of Pennsylvania Avenue and the Mall. The main elements in the plan include a large office-library wing, three "pods" for exhibitions, and a central court, roofed by a skylighted space frame, for circulation and sculpture display.

The dimensions and angles of the plan's adjacent and overlapping isosceles triangles cannot, of course, deviate, and the fixed geometry made the integration—an architectural given—of appearance, structure and services a rigorous exercise, requiring constant cross-conferences between architects, structural engineers, mechanical engineers, contractors and suppliers.

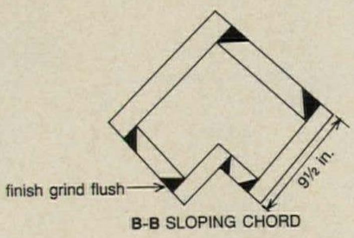
Another factor, although it is not evident in either materials or craftsmanship, was budget. The $75 million in donated funds from Paul Mellon (this is a private gift to the nation) carried no carte blanche for the designers, and expenditures, which must cover extensive underground facilities as well as the marble building, are carefully monitored for value.

NATIONAL GALLERY OF ART, Washington, D.C. Architects: *I.M. Pei & Partners—I.M. Pei; Leonard Jacobson, project architect.* Engineers: *Weiskopf & Pickworth* (structural); *Syska & Hennessy* (mechanical/electrical); *Mueser, Rutledge, Wentworth & Johnson* (foundation). General contractor: *Chas. H. Tompkins Co.* Construction consultant: *Carl A. Morse, Inc.* Space frame fabrication: *Chicago Heights Steel.*

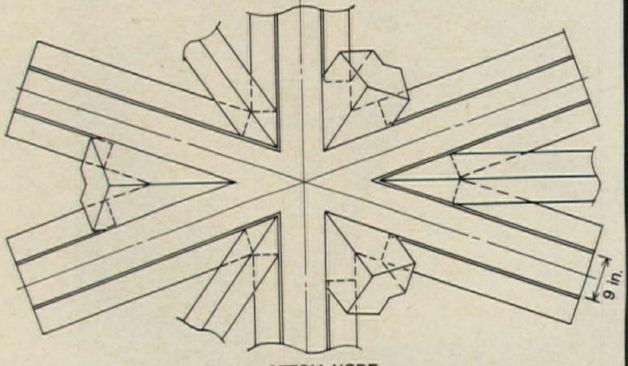




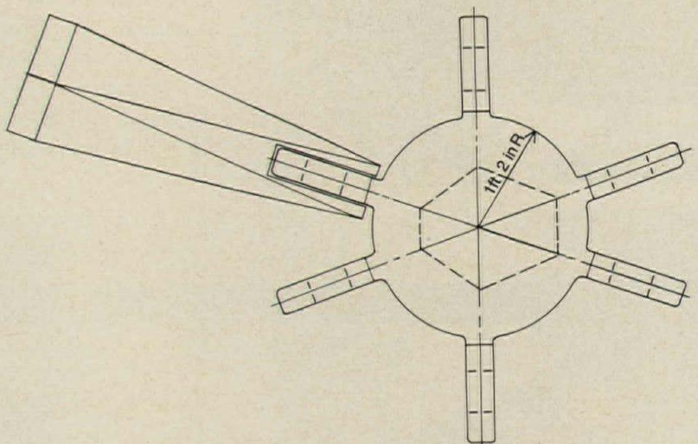
A-A BOTTOM CHORD



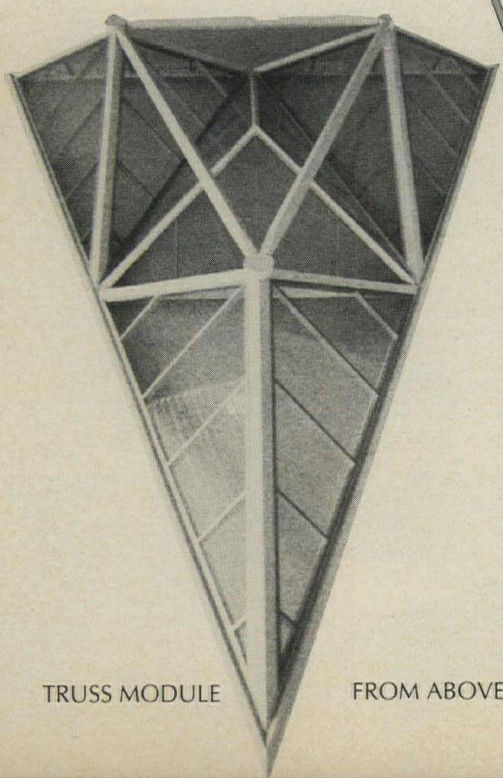
B-B SLOPING CHORD

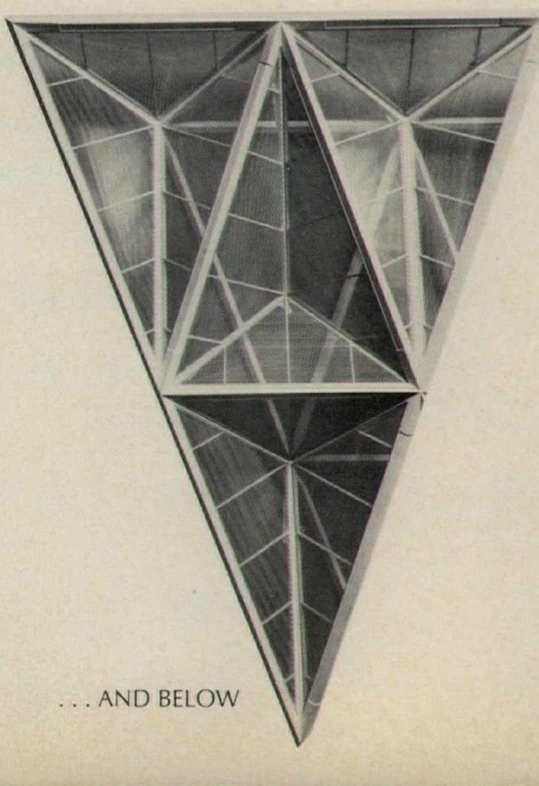


C BOTTOM NODE



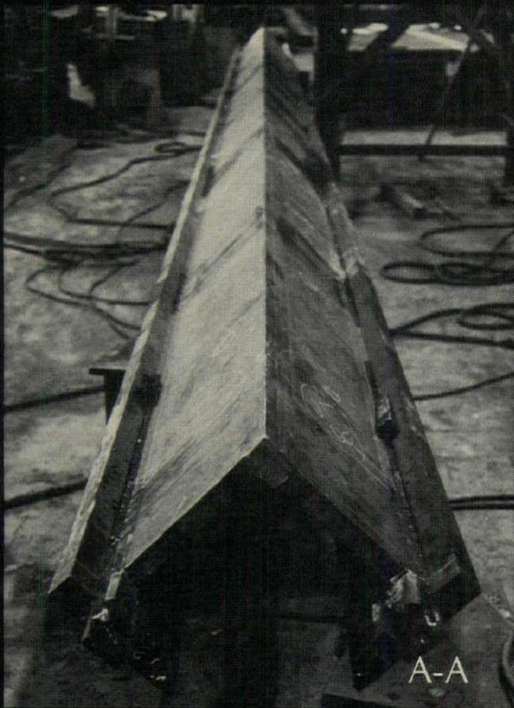
D TOP NODE AND CHORDS

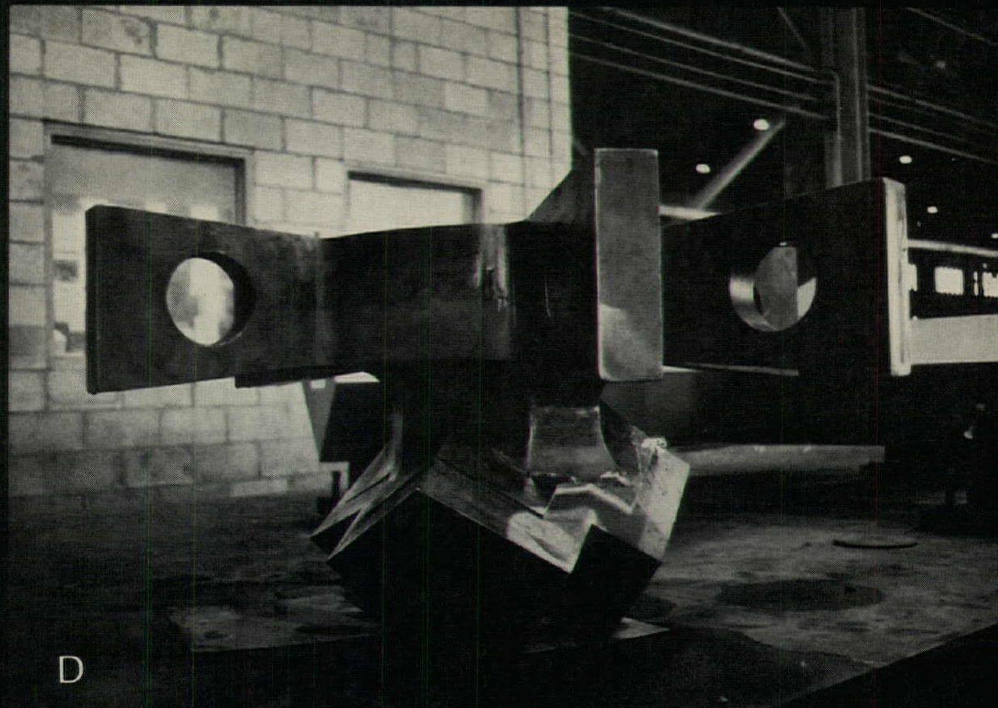


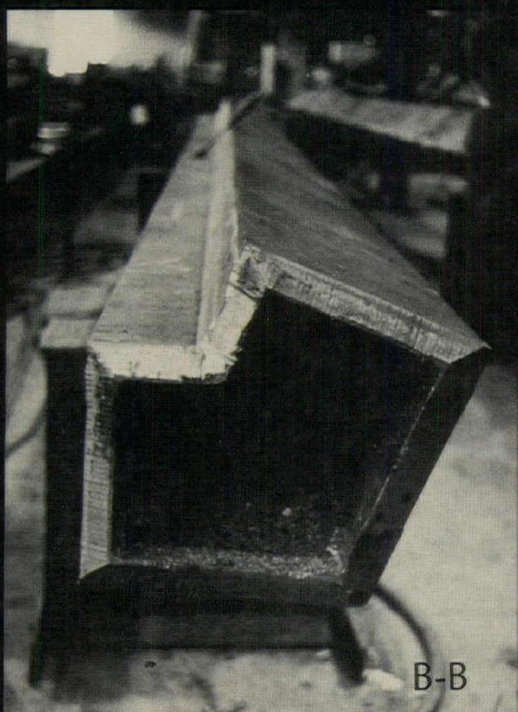


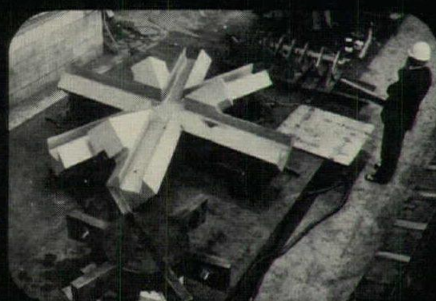
TRUSS MODULE FROM ABOVE . . . . . . AND BELOW

Huge skylight—150 ft at the base, 225 ft along legs—comprises 25 steel space frame modules. Basic structure includes three straight members: top chords, bottom chords (A-A), and major diagonals (B-B); smaller diagonals form subsidiary tetrahedron that supports glazing (lower right). Cast-steel nodes join these members at top and bottom. Top chords—fairly conventional box sections welded to cast tapered ends (far right, center)—are pinned through horizontal fingers of top node (D). Bottom nodes (C) in center of skylight (perimeter nodes necessarily vary) have six channeled fingers, to which lower chords are welded, and three diagonal fingers to receive major diagonals; secondary diagonals are welded directly into three remaining angles. Unconventional sections of bottom and diagonal chords were dictated by architectural concern for light appearance; bottom chords also house drains and wiring.

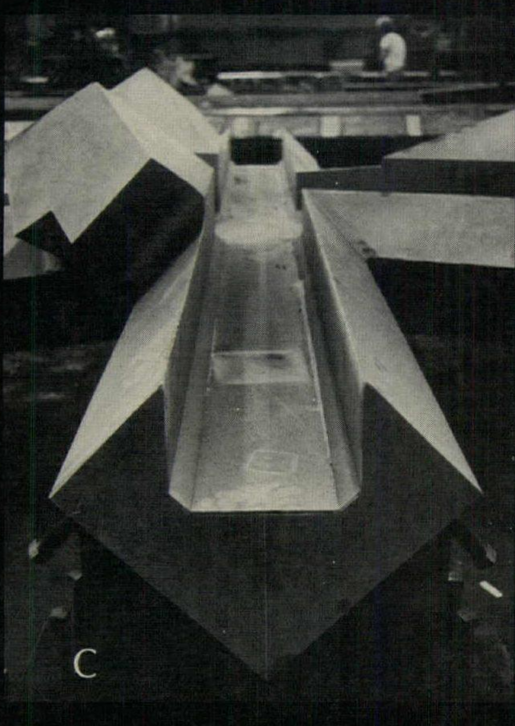


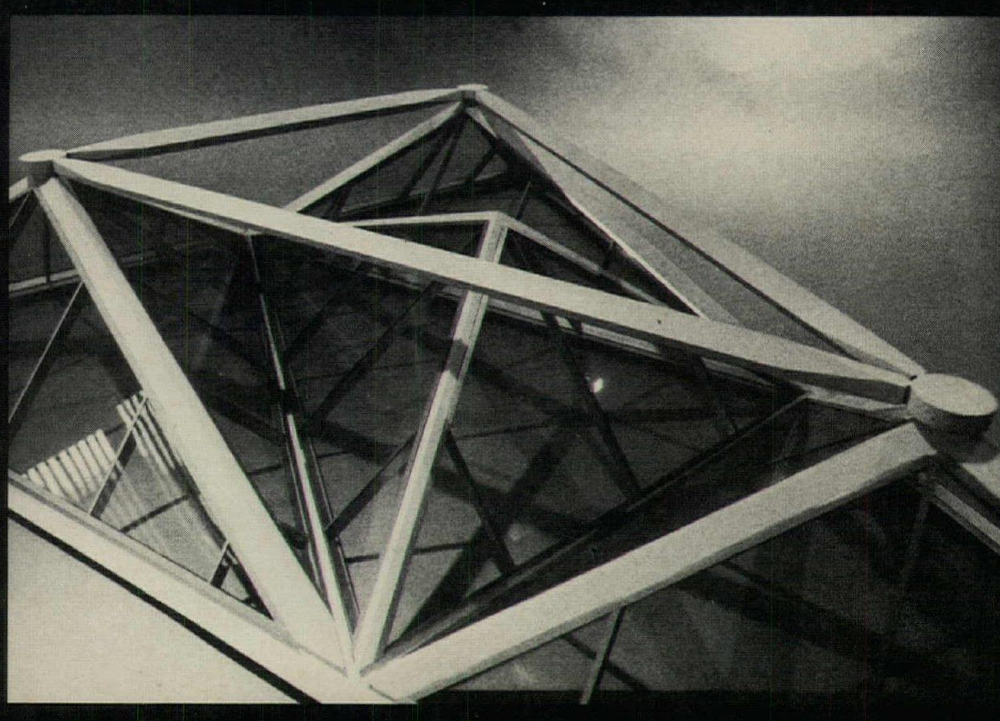


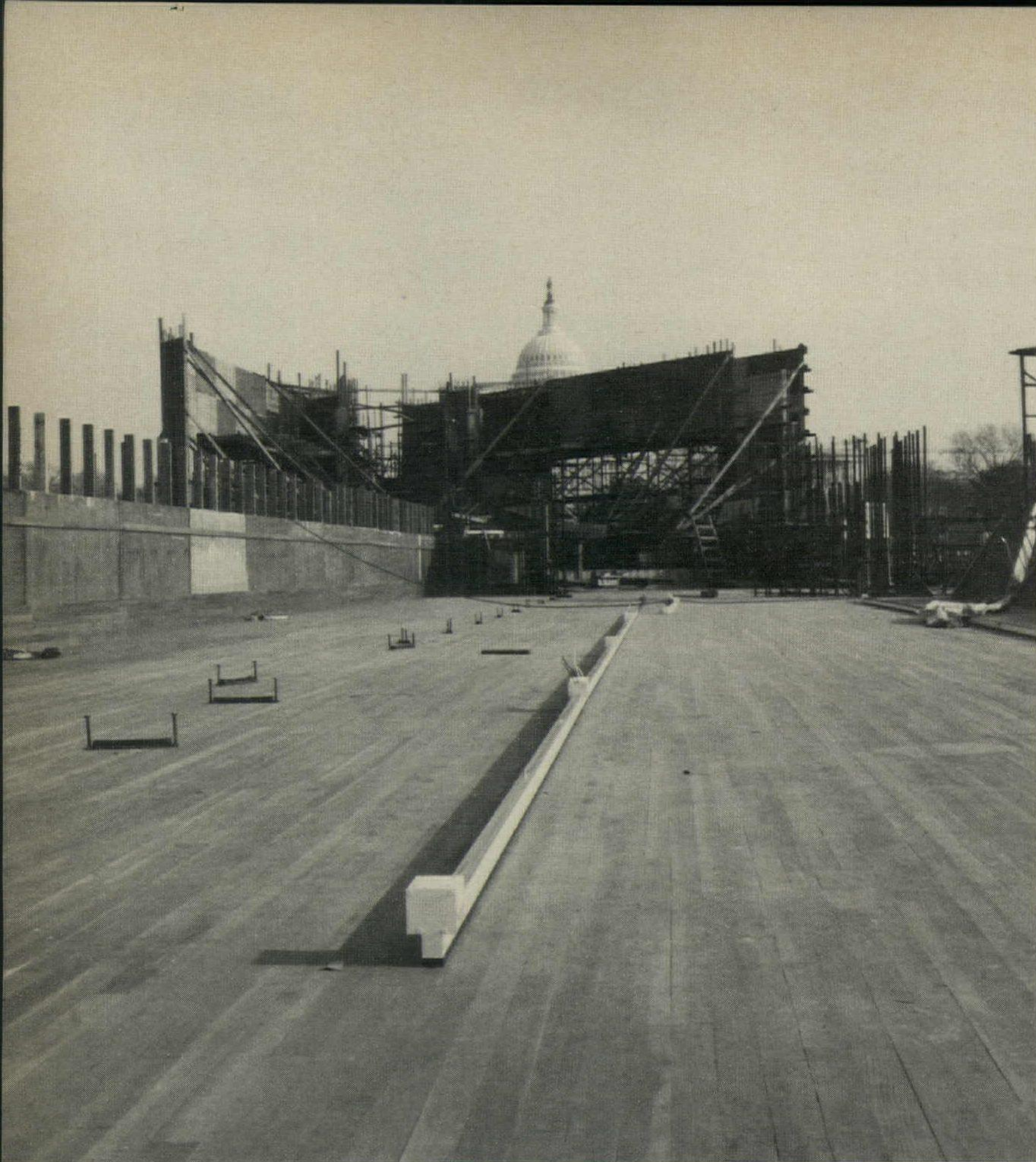


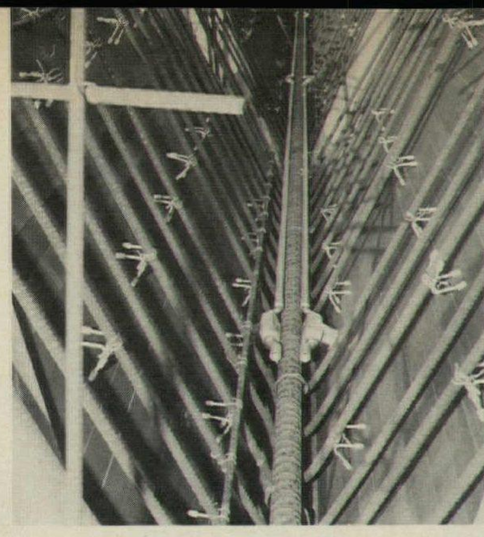


Space frame required three large steel castings: bottom node (C) (weight 5 tons, after machining), top node (D), and tapered ends of top chords (right). Straight members (A-A, B-B) are welded sections. Stainless steel pins fasten the top chords through fingers of top nodes. Skylight will rest on sliding bearings to accommodate differential thermal expansion of exposed and interior space frame members.









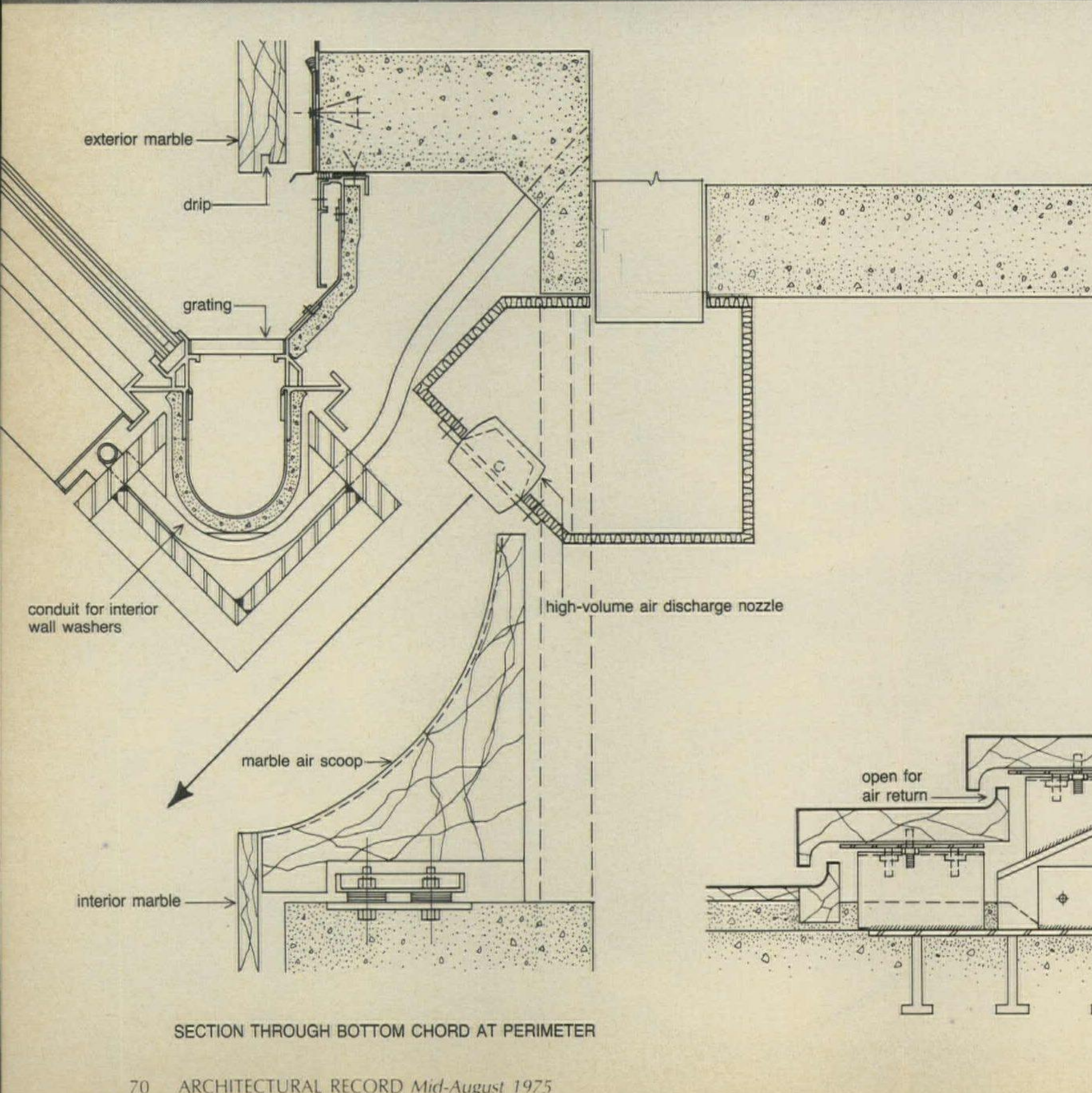
The beauty of the architectural concrete at the National Gallery originates partly from the remarkable formwork—one can justifiably call it cabinetwork—and partly from its material—the fine aggregate contains pinkish marble dust from the Tennessee quarry that supplied stone for both the new and old buildings.

On the main floor, ceilings above the entries and exhibition spaces are three-way coffered slabs. Along the Pennsylvania Avenue edge of the building, a concrete girder spans 135 ft along one side of the central court, and provides partial support for the large coffered slab at the main entrance (see formwork, with lighting track in place, top left, and coffers opposite, with girder at upper right corner). The depth of this long girder could not exceed 4 ft, the depth of the coffered slab, and is reinforced with exceptionally large bars.

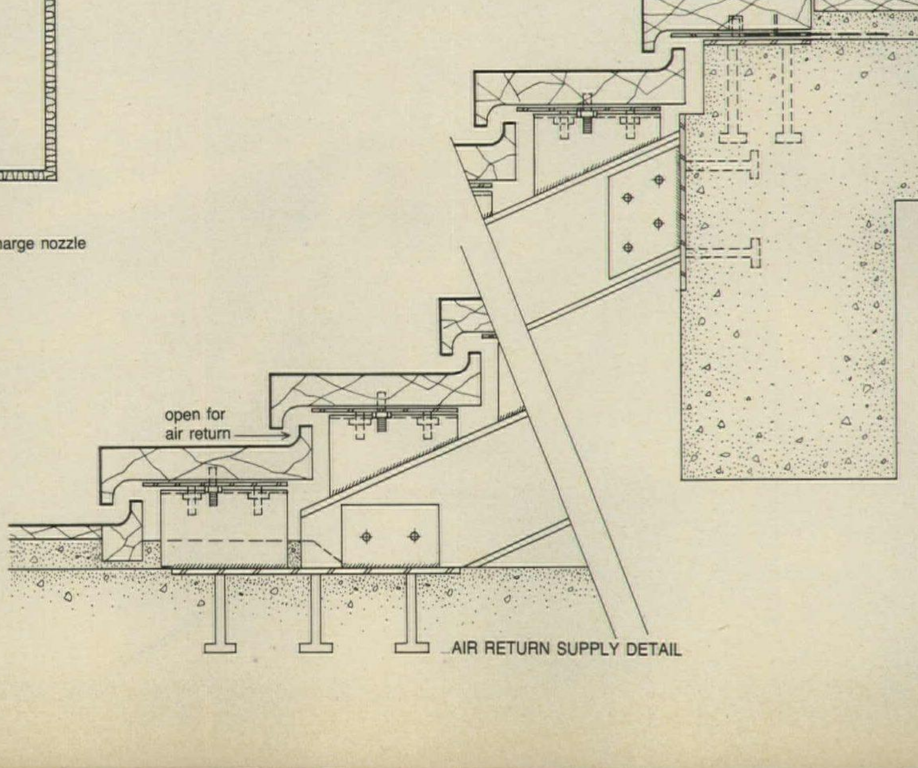
The photograph directly above shows the inside of a coffer form, with conduit and electrical penetrations in place.

The architects wanted services in the large court to be invisible. From unobtrusive "air scoops" just beneath the skylight (lower left), high-volume nozzles supply air, which is returned—also invisibly—through "risers" in the grand staircase (below), through pits around several trees planted in the court, and through a planter.

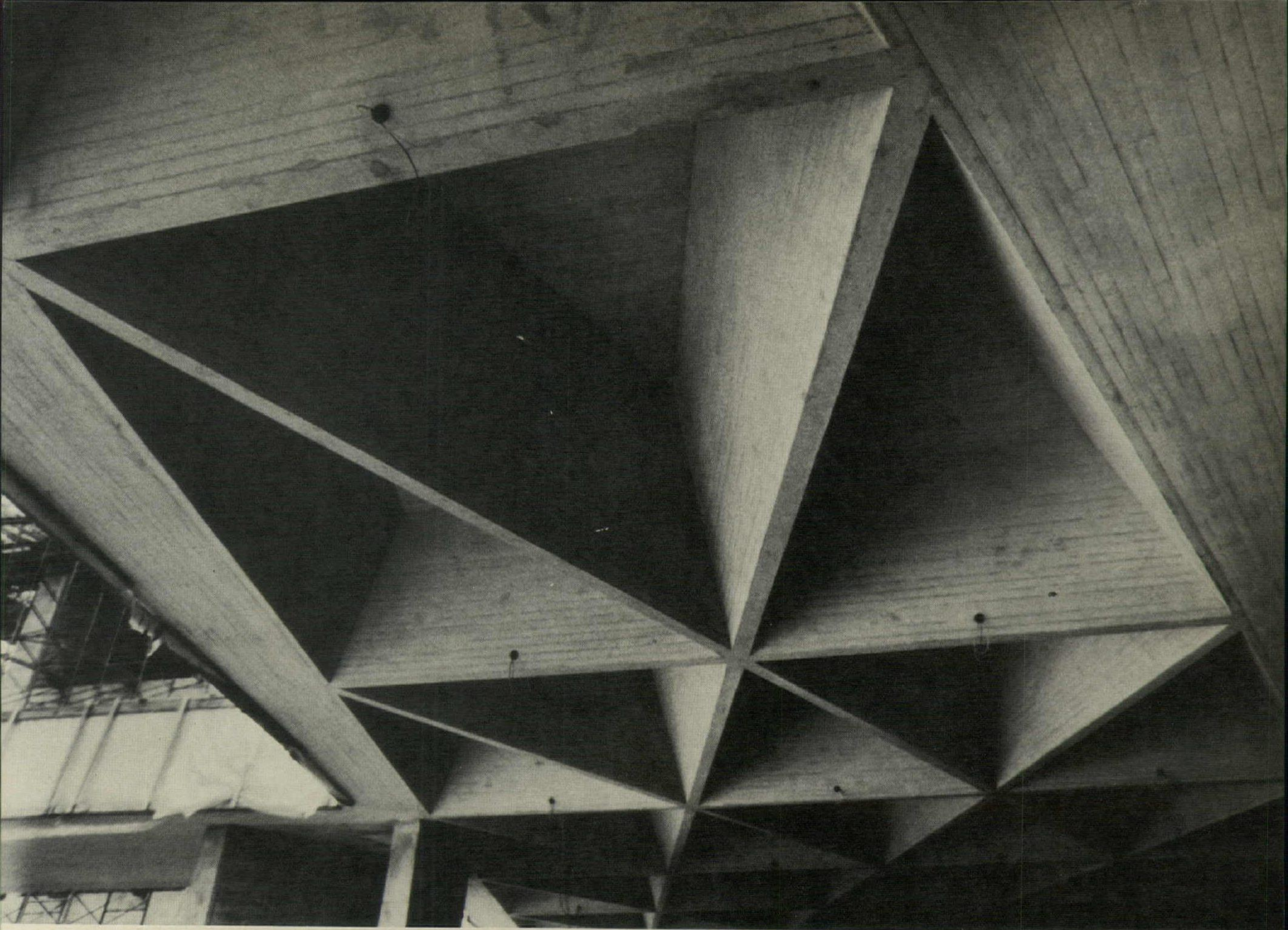
As one of the building's structural engineers remarks, "People have to work very hard to make things look simple."

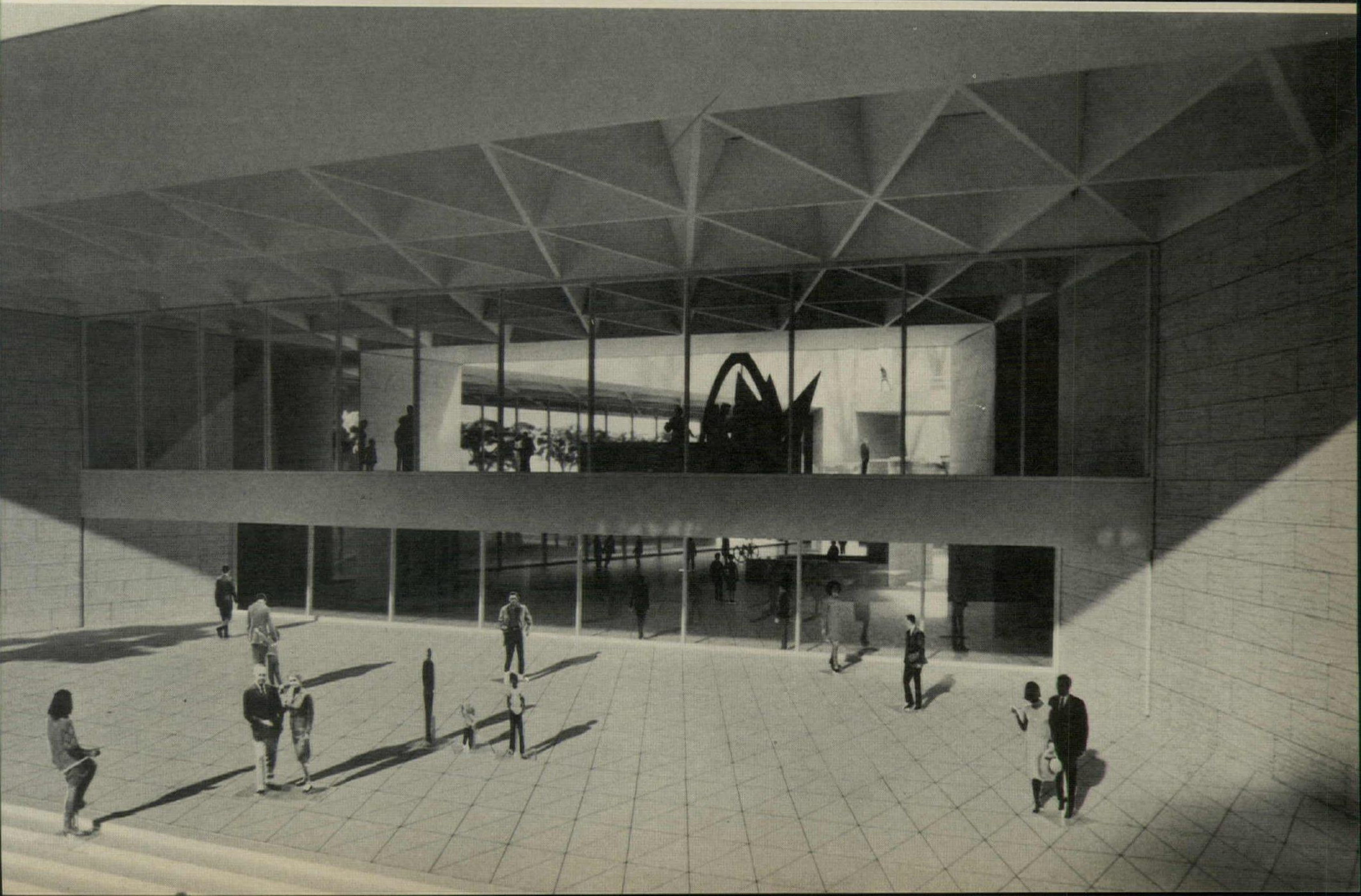


SECTION THROUGH BOTTOM CHORD AT PERIMETER

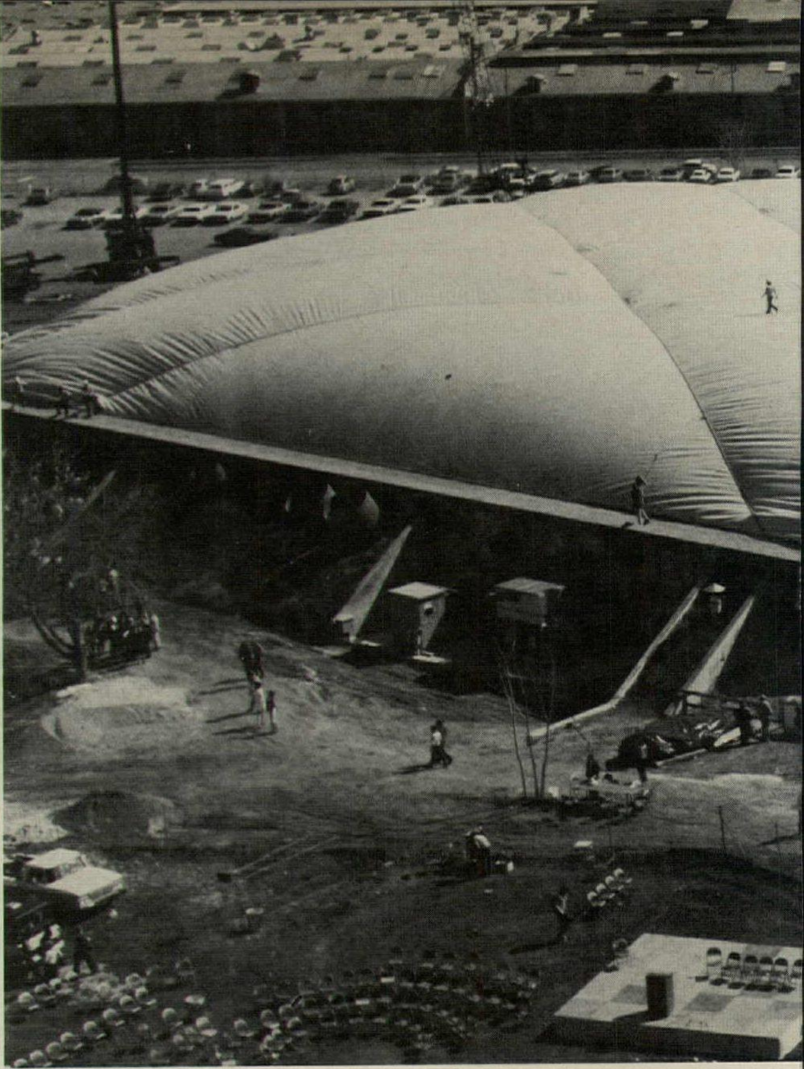


AIR RETURN SUPPLY DETAIL





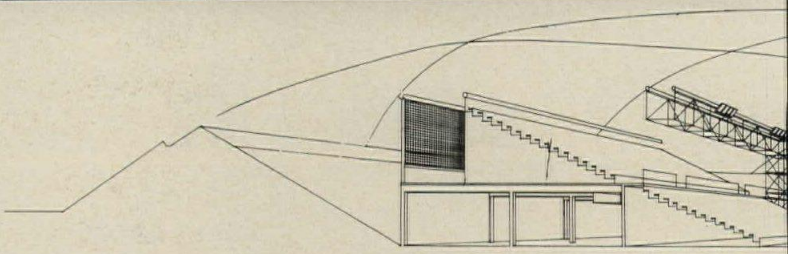
TECHNIQUE IN EVOLUTION: THE DESIGN OF AIR ROOFS GAINS IN SOPHISTICATION



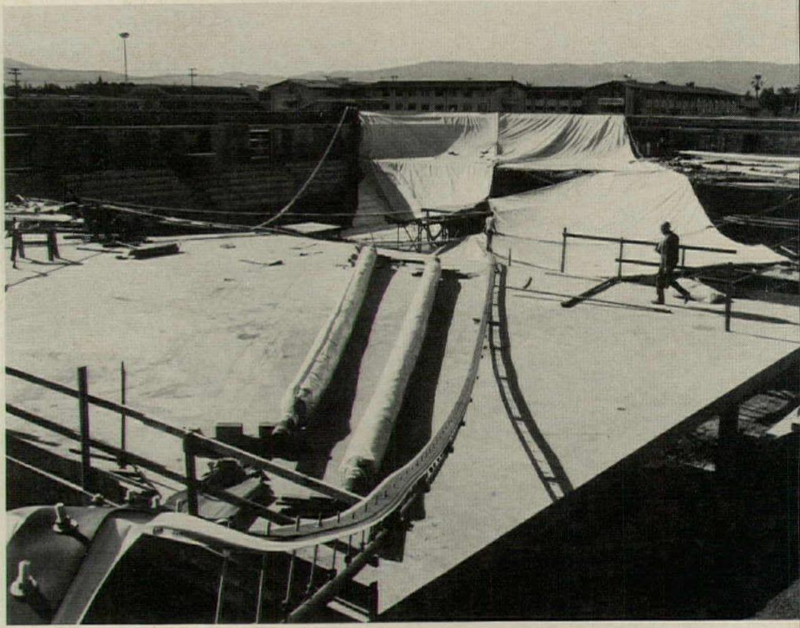
Since designing the air-supported roof for the U.S. Pavilion at Osaka's Expo '70, engineers Geiger Berger Associates have designed a number of more advanced pneumatic structures and have greatly developed the theoretical bases for these buildings. (Mr. Geiger has, indeed, patented a mathematical system for determining the relationship of cable location to ring plan.)

One of the basic rules for the design of large-scale air structures is that they assume as flat a surface as possible to minimize the effects of wind load. But the restraint on the cables needed to produce this low profile subjects the compression ring to large forces. At Osaka, the ring is a superellipse—a sort of squashed oval whose form is mathematically defined. Chosen for functional and esthetic reasons, this shape also turned out to be most efficient structurally. Superellipses are especially effective when cables are strung from the "corners" so that the ring acts as an arch, thus reducing bending stresses.

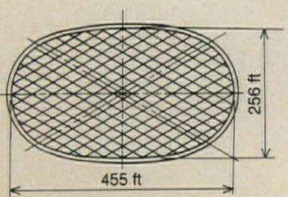
In recent designs, Geiger Berger have been able to reduce the number of cables—and hence the number of expensive connectors—required for air-supported roofs. An essential limitation in spacing these cables is the strength of the fabric, which can span no more than 40-45 ft. The great number of cables at Osaka (see comparative plans below) reflects the extraordinary wind-load strength needed in a typhoon zone. At Santa Clara, however, where neither high winds nor snow were major considerations, the number of cables is reduced to three in each direction.



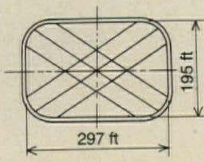
Leavey Center at the University of Santa Clara, shown on these pages, comprises two air-supported structures—one a superellipse for basketball and other sports, the other a smaller superellipse for swimming meets. The arena roof, which is permanent, is Teflon-coated fiberglass restrained by skewed cables. The swimming pool roof is retractable. The fabric—vinyl-coated polyester—is stored in a sausage-like roll and will be stretched and connected to the ring manually; transverse cables are encased in the fabric.



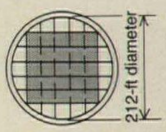
THOMAS A. LEAVEY ACTIVITIES CENTER, University of Santa Clara, California. Architects: *Albert A. Hoover and Associates* (principal); *Caudill Rowlett Scott* (design); *Philip Welch* (consultant). Engineers: *Pregnoff/Matheu/Kellam/Beebe* (structural); *Geiger Berger Associates, P.C.* (air structure); *G.M. Simonson & T.R. Simonson* (mechanical/electrical). General contractor: *Johnson and Mape Construction Co.* (construction manager).



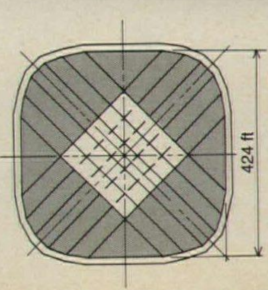
U.S. Pavilion, Osaka, Japan



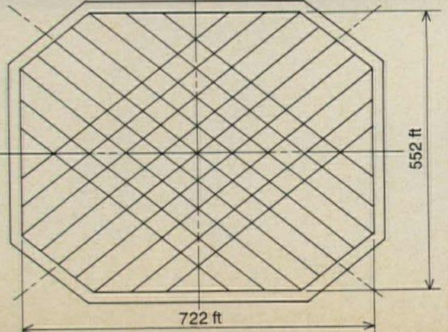
University of Santa Clara, California



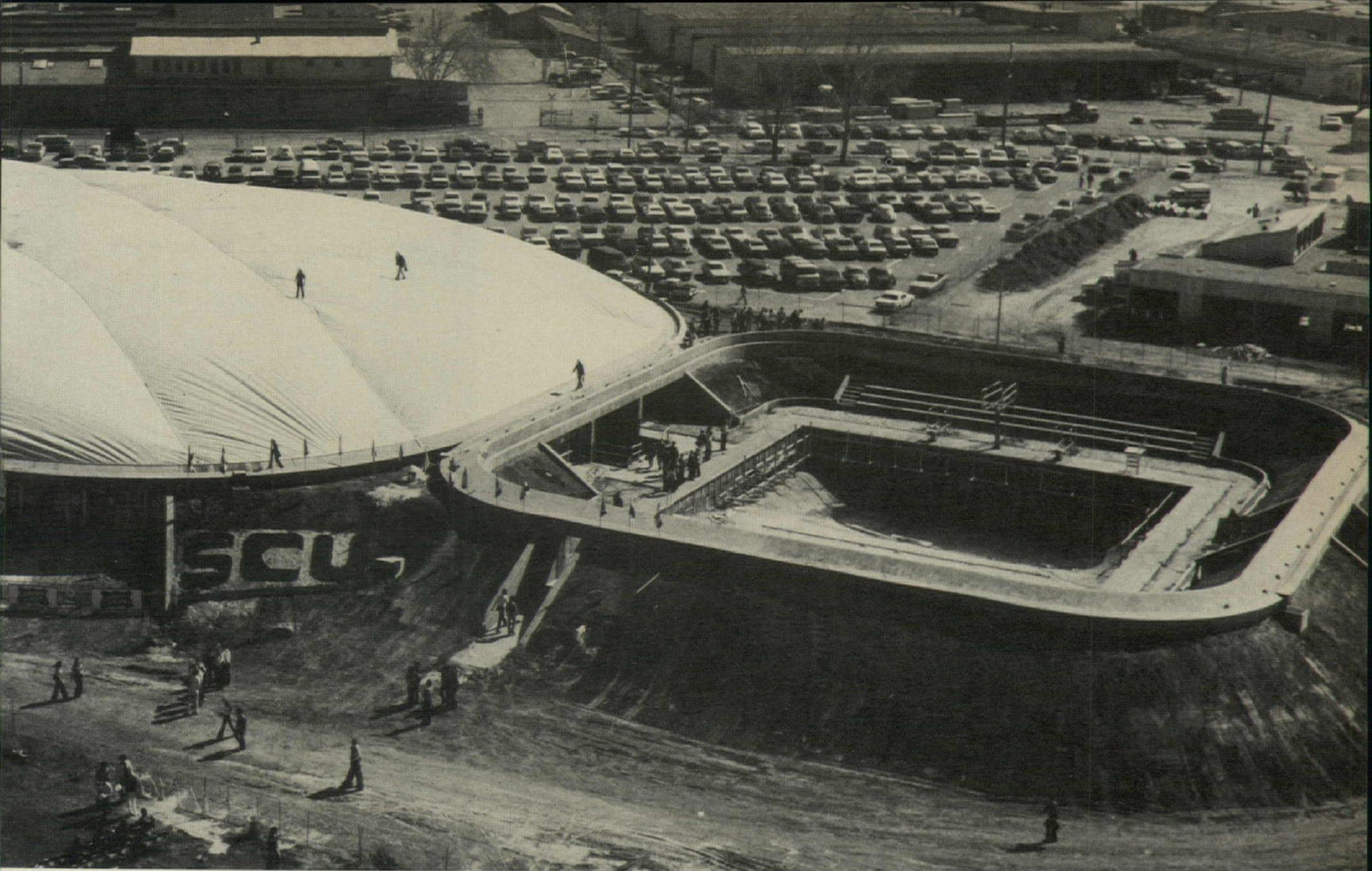
Milligan College, Tennessee

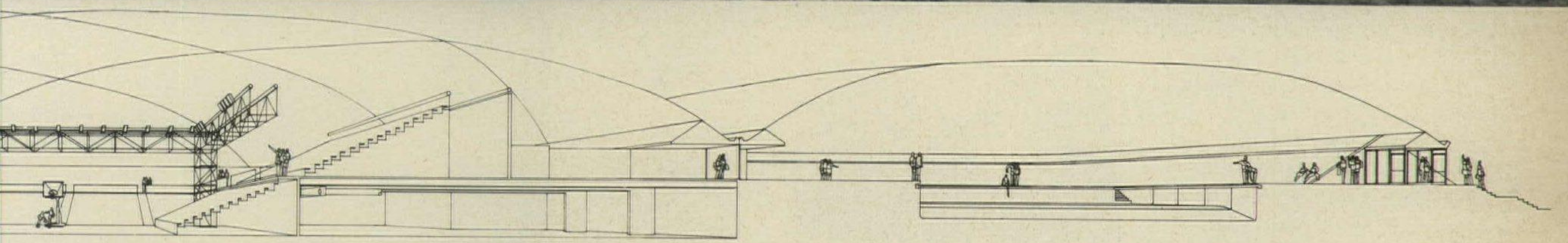


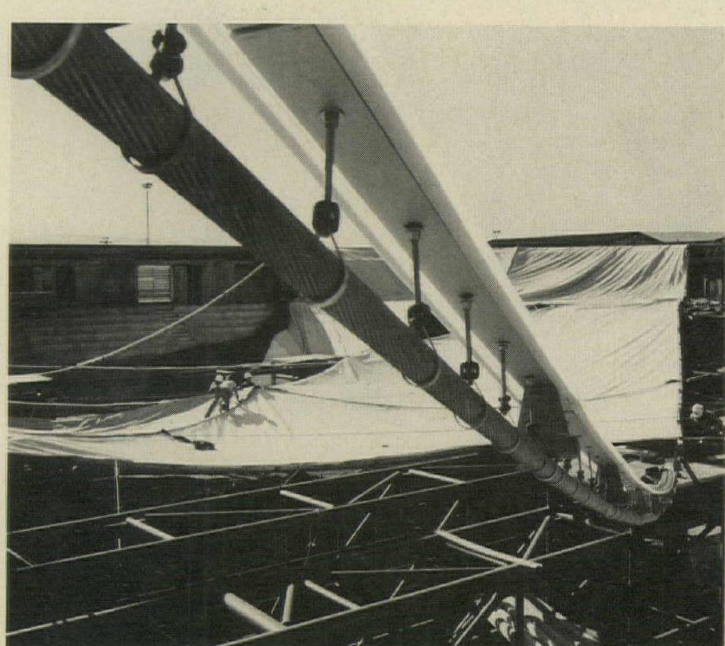
Uni-Dome, University of Northern Iowa, Cedar Falls



Pontiac Stadium, Michigan







At Santa Clara sports facility, conventional pipe hangers support 1⅞-in. cables below fabric, which is joined by bolts through continuous neoprene strips. Heat-sealed fabric seams, 12 ft apart, are perpendicular to long edge of ring. Where cables cross, they are held by U-clamps welded to steel-pipe sleeves.

William C. Eymann

The main building in the new athletic complex will seat 5,000. Because the fabric roof cannot support heavy mechanical and electrical equipment, freestanding frame accommodates lights and other gear; power lines are carried above roof cables. (Wrinkles apparent above disappeared when inflation was complete.)

A BRAVURA PERFORMANCE LENDS GLAMOUR TO A CONCRETE STRUCTURE

The problems a structural engineer expects to encounter with exceptionally long spans are compounded when those spans must carry exceptionally heavy loads. At the Medical College of Ohio at Toledo, the mix of problems included: library stacks supported on a 90-ft clear span; windows capped by 90-ft concrete beams; a combination of precast and cast-in-place concrete, with various deflections; and uneven loading above glass partitions.

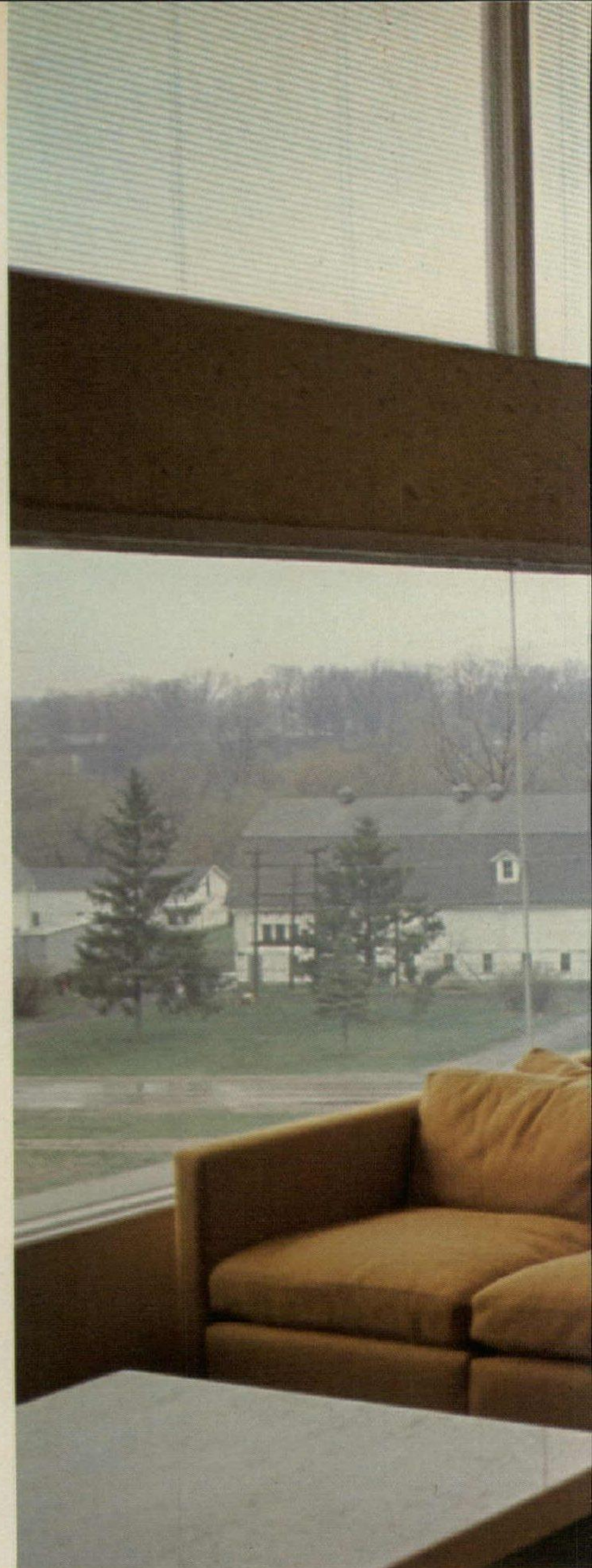
The school's program for its new building called for three distinct facilities—a student-faculty union, administration offices, and a library with limited access. Moreover, the building was to be a symbolic entrance to the campus. The architectural solution places an office block at one end of the building and a separate union building tucked between a pair of stair towers at the other, with the library on the fifth floor bridging an open area between the other elements and serving as a lintel above the ceremonial gateway.

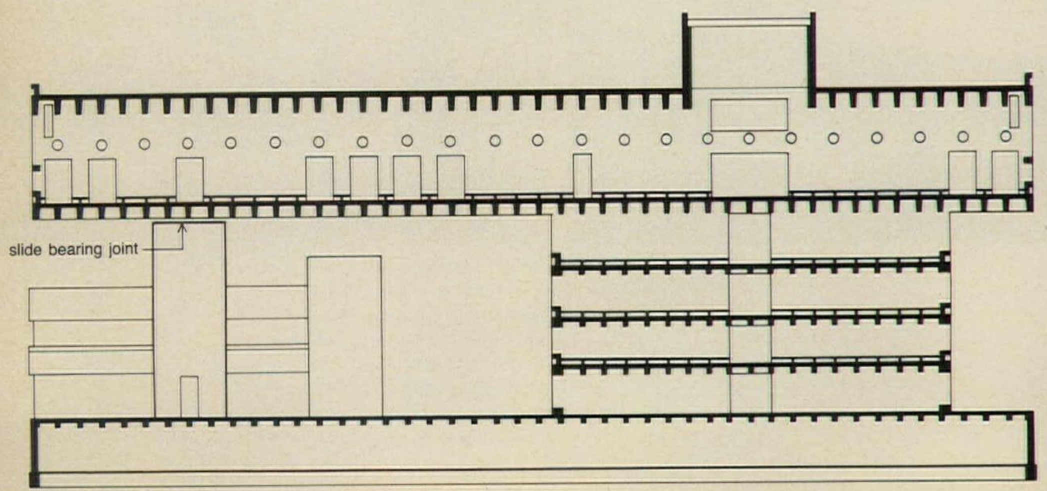
This solution places a heavy load—100 psf for library stacks, plus 50 psf for the floor slab—above an 80-by-90-ft void. The floor's 90-ft precast single tees are supported by two concrete Vierendeel trusses, 25 ft deep and 232 ft long, spanning the passageway. The Vierendeels are in turn supported by bearing walls at the stair tower and around the office block. Cantilevers project outside each truss to support carrels, mechanical space and exterior walls. Apertures in the Vierendeel web become doorways.

The great length of concrete elements in both directions created special concern for the effects of creep during curing and of thermal movement. The Vierendeels therefore bear on frictionless joints at the stair towers, allowing movement parallel to the plane of the trusses, though the bearings' stainless steel housings restrain transverse movement. Both ends of the 90-ft tees bear on Teflon-coated steel pads, one end carried on a sliding bearing, the other fixed but allowed to rotate.

In addition, the building has long expanses of glass both at the end wall windows and at partitions in offices beneath the library. Extremely careful analysis of loading ensured that deflection would not place intolerable stress on glazing (see diagrams below and on next page).

MEDICAL COLLEGE OF OHIO AT TOLEDO, Library, Administration and Student-Faculty Building, Toledo, Ohio. Architects: *Don M. Hisaka & Associates, Architects, Inc.* Engineers: *Gensert Peller Associates* (structural); *Evans & Associates, Inc.* (mechanical); *William B. Ferguson* (electrical). General contractor: *Rudolph/Libbe/Inc.*

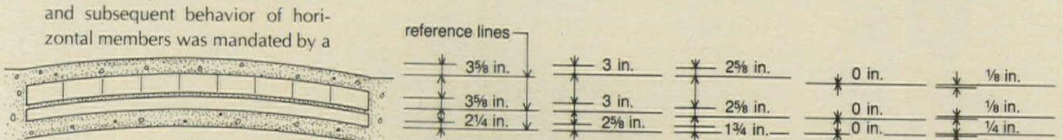


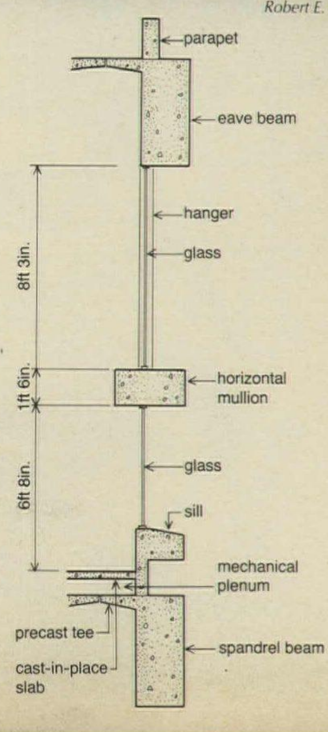


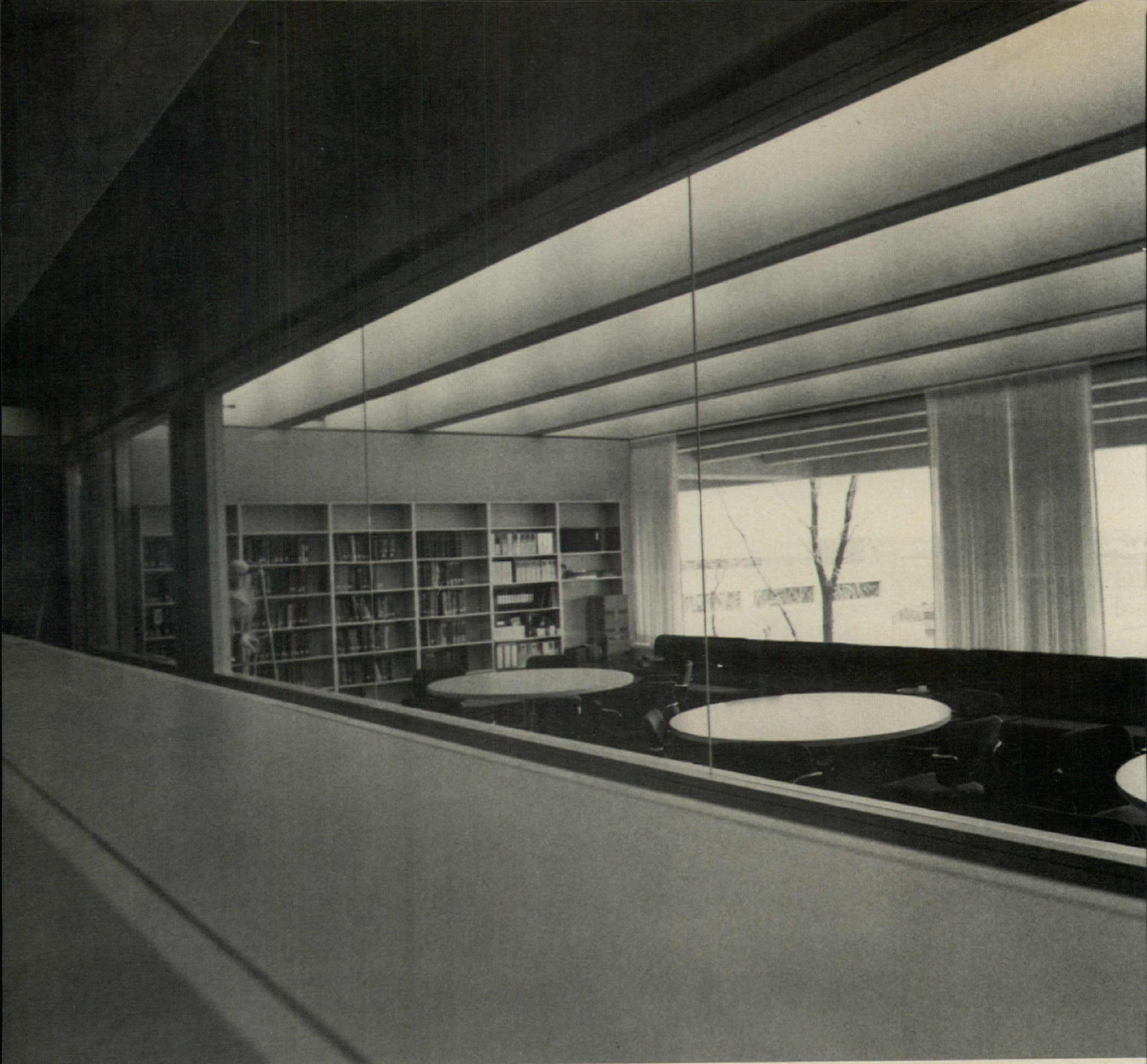
ELEVATION-SECTION

Robert E. Fischer photos

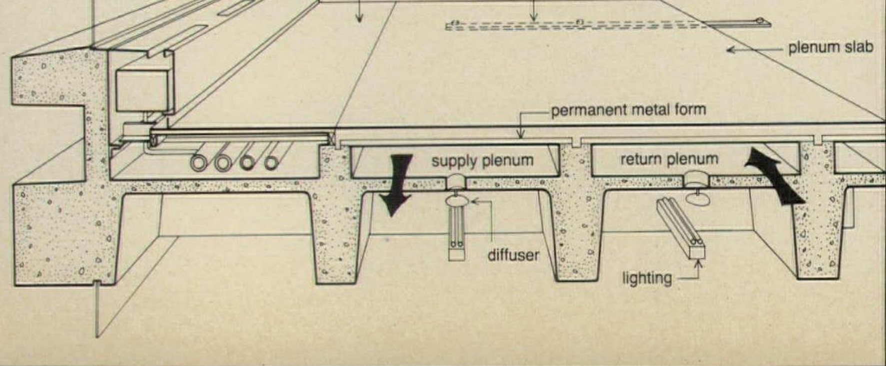
With an impressive show of structural audacity, a 90-ft concrete horizontal mullion surmounts a 90-ft butt-glazed window. Apparent vertical mullions for upper lights are in fact steel hangers. To protect glazing, close analysis of the end wall to calculate depth of initial camber and subsequent behavior of horizontal members was mandated by a number of considerations: deflection of the cast-in-place concrete must match as nearly as possible deflection of the precast tees at floor and roof; all three horizontal members required post-tensioning; deflection would increase as dead load was superimposed and as creep occurred.

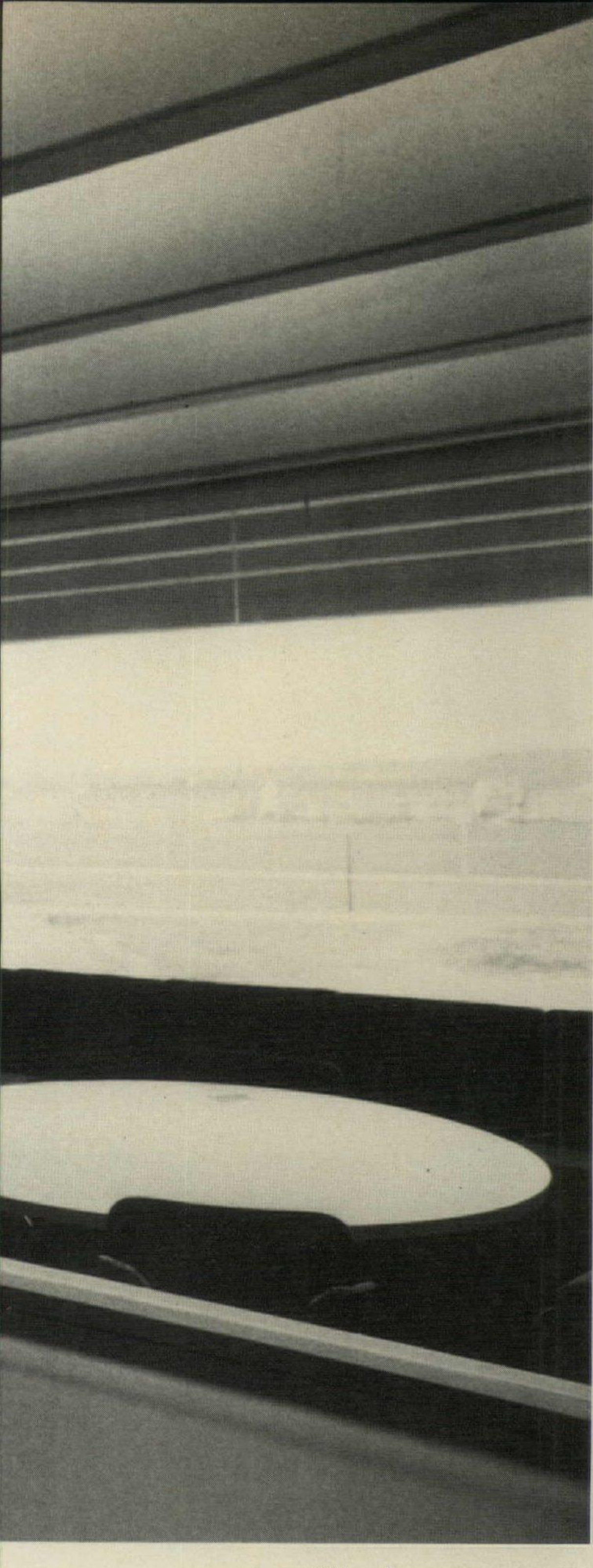




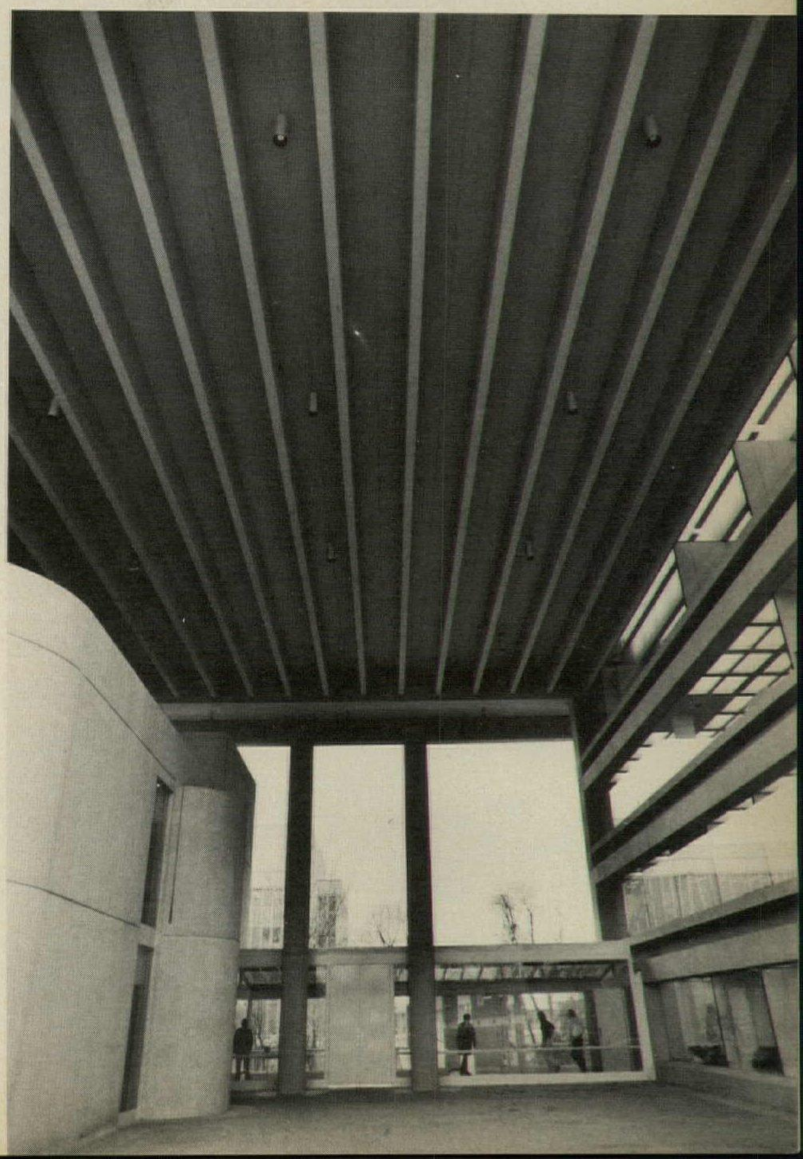


Floors in office block are supported by concrete waffle slabs, topped by a plenum slab and left exposed on the underside. Eight-in. voids between waffles and plenum slab carry supply and return air in alternation, except at perimeter, where hvac piping is housed beneath removable flooring. Fluorescent strips for indirect lighting are inserted in coffers and between tees.

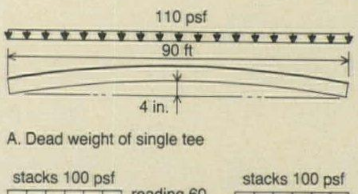




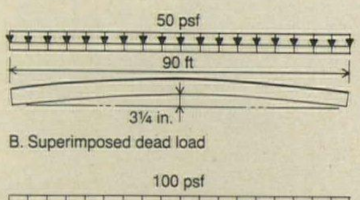
Inside face of Vierendeel truss is exposed at top of grand staircase to library floor. The girder conceals mechanical space behind, and is pierced by round outlets for air supply. Large exhaust grille beneath skylight leads directly to fan room supported by balcony tees. Passageway through the building (bottom right) is flanked by semi-detached student-faculty center and four-story office block. Glass-enclosed tunnel at rear runs to neighboring buildings. (For architectural coverage, see RECORD, August 1975, pages 86-89.)



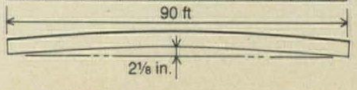
While ordinary usage assumes overall uniform loading, here heavy loads are uneven, threatening windows and partitions in offices directly beneath library (above and lower right). Analyzing probable deflection of tees, engineers calculated separately magnitudes and locations of both sustained loads and temporary live loads, and designed reinforcement and post-tension accordingly.



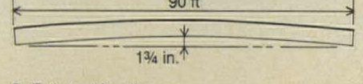
A. Dead weight of single tee



B. Superimposed dead load

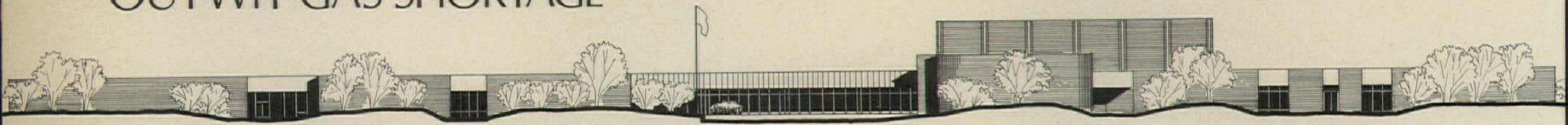


C. Partial stack loading



D. Full stack loading

76 HEAT PUMPS AND ONE SMALL BOILER OUTWIT GAS SHORTAGE



In Westminster, Colorado, a suburb of Denver, the most economical fuel is natural gas, despite a local shortage that led the utility to ration its supply for the new high school to 7,500 cfh, while similar buildings in the area use about 17,500 cfh. Attacking this problem, architects and engineers determined to minimize wastage, using insulation and insulated glass, and to make the most of everything by redistributing air to other spaces and recovering energy from exhaust.

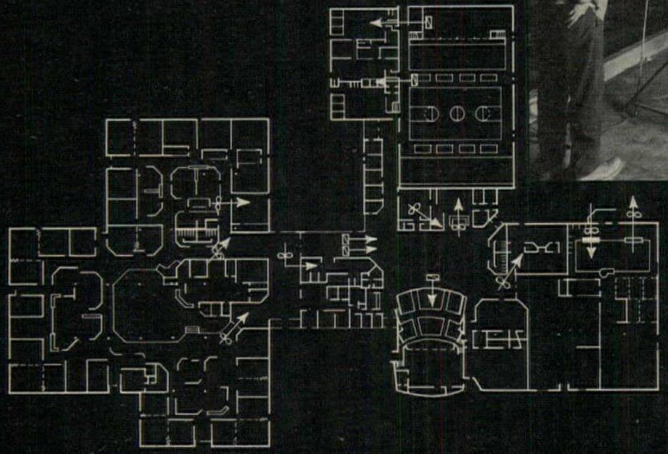
The owner's requirement that most parts of the buildings be air-conditioned suggested the use of a water-loop heat-pump system, which can either heat or cool, as well as redistribute heat from warmer to cooler areas. Further, conditioned air that would normally be exhausted locally is circulated to other warmer (or cooler) areas by a fan system, limiting the need for fresh air.

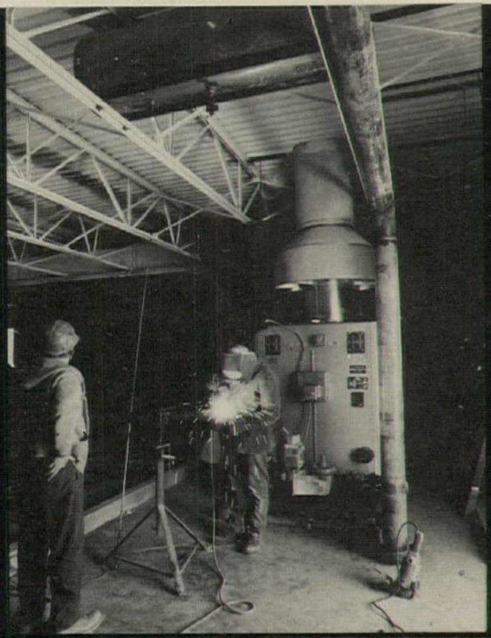
The basic components of the system include 76 water-to-air unitary heat pumps, ranging in capacity from 1 to 5 tons, and a gas-fired boiler, which provides hot water both for the loop and for domestic use. Because of the efficiency of the heat-pump system, the superior insulation of the building shell, and minimal intake of fresh air, boiler requirements for gas were held to 2,700 cfh, 40 per cent of the consumption in conventional systems, say the engineers.

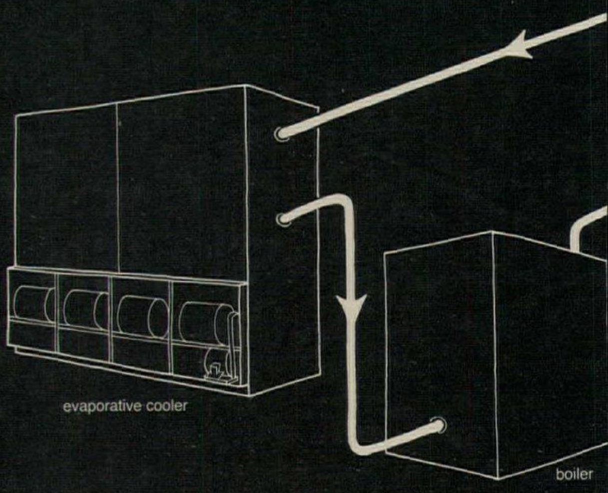
Supplemental domestic water heating is provided by an electric immersion heater, needed only at times of peak demand for both space heating and domestic hot water. In extreme cold, heat can be extracted from the 2,000-gal storage tank. If the gas supply is temporarily curtailed, the immersion heater can provide some space heating via the water loop.

In the school's shops, a heat recovery unit salvages heat from noxious exhaust, and filters remove dust from recirculating air.

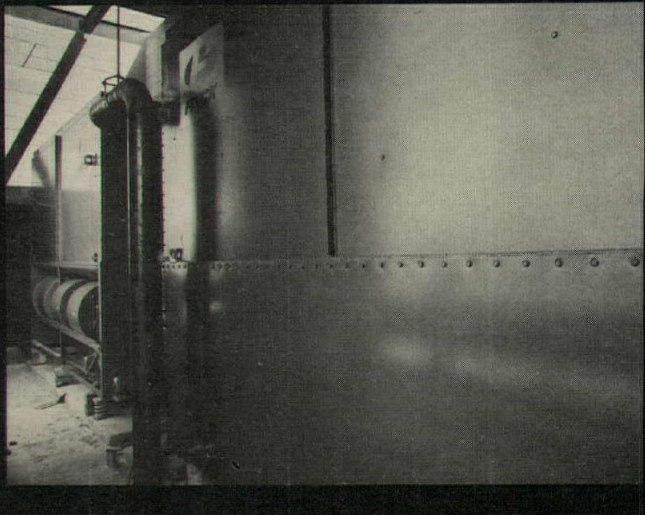
WESTMINSTER HIGH SCHOOL, School District #50, Westminster, Colorado. Architects: *William Blurock & Partners*. Engineers: *Martin & Tranbarger* (structural); *Nack & Sunderland* (mechanical); *Frederick Brown Associates* (electrical); *KKBNA* (civil). Contractors: *Construction Management Services Division, Mead & Mount Construction Co.* (general); *Howard Electric and Mechanical Co.* (mechanical/electrical).



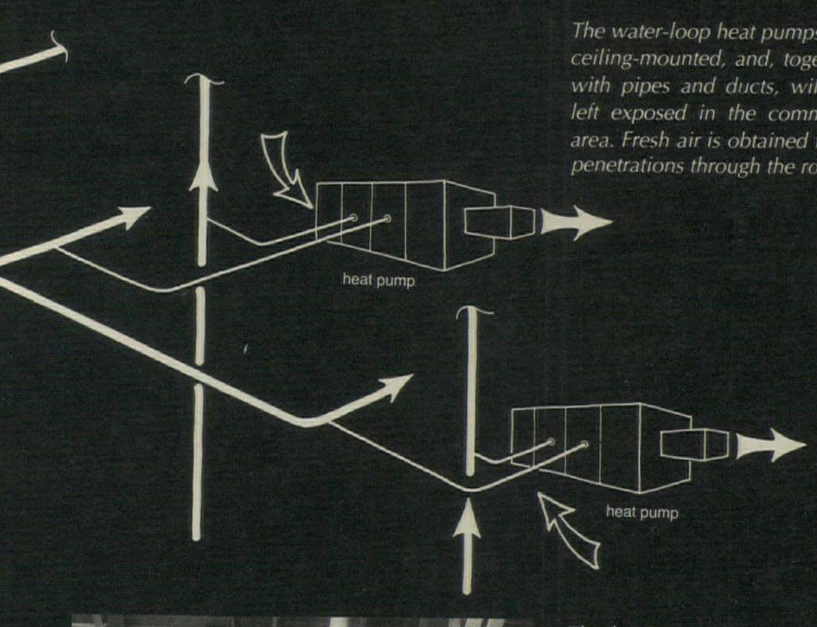




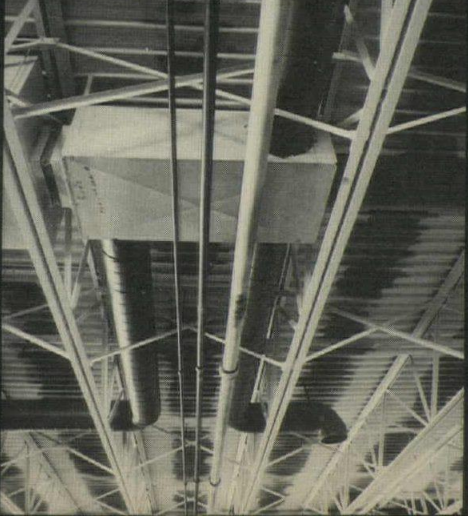
Load on the hvac system is reduced through use of large fans (see plan) separate from the heat pump units. "Used" conditioned air is added to spaces having high loads or exhausts.



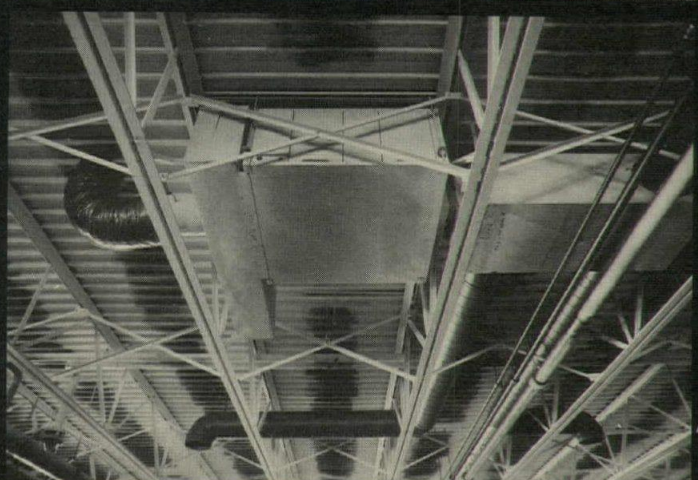
During cold snaps or after weekends, heat may need to be added to the water loop by means of the gas-fired boiler. In mild weather, excess heat in the water loop is rejected to the outdoors by the evaporative cooler.



The water-loop heat pumps are ceiling-mounted, and, together with pipes and ducts, will be left exposed in the commons area. Fresh air is obtained from penetrations through the roof.



The heat pumps range in size from 1 to 5 tons of refrigeration. Fresh air enters one end of the unit through a thin plenum chamber where it is mixed with return air. Conditioned air leaves the opposite end through a supply-air plenum chamber (distribution box), to which ducts are attached to serve various spaces.

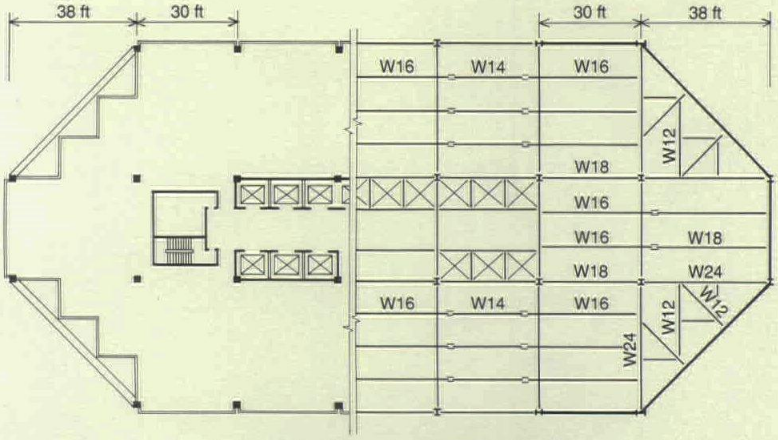


Robert E. Fischer photos

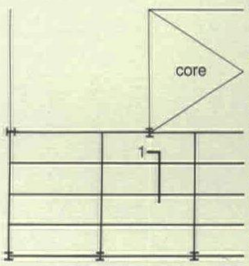

CARLS
STEAKS
ST LOUIS JEWELRY

VERTICAL TRUSSES PROVIDE WIND BRACING AND A POWERFUL DESIGN MOTIF

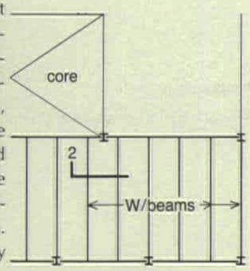
Robert E. Fischer photo



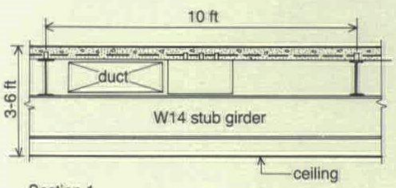
Stub-girder framing uses high-strength girder to span 38 ft from core to perimeter. Stub pieces—3-ft lengths of wide-flange section shop-welded to girder's top flange—alternate with continuous beams; ductwork fits between. At corners, beams extend diagonally to frame into horizontal truss members and to brace diagonal members at one of the two intermediate levels (geometry forbids this at third level). Corners are supported vertically by slender square tube sections.



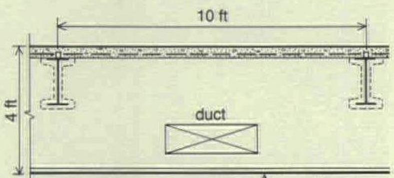
STUB GIRDER SYSTEM



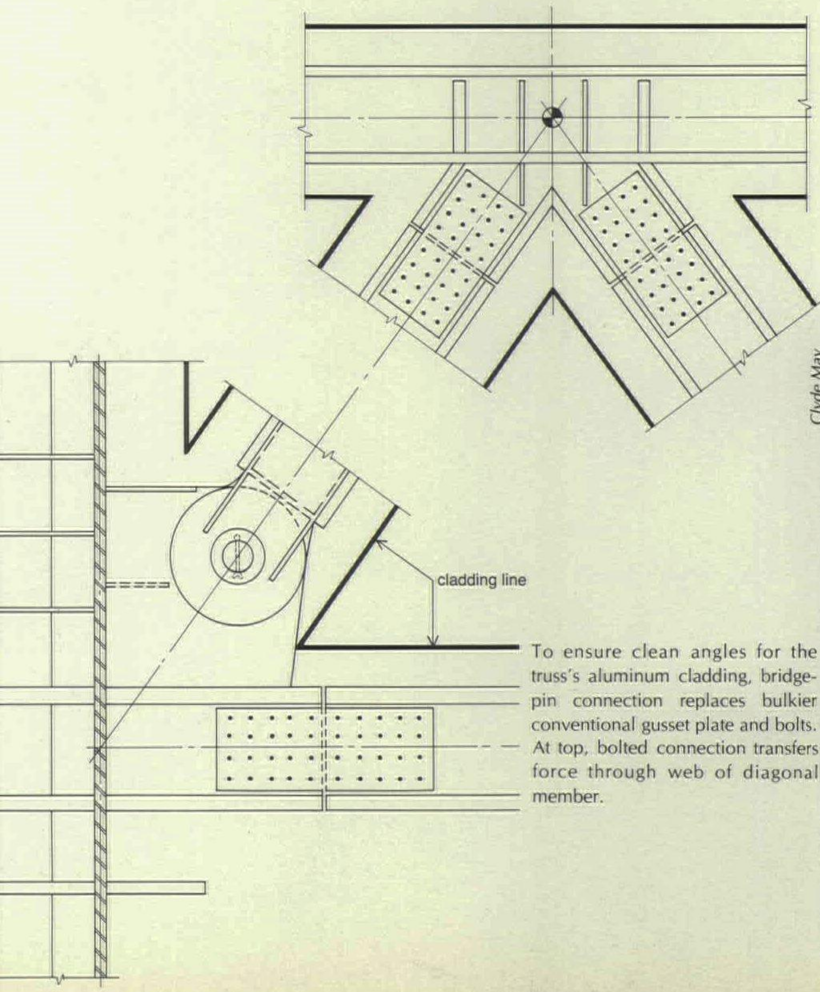
CONVENTIONAL SYSTEM



Section 1



Section 2



To ensure clean angles for the truss's aluminum cladding, bridge-pin connection replaces bulkier conventional gusset plate and bolts. At top, bolted connection transfers force through web of diagonal member.

DETAIL OF K-BRACING

The monumental K-bracing at the corners of St. Louis' Mercantile Tower evolved from an interaction of architectural concern for site plan and structural concern for wind bracing of the narrow 35-story building—and on three projected sister towers at Mercantile Center, one of which will rise more than 50 stories.

So that sunlight can penetrate the rather dense block of buildings, the architects cropped the corners to produce an elongated octagonal plan. From the inception of the design, the engineers worked closely with the architects to devise an exterior truss bracing system, which provides a number of structural advantages. In the system that evolved, vertical trusses were located on all four diagonal corners. This position, which according to engineer Joseph P. Colaco enhances torsional rigidity, led to the "channel bracing" at each end of the building. This "channel" is a five-sided rigid shape at the outside wall (see bold lines on structural plan), formed by welds at both ends of the short face and another weld at the bay adjacent to the trusses on the broad face. The building thus acts as a partial tube, with wind loads across the building taken by all four trusses. There is no interior core bracing, and the floor framing is designed only for gravity load; it also works as a diaphragm to transfer wind load.

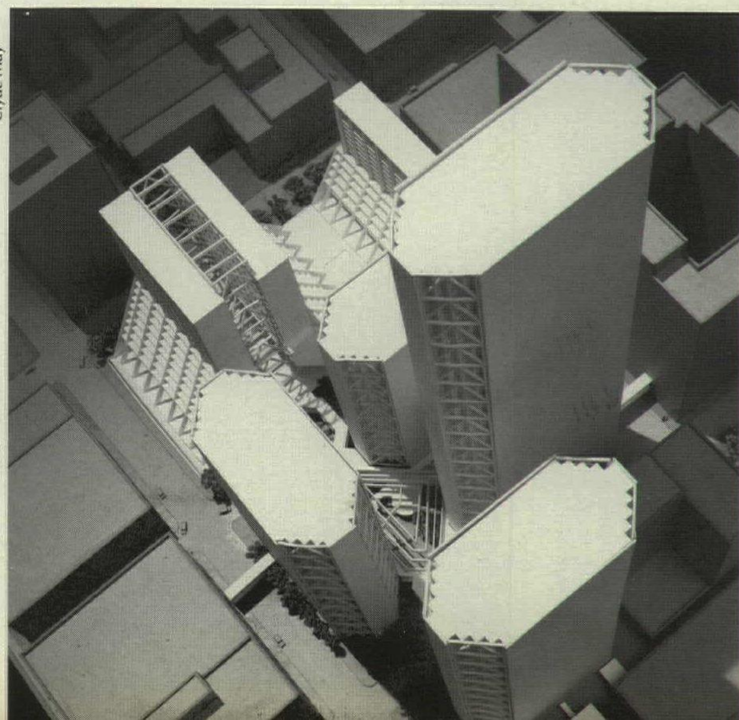
Each segment of the truss is three stories high, a condition that demanded careful architectural and structural detailing. The corners of the saw-tooth floors frame into the horizontal truss members at every third level (see framing plan, top left). At the intermediate level directly below the horizontal members, the diagonals are braced in order to reduce their slenderness ratio.

In addition, connection details at the junction of diagonals and both vertical and horizontal members had to be carefully worked out to minimize bulk and simplify construction (below left).

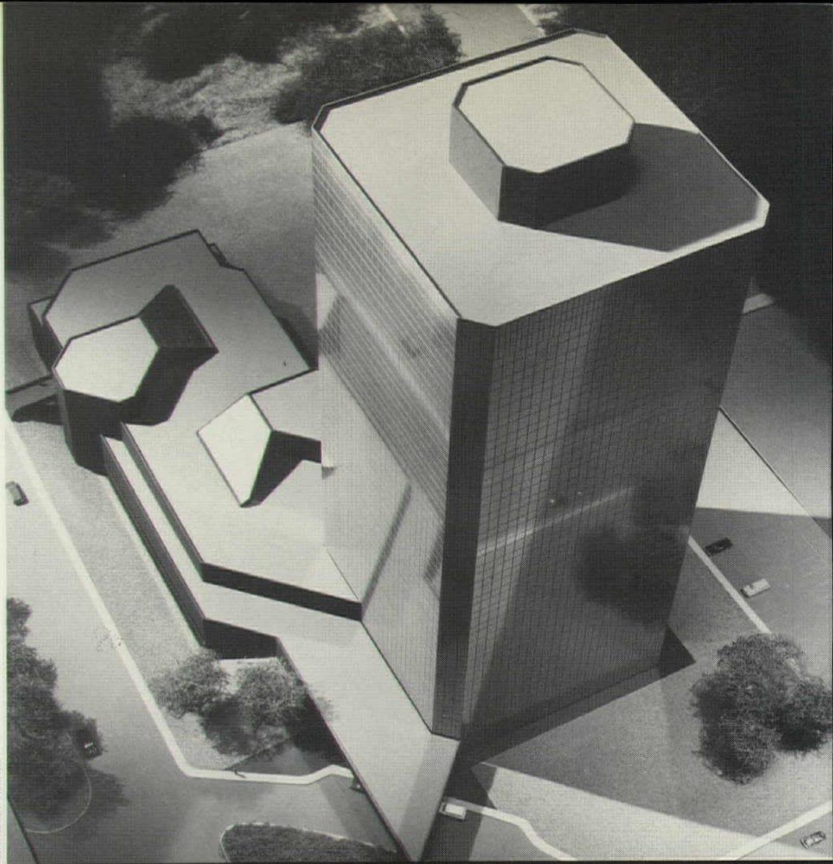
The structural design effected considerable savings by utilizing a stub-girder system for floor framing (see drawing above left). The engineers estimate 25 per cent reduction in structural steel requirements for a conventional system, 15 per cent in structural cost. Because the depth of the floor is 6 in. less than that of conventional beams and slab, thus reducing the height of the tower some 17 ft, further savings occurred in the curtain wall and in vertical risers.

MERCANTILE TOWER, St. Louis. Owner: *Mercantile Center Associates a Joint Venture (Mercantile Trust Co., Crow, Pope & Land Enterprises).* Architects: *Sverdrup & Parcel and Associates, Inc.; Thompson Ventulett & Stainback, Associate Architects.* Engineers: *Ellisor Engineers, Inc.* (structural); *Chenault & Brady, Inc.* (mechanical/electrical). Contractors: *Mercantile Trust Construction Joint Venture (Henry C. Beck Co. and Millstone Construction Co., Inc.)* (general).

Clyde May



CRITICAL DETAILS SUSTAIN CAREFUL ANALYSIS AND EXTENSIVE TESTING



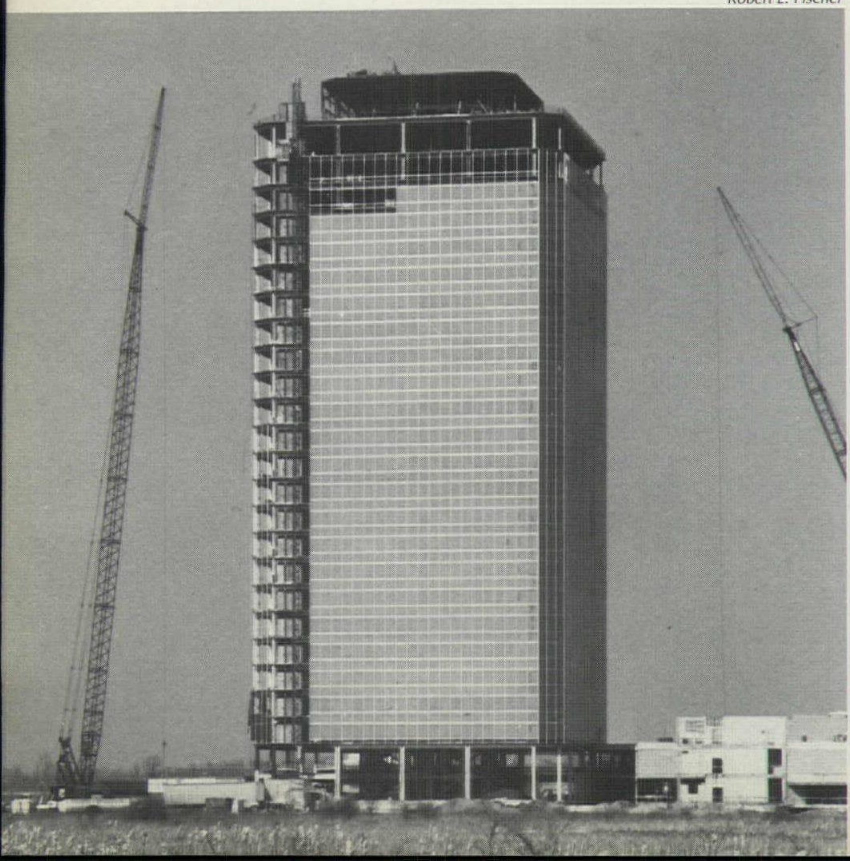
Balthazar Korab

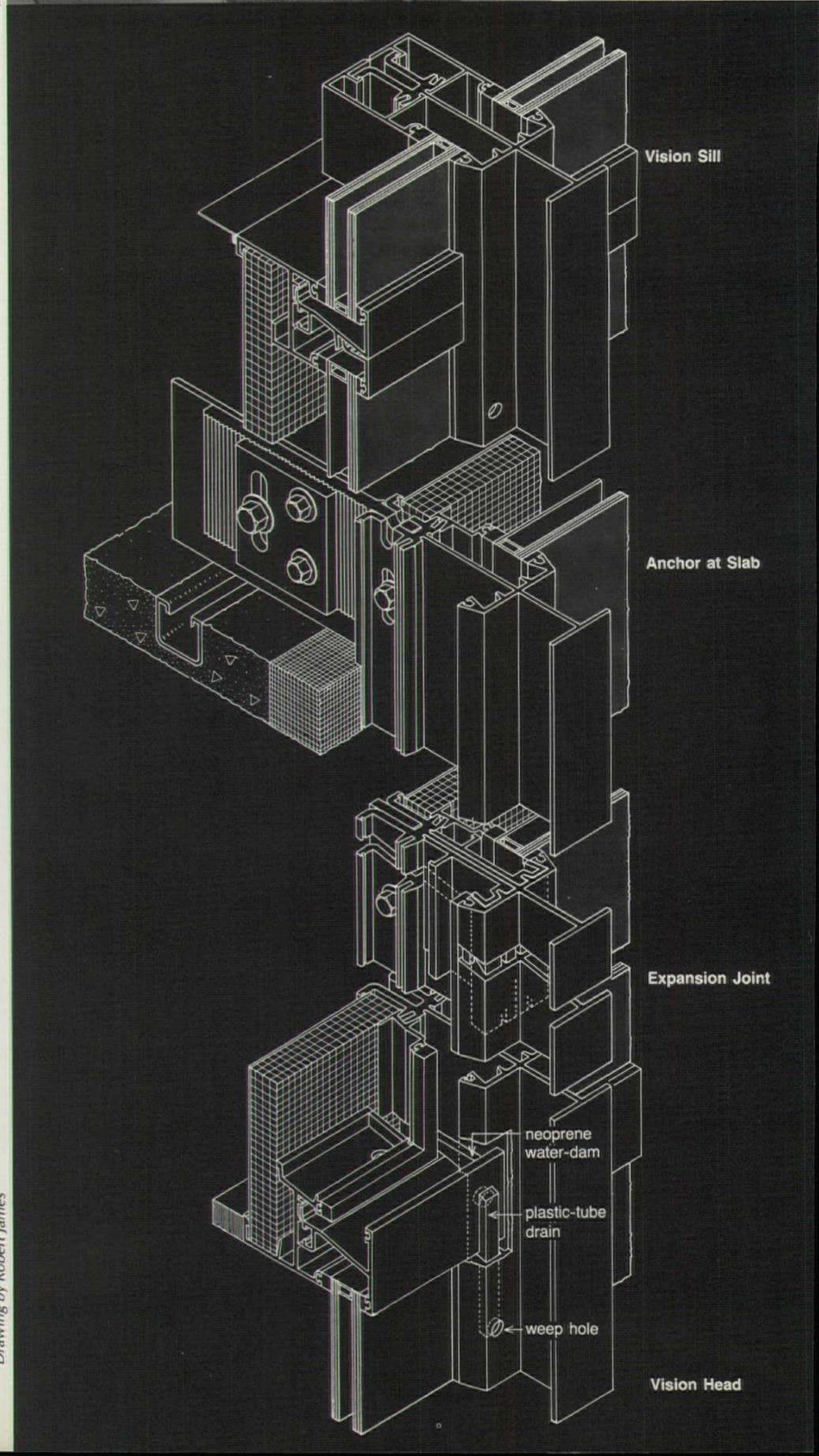
Recognizing the importance of curtain wall detailing for a 25-story tower on an exposed site, and convinced that experienced manufacturers had greater familiarity than they with available components and with economical methods of assembly, Smith, Hinchman & Grylls enlisted technical help from a selected group of prospective curtain-wall contractors. In a procedure carefully designed to prevent unfairness, six manufacturers (three later dropped out) were invited to submit designs. Since low bid would not necessarily prevail, and since they were bidding against their peers, manufacturers knew they had a reasonable chance of getting the contract.

The architectural design was a "stick wall" of reflective glass with bright aluminum frame. A model was subjected to extensive wind-tunnel testing to determine required design strengths for wind load, and the results dictated the types of glazing and their locations. (The tests also yielded data about the force and direction of turbulence around the tower and at pedestrian level.) The A/E firm then gave prospective bidders two sheets of schematic details, architectural and structural drawings, and a performance specification. Bid conditions called for the submission of a schematic design package, shop drawings and material samples.

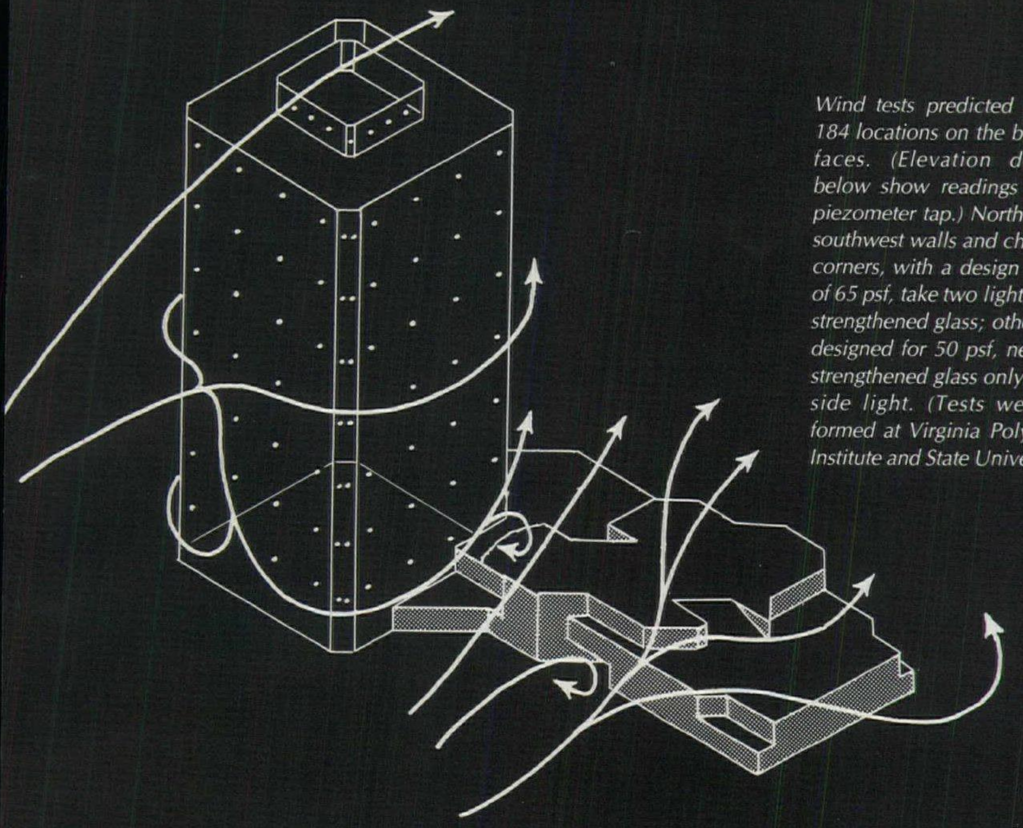
AMERICAN CENTER, Southfield, Michigan. Owner: *American Motors Realty Corporation.* Architects and engineers: *Smith, Hinchman & Grylls Associates, Inc.* Consultants: *Peter Corsell Associates* (curtain wall and wind testing); *Cushman & Wakefield* (project consultants). General contractor: *R. E. Dailey & Company.* Curtain wall: *PPG Industries, Inc.*

Robert E. Fischer

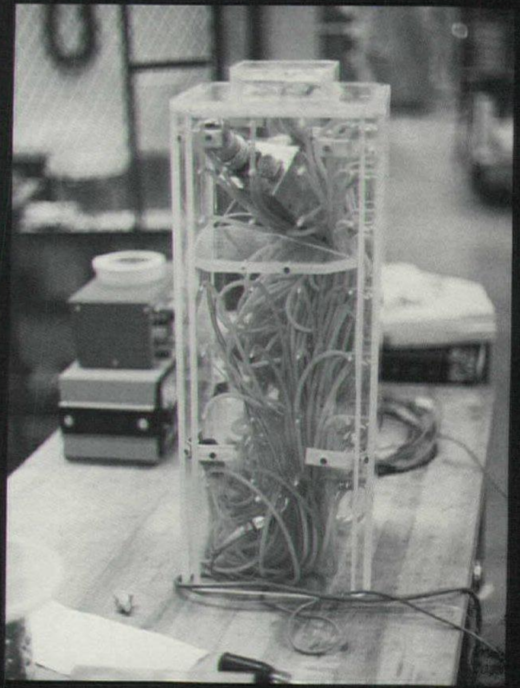


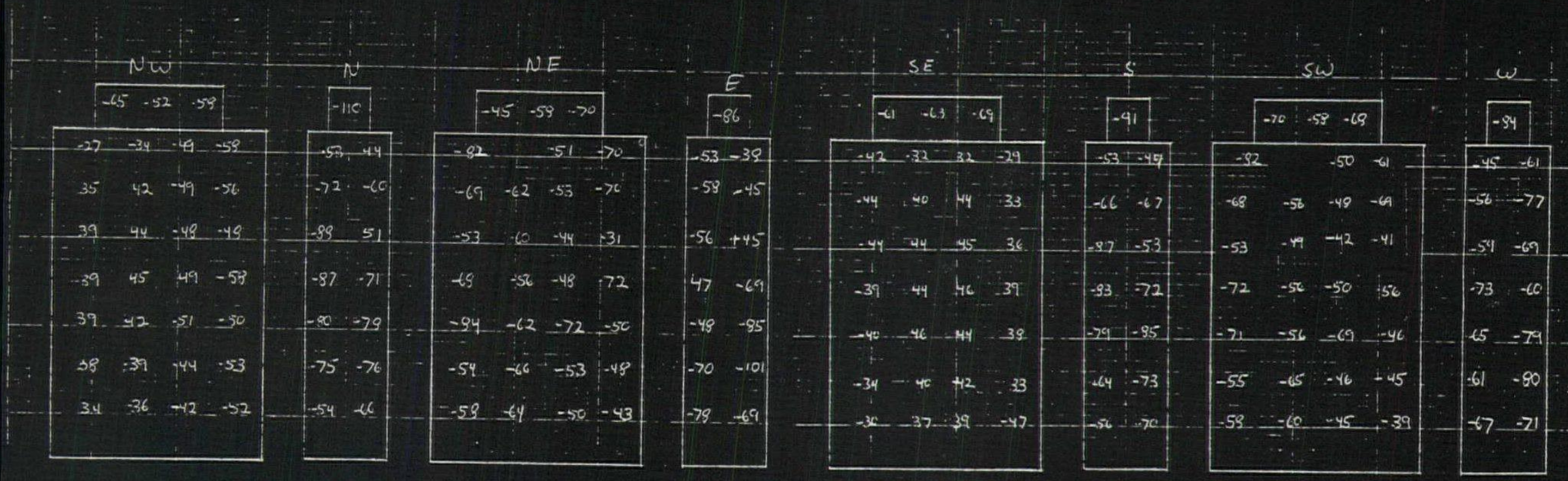


Drawing by Robert James

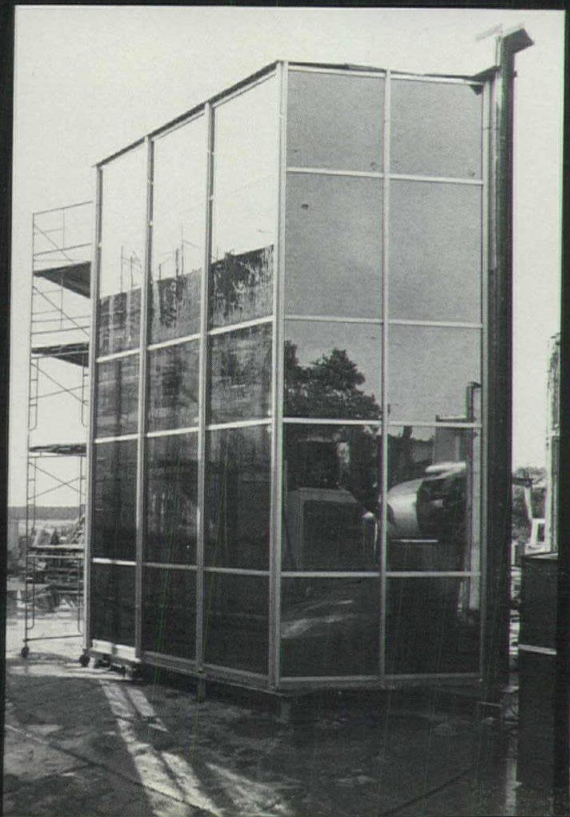


Wind tests predicted loads at 184 locations on the building's faces. (Elevation diagrams below show readings at each piezometer tap.) Northeast and southwest walls and chamfered corners, with a design strength of 65 psf, take two lights of heat strengthened glass; other faces, designed for 50 psf, need heat strengthened glass only for outside light. (Tests were performed at Virginia Polytechnic Institute and State University.)

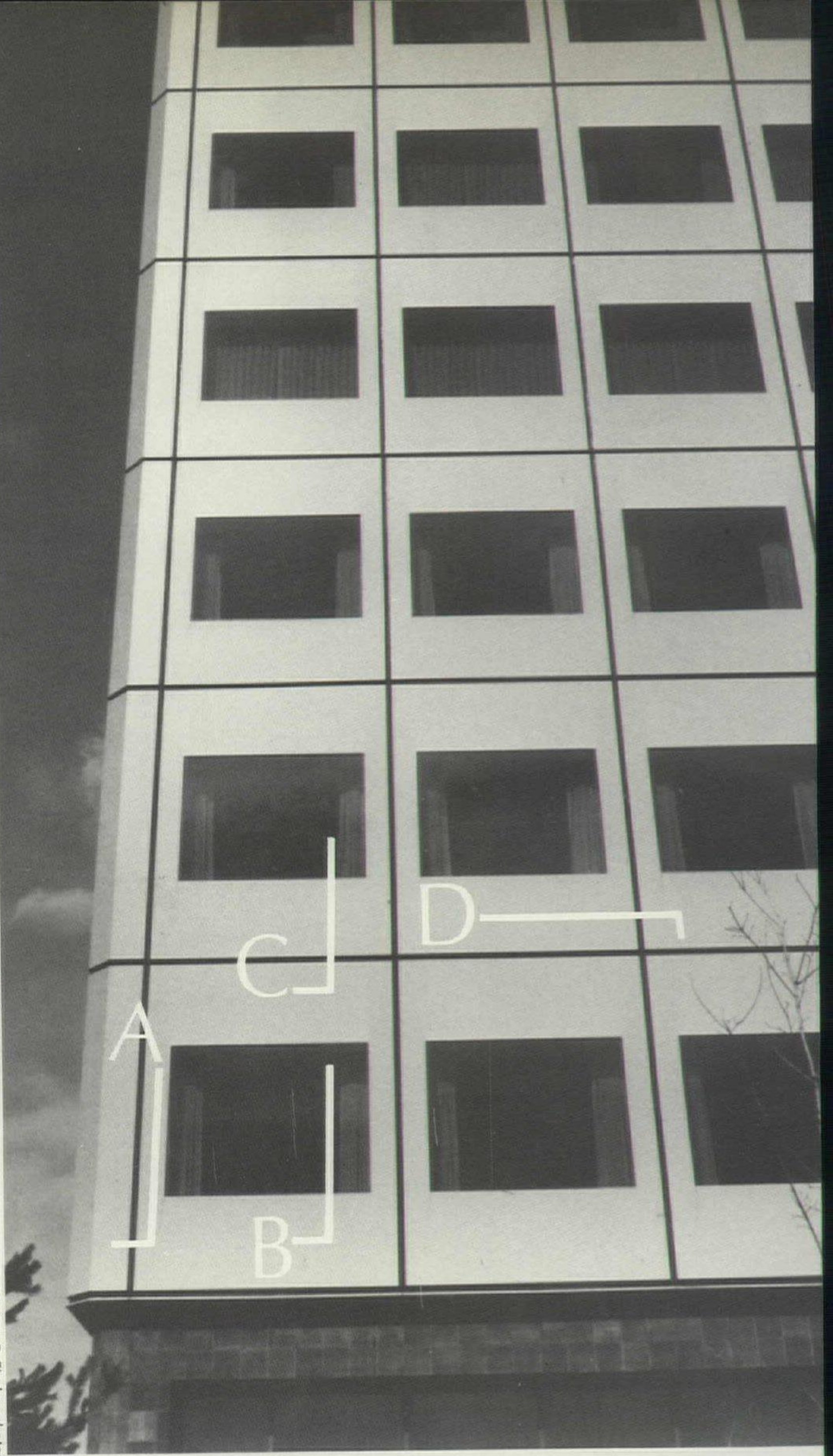




Curtain wall had to be designed for high negative pressures—as much as 80 psf at the top two floors. Because of these high suctions, special attention had to be given to weeping of potential leakage. Any water that gets through at glazing drains into the dammed channel below the sill, and thence through a concealed plastic tube. The length of the tube increases static head to ensure drainage. Mock-up testing (right) was a bidding condition.



PANELIZED WALL HOUSES WEEPAGE SYSTEM OF GREAT SOPHISTICATION



Robert E. Fischer photos

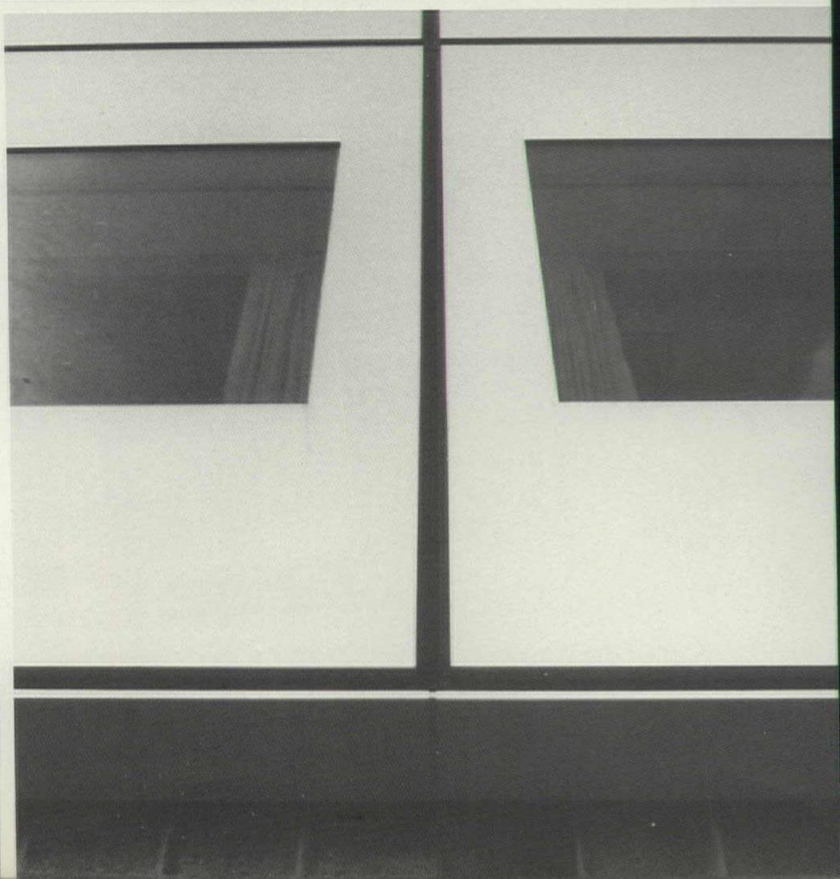
For the Ann Arbor Properties Building, Smith, Hinchman & Grylls designed a less conventional wall than at American Center (see previous page). Concern about water penetration was correspondingly greater, since experience with panelized curtain walls is less.

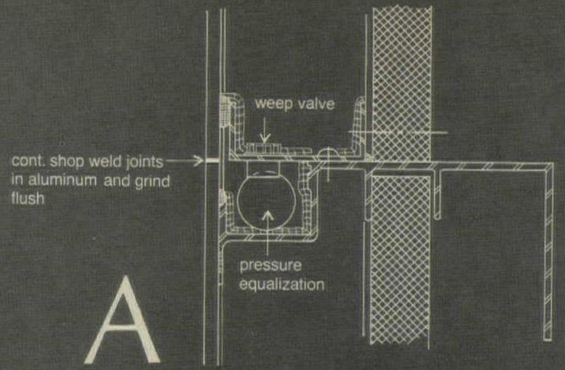
The wall is sheathed with insulated aluminum panels, the joints sealed by 3-in. neoprene expansion gaskets. Panels are designed as rainscreens—that is, the engineers accept that some moisture can penetrate the seals. The defense is to equalize pressure inside and out so water will drain easily and wind-driven rain will not be sucked in.

Each panel houses two types of channels—one around the edges to serve the gaskets (C, D) and one at the glazing sill (A, B), which opens into the vertical channels at side of panel.

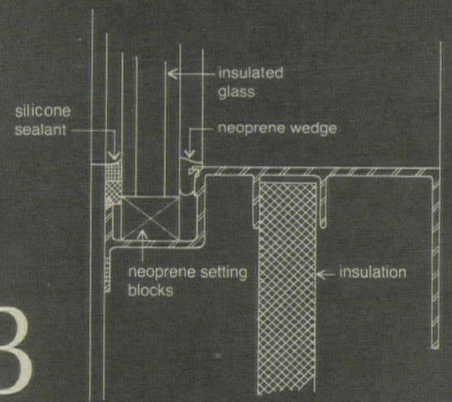
To prevent suction into the panel, pressure must be equal inside and outside the skin, and the weepage system is equipped with a highly sophisticated pressure equalization system. Weep holes at the bottom of each panel double as exterior pressure equalization holes; interior pressure equalization holes appear in top channel behind the gasket. To inhibit flue action behind vertical gasket, air baffles are inserted behind splices. A channel around window head and jambs feeds into sill channel through a one-way weep valve.

THE ANN ARBOR PROPERTIES BUILDING, Ann Arbor, Michigan. Architects and engineers: *Smith, Hinchman & Grylls Associates, Inc.* General contractor: *Spence Brothers.* Curtain wall: *Cupples Products.*

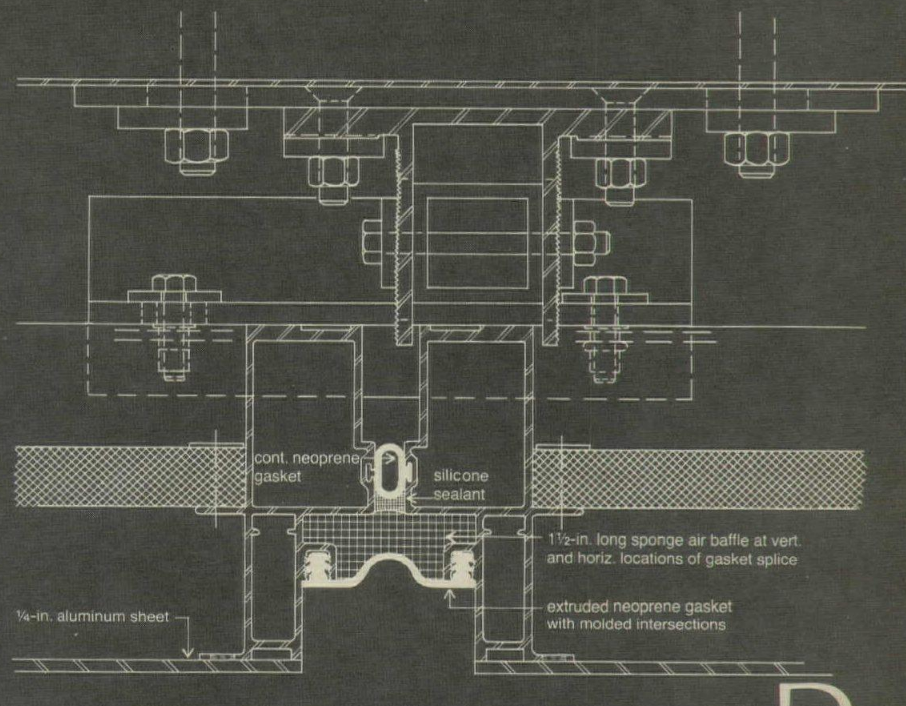




A

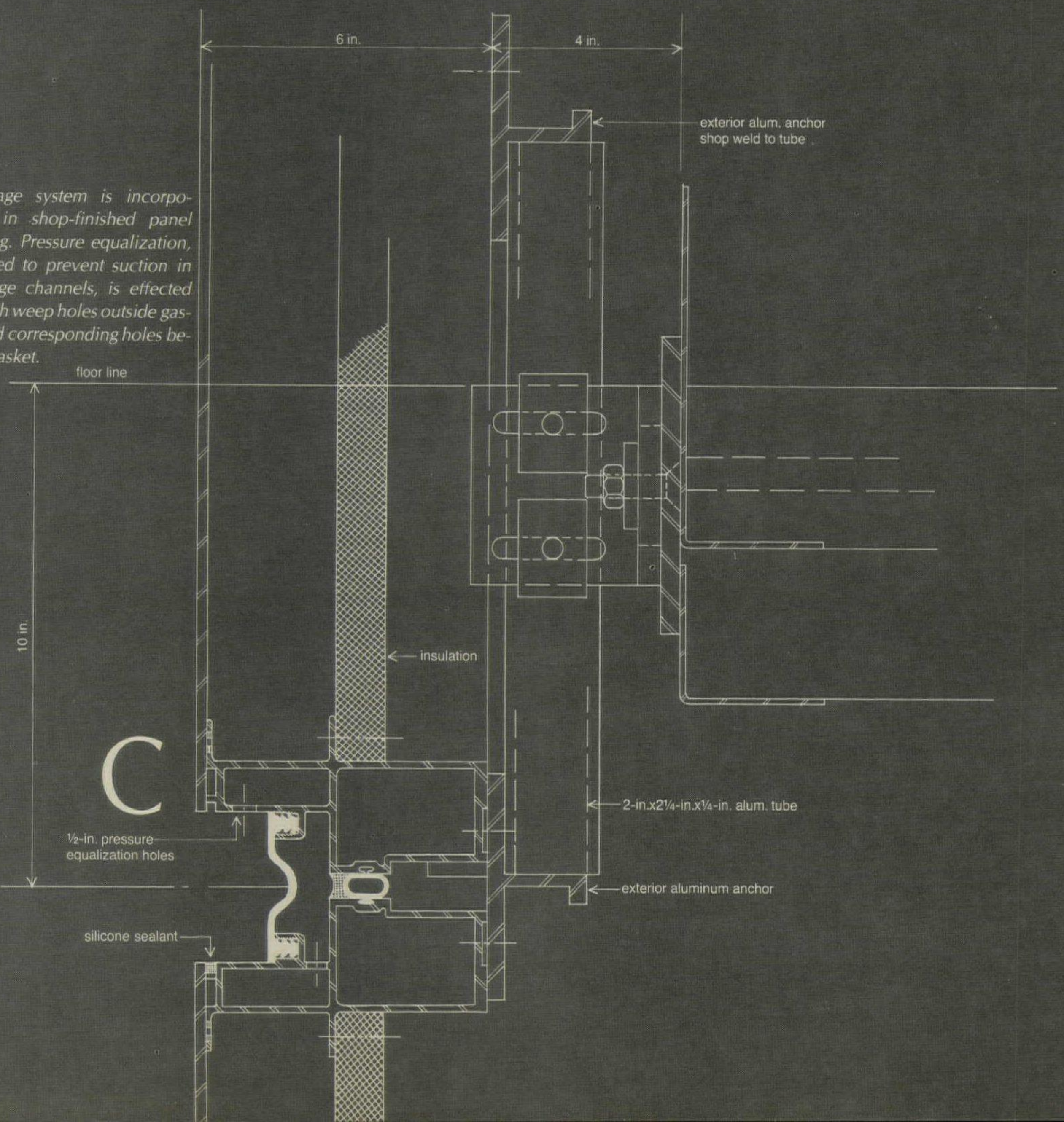


B



D

Weepage system is incorporated in shop-finished panel framing. Pressure equalization, required to prevent suction in drainage channels, is effected through weep holes outside gasket and corresponding holes behind gasket.



C

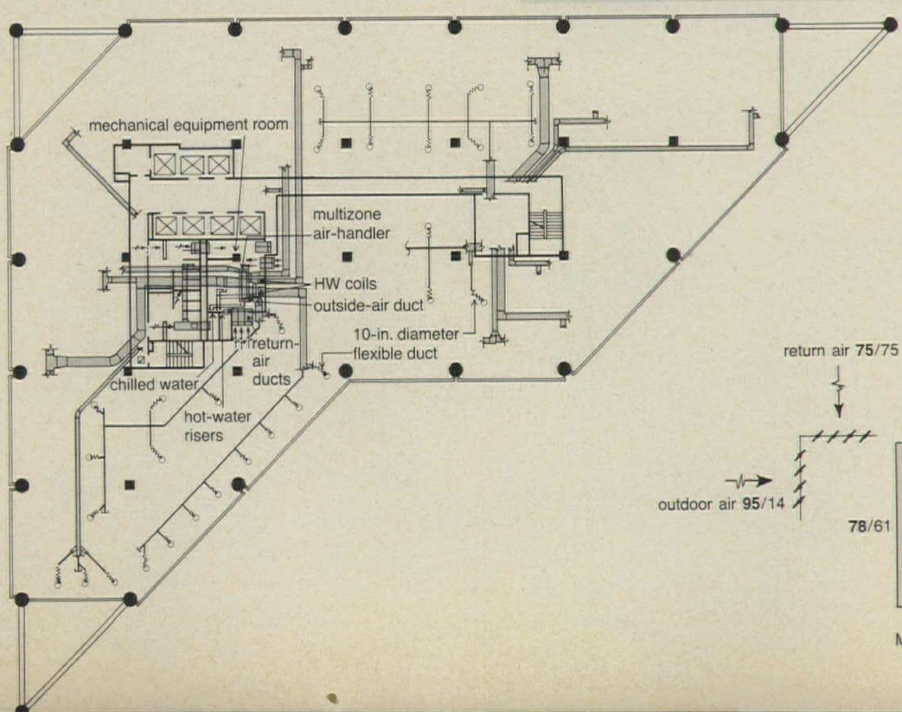
TEAMWORK SHAVES MECHANICAL COSTS IN A RENTAL TOWER

The developers of this building put together a team of specialists in design, leasing, engineering, and construction to meet the challenges of difficult site, budget, construction time, and life-cycle costs.

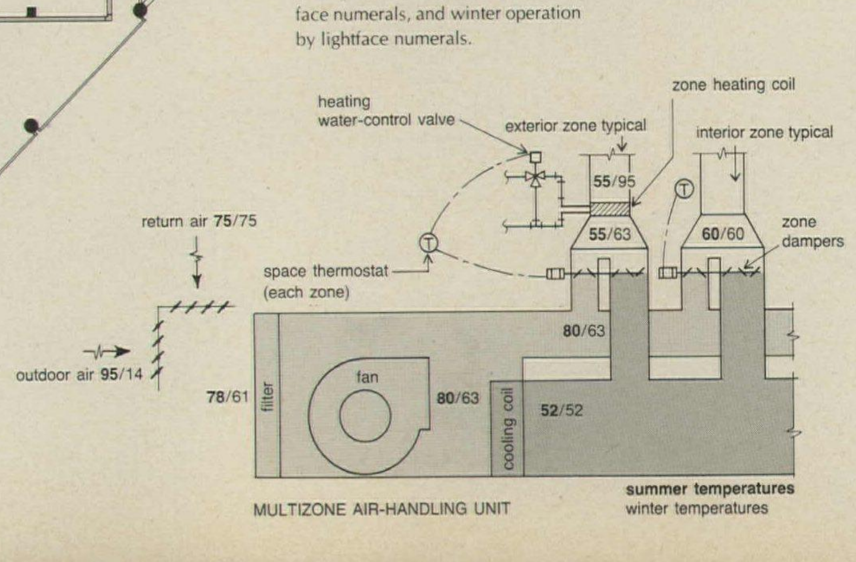
Mechanical and electrical systems were budgeted at a low figure of $5.33 per sq ft, demanding close attention to hvac-system-related costs. The mechanical/electrical engineers estimate that use of reflective, insulating glass, for example, will save $36,000 per year, net, in capital and operating costs.

The hvac system saves energy in three ways: First, the two 1,200-ton chillers have double-bundle condensers that capture internal heat for reuse at the perimeter. Second, each floor has two multizone-type fan-coil air handlers, each designed for eight zones—several serving the perimeter, and the balance, interior. Thus, each floor can be operated separately. Third, the air-handling system never "reheats" already cooled air, as some multizone systems do. In the heating mode, cooling-coil face dampers are fully closed and bypass dampers are fully open, so no air is blown through the cooling coil. A thermostat-controlled, three-way valve modulates supply of hot water to the heating coils. Water is distributed by a four-pipe system.

PEACHTREE SUMMIT, Atlanta. Owners-Developers. *Diamond & Kay Properties and P.C. Associates.* Architects: *Toombs, Amisano & Wells.* Engineers: *Ellisor Engineers, Inc.* (structural); *Herman Blum Consulting Engineers* (mechanical/electrical). Contractors: *Henry C. Beck Company* (general); *Sam P. Wallace Company, Inc.* (mechanical); *Fischbach & Moore* (electrical).

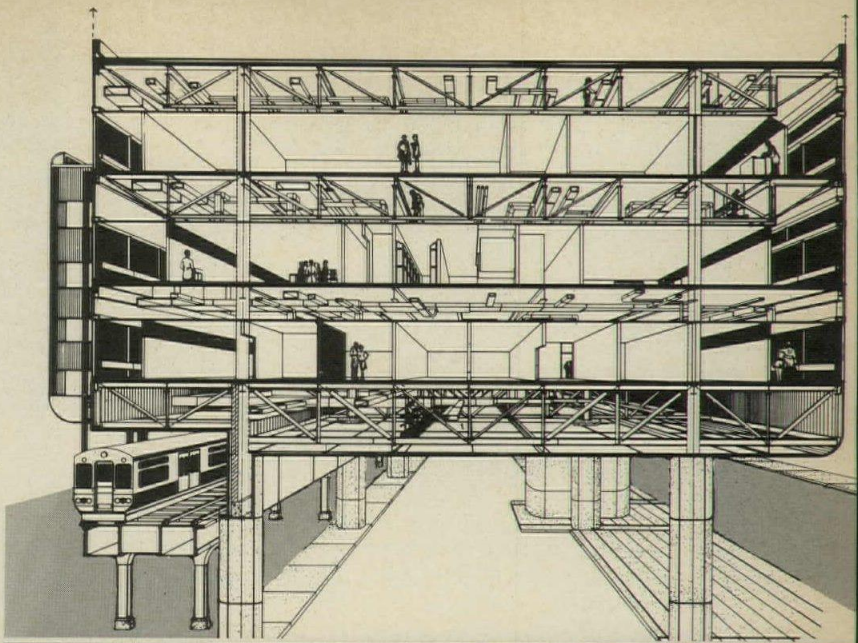


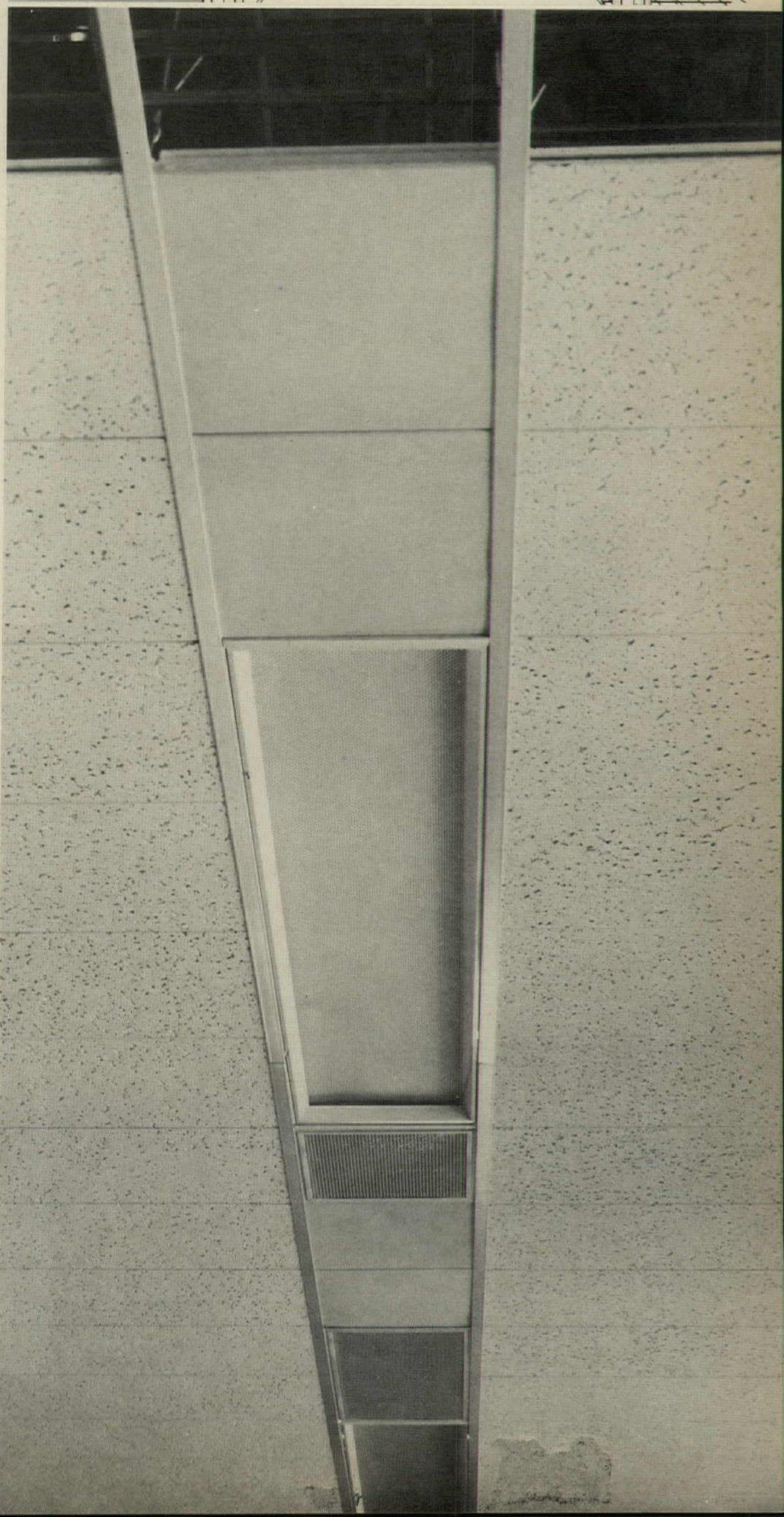
Because of the stretched-out plan, each floor has two multizone air-handlers. Each of these serves eight interior and perimeter zones. Summer operation is indicated by boldface numerals, and winter operation by lightface numerals.

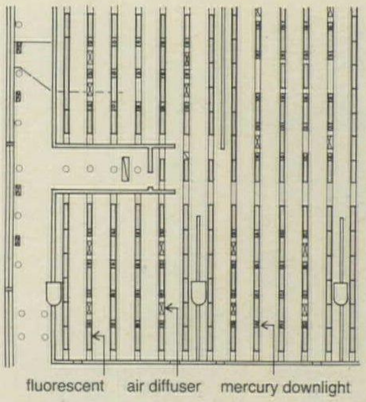


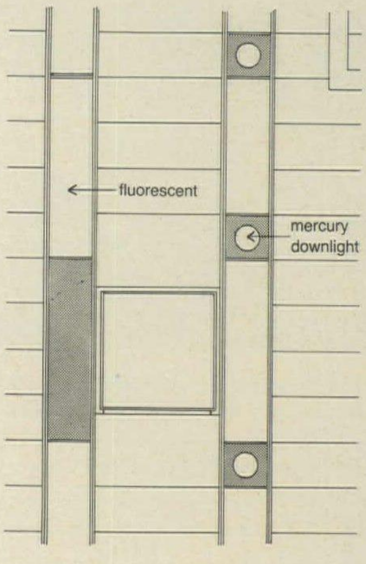
MULTIZONE AIR-HANDLING UNIT

MEDICAL TEACHING FACILITY ACHIEVES FLEXIBILITY WITH A SERVICE-STRIP CEILING









Service strips, 1 ft wide, and 4 ft on center, allow lighting, air registers, and plumbing to be adapted to changing requirements. All inserts into the strip are finished the same color, including blank panels. Sprinkler heads are outside the strips, in the acoustical panels, to preserve flexibility.

Rush Medical College, a reinstituted teaching facility associated with St. Luke's Medical Center in Chicago, will have, by fall 1976, a new $17 million building to house a multidiscipline laboratory, a gross-dissection laboratory, and a new medical library.

While interstitial spaces provide access to mechanical/electrical services, some means were needed to permit the ceiling to be adaptable to changing lighting, ventilation, and plumbing.

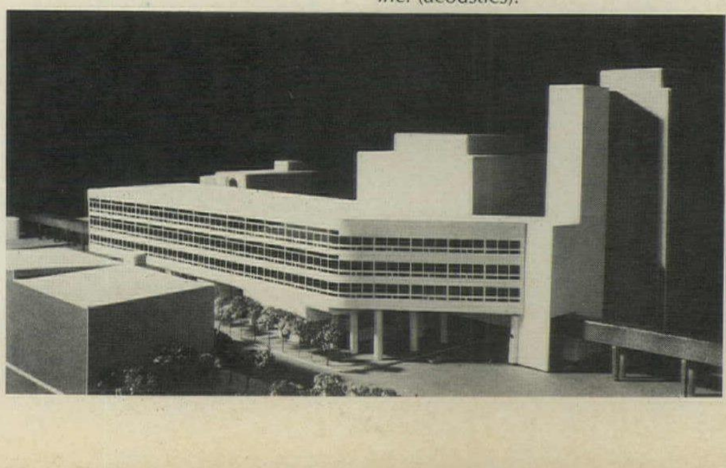
The answer: 1-ft-wide service strips, 4 ft on-center, continuous across the building (except where interrupted by core areas, etc.). Developed by Carl Hunter of the architects' office, and David Mintz, lighting consultant, the strip allows flexibility on a 6-in. module.

Illumination can be varied from 50 to 200 footcandles by changing the spacing of, and the number of lamps in, fluorescent luminaires, and by introducing 12-in.-square 175-watt mercury-lamp luminaires.

The strip also allows flexibility for supply and exhaust air, and accepts flues, gas outlets, laboratory piping, etc.

Flexibility is obtained within a visually ordered system.

RUSH MEDICAL COLLEGE, Chicago. Architects: *Metz, Train, Olson & Youngren, Inc.* Engineers: *C. A. Metz and LeMessurier Associates, Inc.* (structural); *Environmental Systems Design, Inc.* (mechanical/electrical). Consultants: *David A. Mintz, Inc.* (lighting); *Bolt Beranek and Newman, Inc.* (acoustics).



A TWO-WAY BAFFLE SYSTEM OPENS THE CEILING FOR SCHOOL FLEXIBILITY

Budget and program requirements led the designers of an Illinois vocational school to a novel two-way baffle system that gives easy access to ducts and electrical distribution.

Pegged by the designers as an "integrated non-ceiling system," the baffle grid consists of 16-in. deep, glass-cloth-faced acoustical board 5 ft apart in both directions. Bare-tube fluorescent strips are centered in one direction over the baffles, which provide reasonable lamp shielding. The baffles are suspended 13 in. below the long-span, open-web-joist roof framing, which is 3 ft. 4 in. deep, allowing sufficient room for air-supply ductwork. The underside of the metal deck was sprayed with a cellulose acoustical material for additional sound absorption.

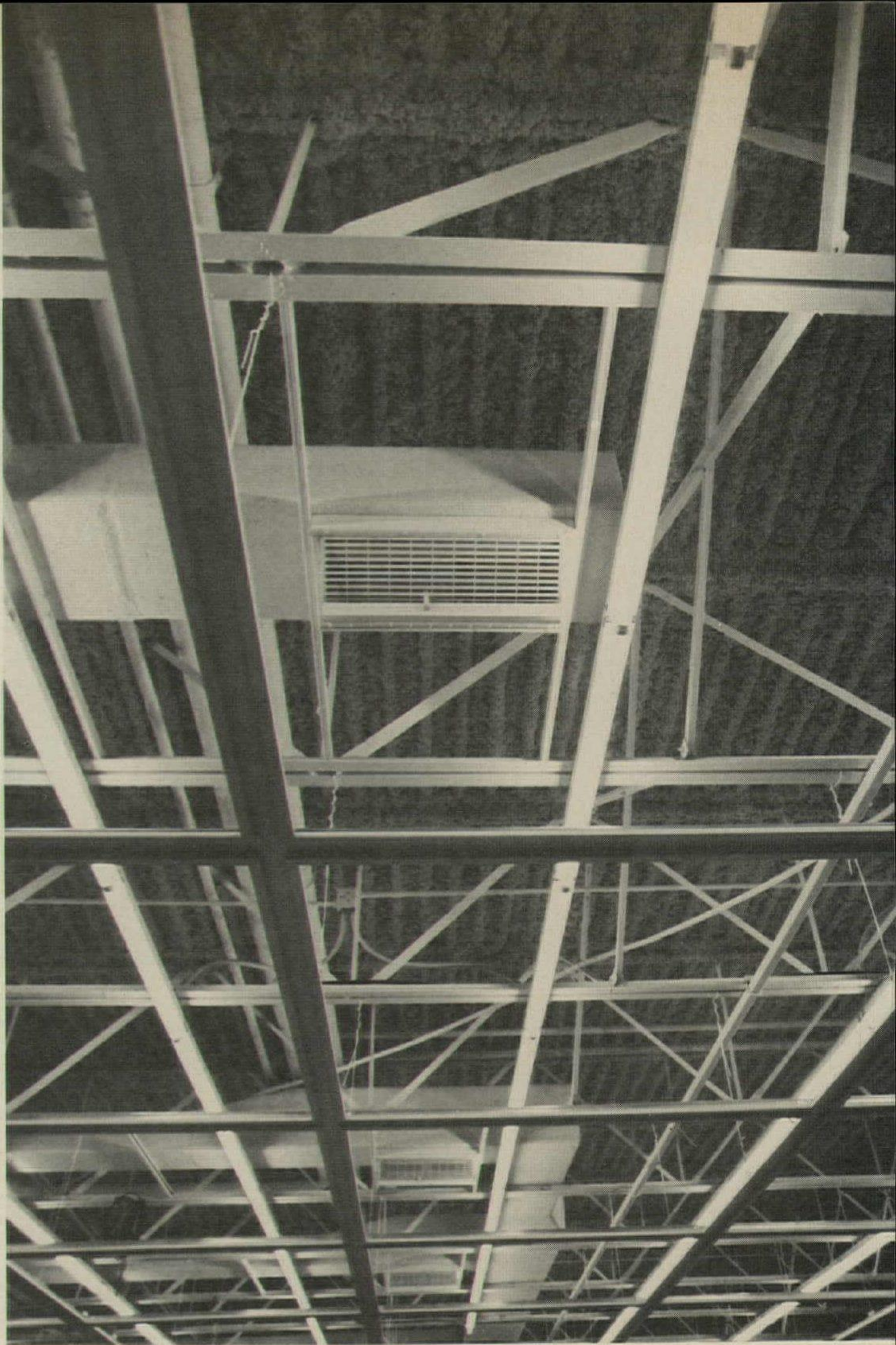
The school is open-plan except for presentation areas, which are enclosed with acoustical ceilings and gypsum-board-faced metal-stud partitions or concrete block walls (where rooms are adjacent to noisy operations).

Budget for the school was set at $21.00 per sq ft by the state which provides 60 per cent of the funding. The 93,300-sq-ft school building actually came in at $21.88 per sq ft.

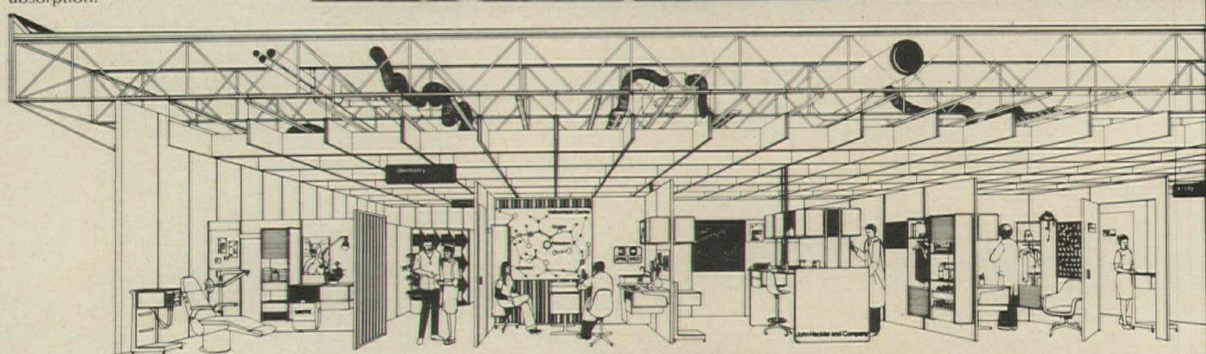
Because the vocational programs are varied in response to industry need, spatial and mechanical flexibility were prime requirements.

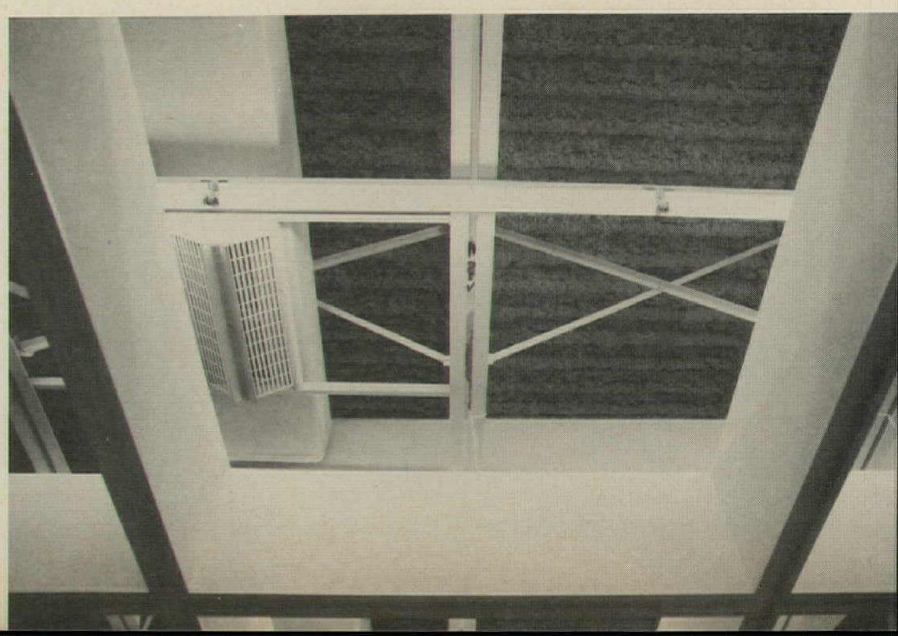
The school is air-conditioned by 10 rooftop multizone units. Hot water is supplied to these units from a central boiler plant in the nearby Pekin High School. Because of the absence of a ceiling, per se, the engineers selected an industrial-type diffuser especially designed for open or egg-crate ceilings.

PEKIN AREA VOCATIONAL SCHOOL, Illinois. Architects: *John Hackler and Company*. Engineers: *The Engineers Collaborative* (mechanical/electrical). Consultants: *Bolt Beranek and Newman Inc.* (acoustics).

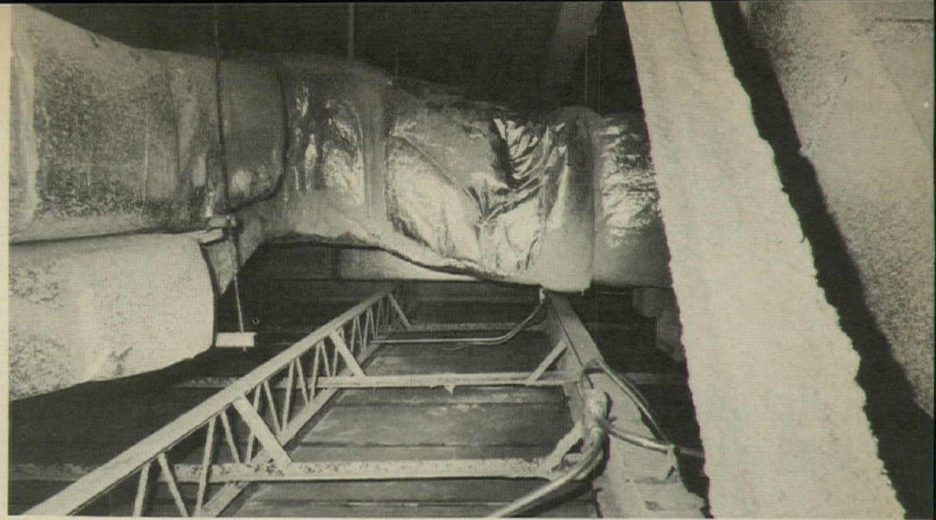


Ductwork and electrical distribution are immediately accessible through the 5- by 5-ft baffle-grid system which provides sound absorption and lamp shielding. Lighting level is 60 fc. Power poles run up next to baffle faces. A special industrial-type diffuser, which can be adjusted for air pattern, was used to get good air distribution. Underside of the deck has sprayed-on cellulose acoustical material for additional absorption.





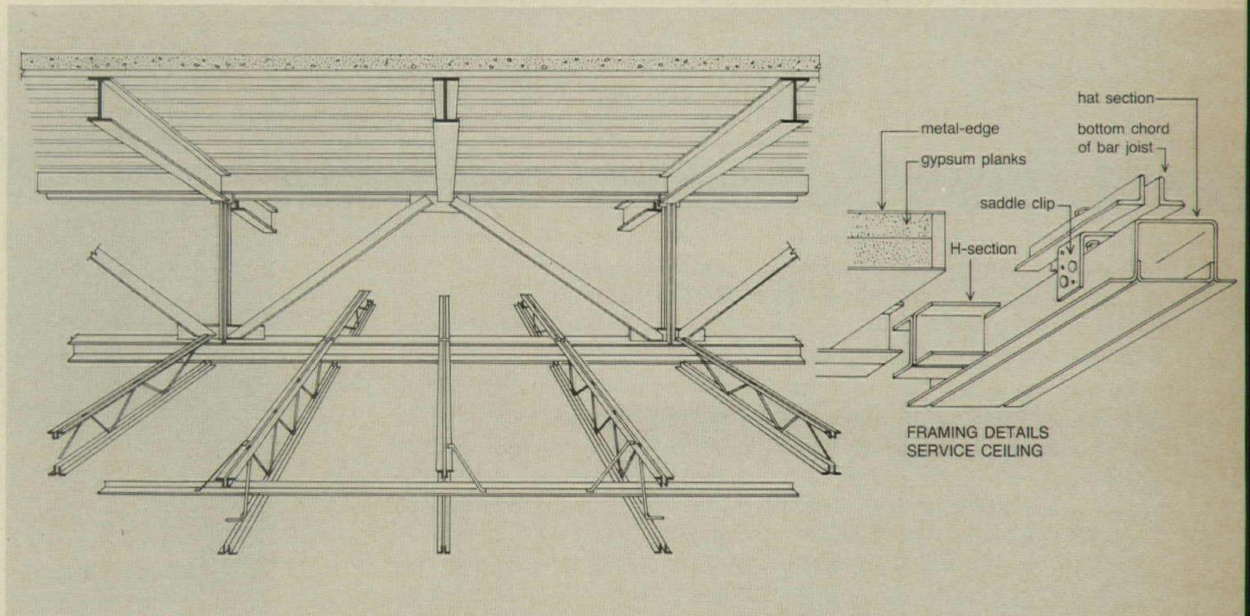
GYPSUM-PLANK CEILING SERVES AS FLOOR FOR INTERSTITIAL SPACE



The laboratories at the Long Health Sciences Center, engaged in cancer research, needed a high degree of planning flexibility to accommodate fairly frequent changes in lab set-ups. The flexibility was achieved by a relatively column-free interior, where the structural floor is supported on 48-ft-long trusses, 22 ft apart. The depth of these trusses—6 ft 8 in—permitted the use of the space between suspended ceiling and floor as "interstitial space," a device familiar in recent hospital design. Since the space provides headroom, workmen can repair and renovate services and utilities without creating disturbance.

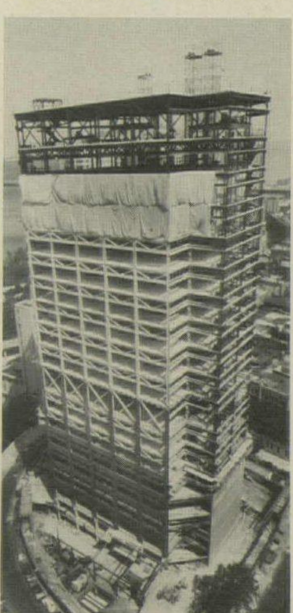
Concluding that a heavy-duty ceiling membrane capable of supporting foot traffic would give less limited access to the interstitial space than would a catwalk, the team of architects, structural engineers and construction managers approached United States Gypsum, whose metal-edged gypsum plank had been used as a structural substrate for apartment flooring, for help in developing a walk-deck system that would also serve as a finished ceiling.

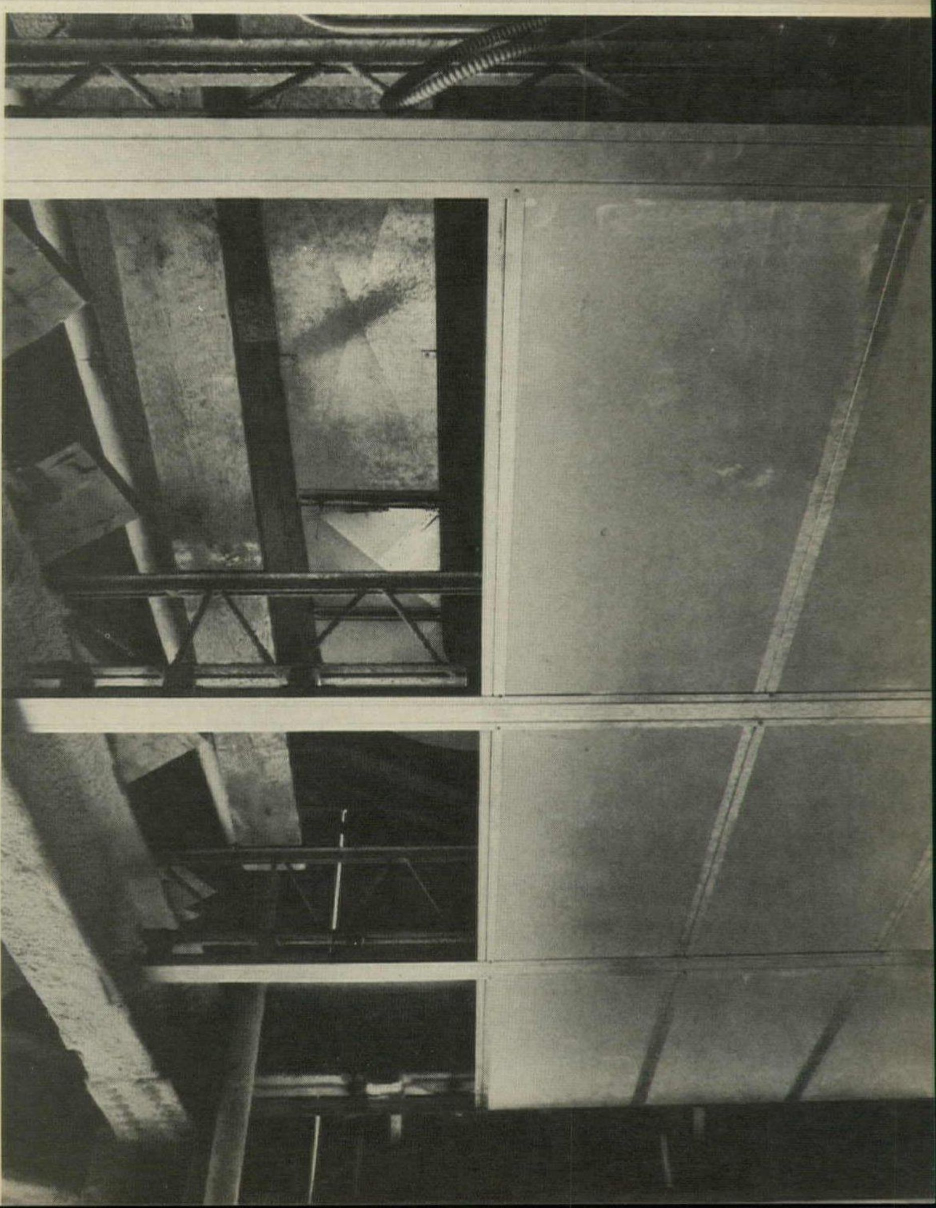
The ceiling is supported by bar joists spanning between trusses. Hung from the lower flanges of the bar joists are hat-shaped sections which support 2-in. deep H-sections within which the gypsum planks are wedged. Use of the joists in this way increases the height of the interstitial space by the depth of the joist, but means that the top flange of the joists must be separately braced. Holes can be easily cut in the plank for new services. For a more finished ceiling a sheet of gypsum board can be attached.



Metal-edged gypsum planks work as ceiling (bottom right) and as a walkway for maintenance crews when they need to make changes in services for the laboratories of the Long Health Sciences Center. The support system for the plank (see drawing) consists of H-sections that rest on hat sections, which in turn hang from the bottom flanges of the bar joists.

The building has wind X-bracing at mechanical floors, and the skin is glass and weathering steel.

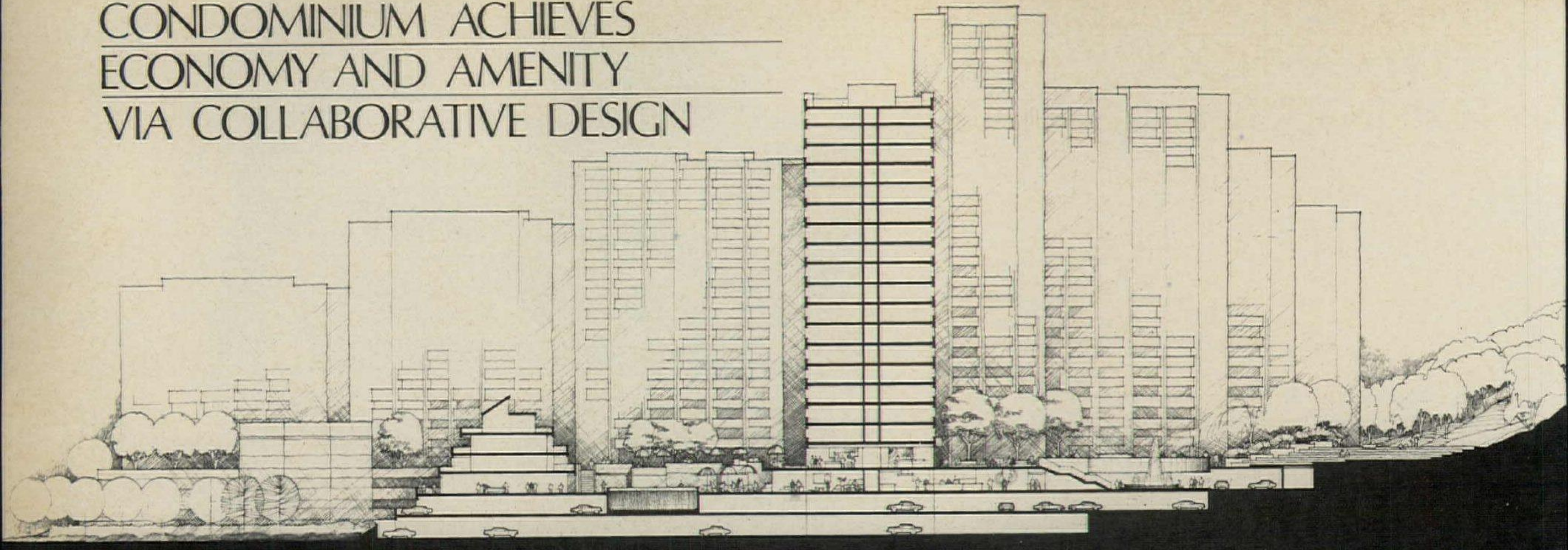




Robert E. Fischer

AUGUSTUS L. LONG LIBRARY/ HEALTH SCIENCES CENTER, New York City. Architects: *Warner Burns Toan and Lunde*. Engineers: *Weidlinger Associates* (structural); *Meyer, Strong & Jones* (mechanical/electrical). Contractor: *Tishman Realty and Construction Co., Inc.* (construction management).

CONDOMINIUM ACHIEVES ECONOMY AND AMENITY VIA COLLABORATIVE DESIGN



Early and continued collaborative-design input from the architect/engineer team led to economical structural and mechanical solutions for this 500-unit condominium in the East Bay area of San Francisco. Because of the future commitment to a total of 2500 units over a 10-year period, both economics and amenities had to be right for commercial success.

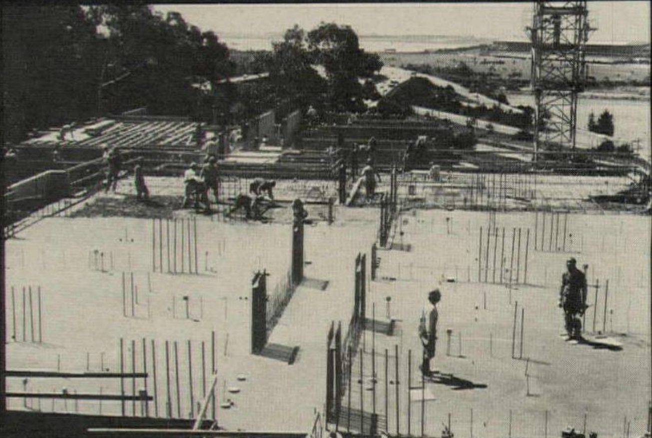
The team, led by architect Harry C. Hallenbeck, sought a form that would provide visual cohesion from start to finish of the project. His studies resulted in the profile shown at the top of the page. The towers, set atop 3-level parking structures, range from 11 to 25 stories in height.

Early structural design was critical—minimum floor-to-floor height was necessary. The structural engineer determined that most economical was the use of reinforced masonry and conventional reinforced concrete shear and bearing walls combined with lightweight-concrete, post-tensioned, flat-slab floors. Seismic code limited building height to 160 ft. Layouts had to be studied to provide advantageously located shear walls.

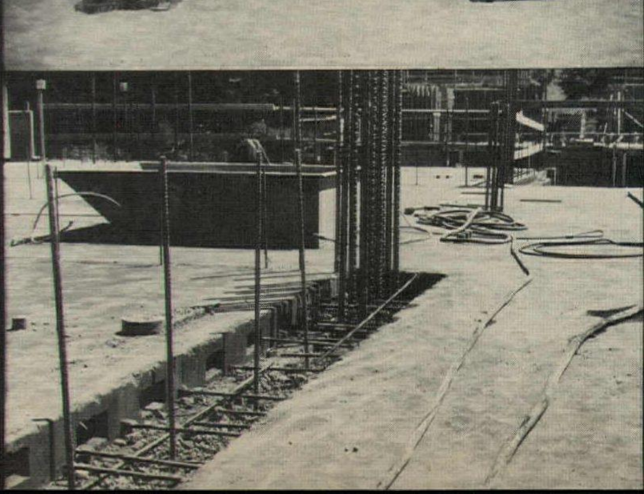
Other important structural constraints included: 1) no drop beams could be used at mechanical chases or across corridors; 2) corridor shear walls had to be separated from the floor slab during post-tensioning and "connected" later (to avoid induced stresses from slab shortening); 3) because the post-tensioned slabs were not designed to carry the exterior masonry infill walls, these had to be "hung" between exterior bearing columns, or, in some cases, to be cantilevered from one of the bearing columns (see detail).

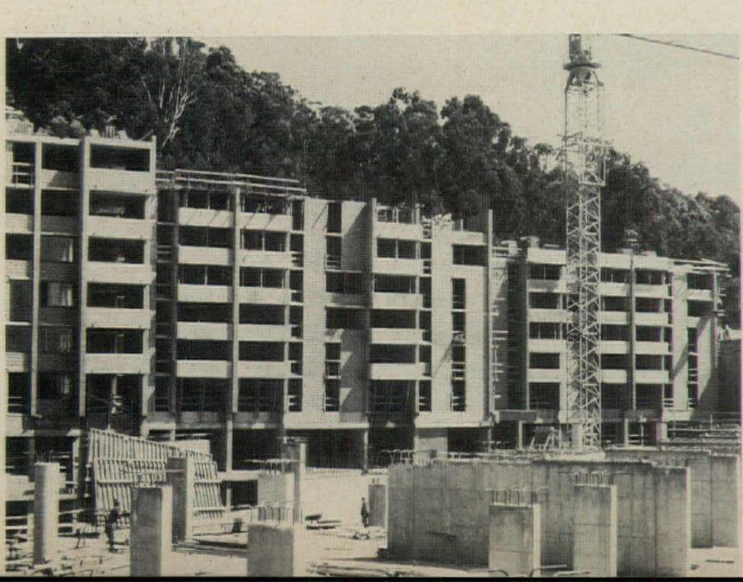
The mechanical and the electrical systems include the latest in life-safety design. The project has a code-required automatic sprinkler system throughout. Elaborate fire-alarm, voice-communication and security systems have been provided, including a computerized surveillance system.

GATEVIEW ALBANY HILL, Albany, California. Architects: *Hallenbeck, Chamorro & Lin.* Engineers: *Shapiro, Okino, Hom & Associates* (structural); *G. L. Gendler & Associates* (mechanical). Consultants: *Cooper, Clark & Associates* (soils); *Bolt, Beranek & Newman, Inc.* (acoustics); *Sasaki Walker Associates* (landscape architects).

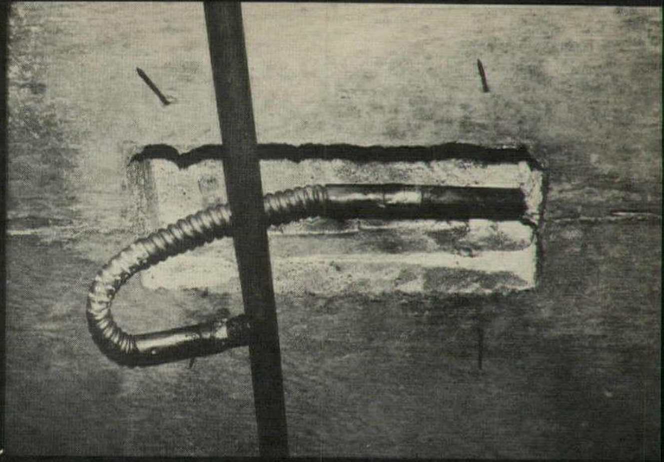


Corridor shear walls are either reinforced concrete, or concrete plus reinforced masonry. Transverse shear walls, spaced no more than 25 ft apart, are reinforced concrete masonry. Pockets, later filled in, had to be left around corridor walls until slabs were post-tensioned.

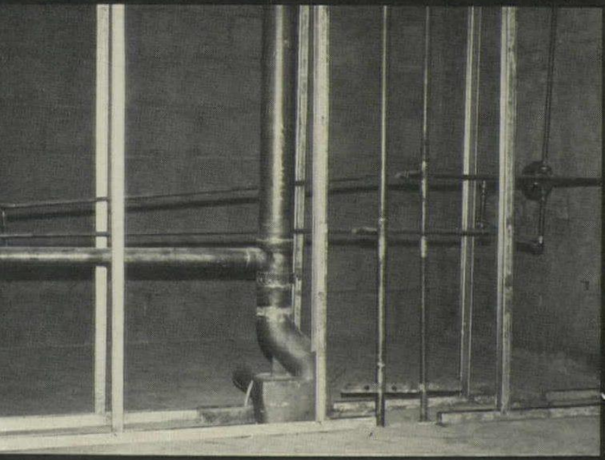




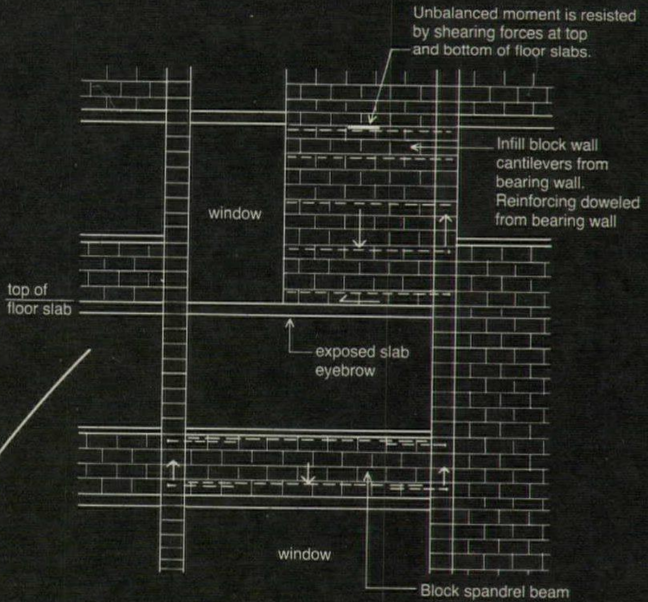
Apartments are fully sprinklered, with different-capacity heads used, depending upon area covered (see symbols on plan). The recessed heads are served by embedded piping.



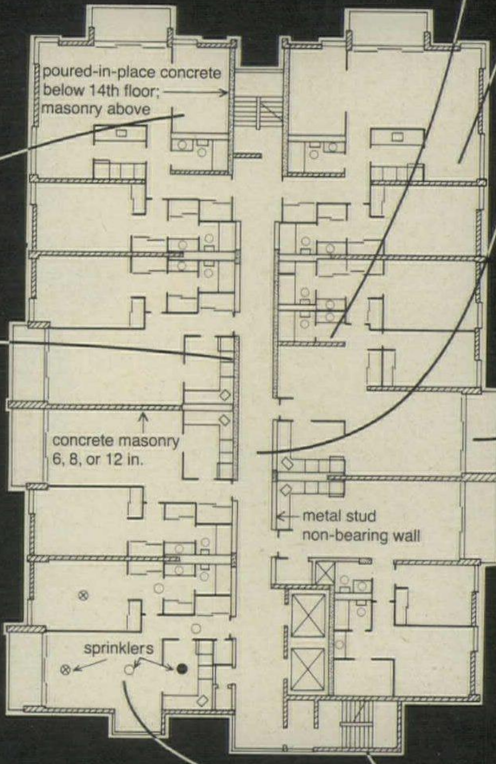
A flexible connector joins corridor header to sprinkler piping at a pocket left in the slab. A dropped ceiling conceals header.

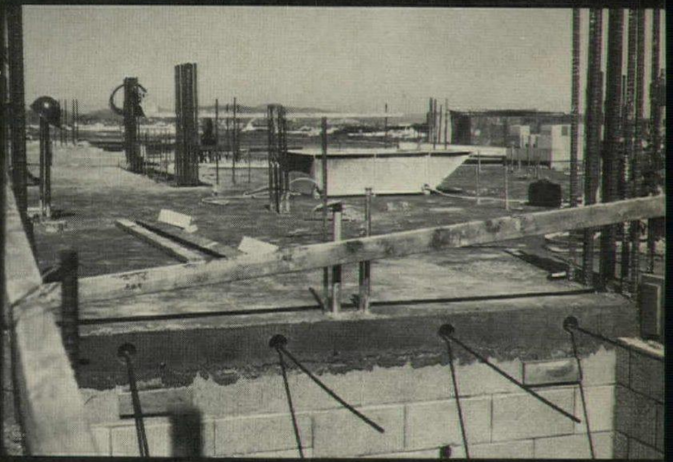


The plumbing is copper tube and pipe and incorporates the patented system that combines stack and vent in one pipe through the use of a special aerator.

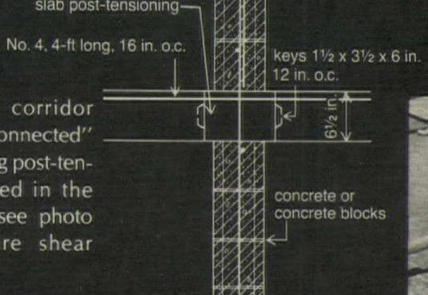


To avoid loading the prestressed slabs at the perimeter, infill masonry walls are hung between load-bearing columns, or cantilevered from one of them (above).

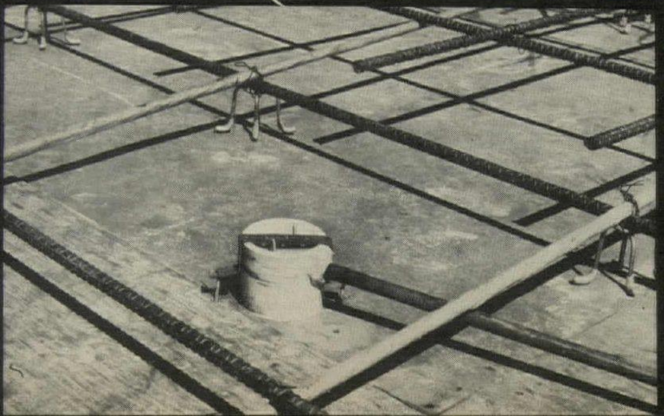




Post-tensioning allows the 6½-in. lightweight concrete slabs to span a maximum of 25 ft.

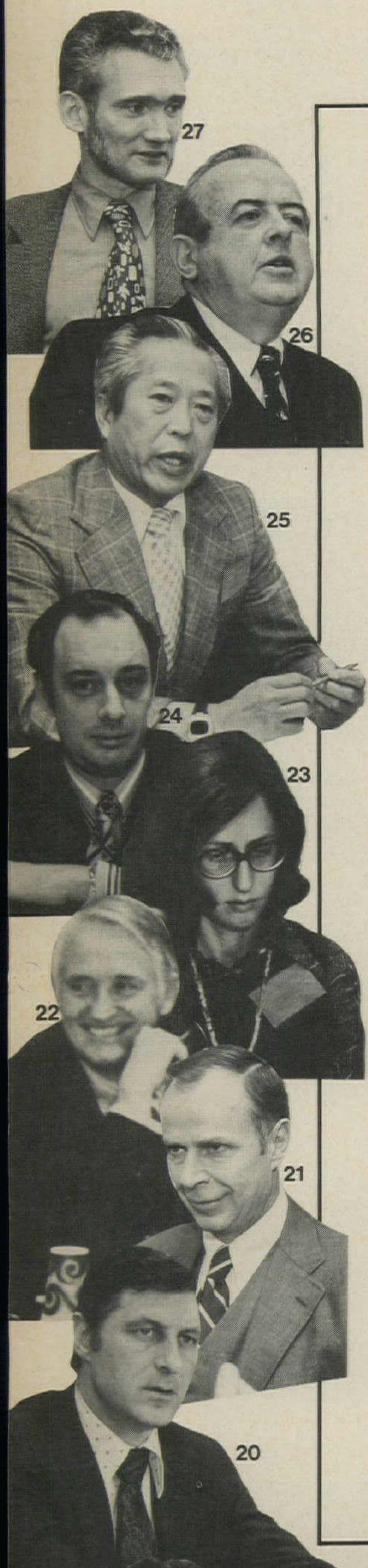


Detail shows how corridor shear walls were "connected" to floor slabs following post-tensioning. Keys formed in the edges of the slabs (see photo across page) ensure shear transfer.



The designers took advantage of the recently-lifted restriction on embedment of sprinkler piping in concrete slabs. Can forms allow recessing of the heads.

ROUND TABLE



1 **Paul Reese Achenbach**
Chief, Building Environment Division
National Bureau of Standards

2 **James Ashley**
Representing the Flat Glass Energy Conservation Committee, and special assistant to the president
Libbey-Owens-Ford Company

3 **Sheldon Cady**
Executive vice president
National Mineral Wool Insulation Association

4 **William Chapman**
President-elect of ASHRAE, and vice-president, Johnson Controls, Inc.

5 **George Clark**
Immediate past president, Illuminating Engineering Society, and Manager, Technical Liaison
GTE Sylvania

6 **Frank Coda**
Executive vice president
Illuminating Engineering Society

7 **Dr. Nina Cornell**
Research Associate
The Brookings Institution

8 **Lewis Davis**
Davis Brody & Associates, Architects

9 **Joseph Demkin**
Director of Energy Programs
American Institute of Architects

10 **Arthur W. Diemer**
President
CC&F Property Management Company

11 **Herbert Gilkey**
Director of Government and Consumer Affairs
Air-Conditioning and Refrigeration Institute

12 **Ian Grad**
Associate partner and
Assistant chief mechanical engineer
Syska & Hennessy, Inc., Engineers

13 **Paul Greiner**
Vice president
Edison Electric Institute

14 **Gerald D. Hines**
Gerald D. Hines Interests

15 **Charles R. Ince**
Associate Administrator for Building Programs
Federal Energy Administration

16 **J. Karl Justin**
O'Brien & Justin, Architects

17 **Gerald Leighton**
Director of Integrated Utility Systems
Department of Housing and Urban Development

18 **Otis M. Mader**
Representing the Construction Action Council
U. S. Chamber of Commerce, and
Vice president, corporate marketing
Aluminum Company of America

19 **Milton Meckler**
Meckler Associates,
Consulting Engineers

20 **Walter A. Meisen**
Commissioner
Public Buildings Service
General Services Administration

21 **Harvey Moger**
Vice president, Mortgage and Real Estate Department
Connecticut General Life Insurance Co.

22 **C. E. Peck**
Representing the NBS Statutory Visiting Committee, and Group vice president, Construction Group
Owens-Corning Fiberglas Corporation

23 **Dr. Maxine Savitz**
Director for Buildings Policy Research
Federal Energy Administration

24 **Lawrence G. Spielvogel**
Lawrence G. Spielvogel, Inc.
Consulting Engineers

25 **William Tao**
William Tao & Associates
Consulting Engineers

26 **Robert G. Werden**
Robert G. Werden & Associates, Inc.
Consulting Engineers

27 **Dr. Richard N. Wright, Director**
Center for Building Technology,
Institute for Applied Technology
National Bureau of Standards

For ARCHITECTURAL RECORD:
Walter F. Wagner, Jr.
Robert E. Fischer
Grace M. Anderson

TOWARD A RATIONAL POLICY FOR ENERGY USE IN BUILDINGS

There is just no doubt that we have the cost-effective technology to reduce energy consumption in both new and existing buildings by a third, or maybe even a half. So why don't we get on with it? Why can't we set reasonable goals and establish policies for energy conservation in building that spread the costs and sacrifices and effort evenly across the industry—and get on with it?

It does take acceptance that the era of profligacy is over. Only then will it be possible for buildings to be designed within the new economic framework required. It does take redefinition (but not reduction) of the quality of building environments. Most importantly, it does take incentives—with everyone abiding by rules applying equitably to all—so that owners will ask architects and engineers to design buildings that operate more efficiently. To discuss this . . . RECORD invited to the Round Table (see listing opposite) some of the top government officials concerned with energy conservation, officers of professional societies, top executives from manufacturers and industry trade associations most affected, architects and engineers with long histories of expertise and concern in this area; knowledgeable developers, owners and lenders—in short, the people who have been developing policies, and the people who are going to live with them.

There was, in the day-long discussion, no opposition to the idea of conservation—indeed the sense of urgency was emphasized. There were thoughtful disagreements, however, over whether we need standards—whether economics of the marketplace, or a system of tax penalties, or a whole new utility organization (see AIA's proposal, next pages) might not be more effective. There were thoughtful disagreements over—if we do have standards—what kind of standard would work best; and good discussions (see next pages) of the merits and shortcomings of the major standards proposals—ASHRAE 90P and GSA's "55,000" budget.

What is "the best way?" The Round Table did not reach a consensus. RECORD editors Wagner and Fischer, who co-moderated, reached this conclusion: Economics alone will not assure the level of energy-saving required. So we feel that standards are needed—to raise the consciousness of designers and owners and to set goals however imperfectly. Our feeling is that the best course would be to accept 90P—even though it does not assure economical operation—on the clear understanding that it is an interim standard—to be revised as soon as possible in the direction of an energy-usage budget approach as data, experience and knowledge is built up.

That's one opinion. We hope, after reading this report on the Round Table, you will find a point of view you can work with. For whatever the method of getting on with energy conservation, surely we must get on with it.—*W.W.*

Do we really need standards? While many were opposed either on principle or because they could not see them working effectively, there was a surprising amount of support for standards

It is probably not an oversimplification to say that some of the architects and some of the owners at the Round Table favor standards for one simple competitive reason: They would put everyone at the same starting point, playing by the same rules. Unspoken, but fairly clear was the idea that responsible developers—anxious to "do the right thing" in energy conservation—considered that standards might, by setting at least minimum standards, permit them to make any extra investment in time and money to build an energy-conserving building without being at a competitive disadvantage with "minimum-cost, minimum quality" developers with no long-term commitment.

Architect Lew Davis spoke of "liking standards" from a strongly philosophical point of view: "How much energy does this country have, and how are we going to distribute the energy? That is the basic question. . . . What we need as architects is input. If there is an energy shortage, I would like to know exactly what is expected of me. If we were told to use so much energy per square foot, I think we could work to that and design a building. Then we could learn (within the constraints) to produce beautiful and vigorous buildings. And then the public would become conditioned to that type of building.

"Energy conservation can affect architecture—and it can affect architecture in a very positive way."

Gerry Leighton of HUD argued the need for standards this way: "We are a capacity-limited society. We cannot continue to build power plants forever. We do not have the fuel supply, or the air supply or water supply for expansion without control. . . . The building industry is one major user of our existing energy supply. Should the Feds set up a major organization to inspect and control every system? Should we go to voluntary standards? Should we find a way to make standards mandatory and yet work through the existing code mechanisms, already well understood by designers and builders? [Others did argue that code-enforcement officials might have trouble.] We elected the latter. . . . The legislation we have proposed calls upon the Federal government to promulgate the standards; and for the states to adopt and enforce them." Present directions are for the government first to establish component standards—with ASHRAE 90P (see later sections) as the probable standard for adoption. Establishment of performance standards would come as a second step—with a two-year timetable."

Wally Meisen, Commissioner of the Public Buildings Service, spoke with typical directness: "The whole purpose of the GSA 'standard' [described in detail later] is simply to set a goal. If you go above that, then you ought to be able to explain why it is necessary in that particular installation. One problem we have with prescriptive standards is that they may not lead you in the most efficient way: how you orient a building may be far more important than how much insulation you have or the relative areas of glass and solid.

"The most important thing is for all of us to get involved with some kind of measure of how we're going, of measuring relative efficiency. We have to get away from the idea that just because we can afford the energy, we can waste it; just because it is cheap, we can waste it."

One panelist asked the government people if they believed that any of the proposed standards could meet the government's stated objective of "saving, in the residential and commerical building sector, the equivalent of 500,000 barrels of oil per day by 1985."

Answered HUD's Leighton: "Yes." Answered FEA's Ince: "Yes."

Building owner Arthur Diemer said: "I am in sympathy with what the government is trying to do in establishing some energy usage base. I'm not sure I agree specifically with the 55,000 Btu figure . . . but I would agree with the principle, I think.

"Through BOMA (Building Owners and Managers Association) we were able to determine the total energy inputs to some 326 buildings across the country, separating buildings known to have computer installations or other heavy users of energy. The average energy input for the buildings was 122,000 Btus. That may be a somewhat simplistic approach, and we are aware that this is a very complex subject. But I think if we disseminated this information to the whole industry, just knowing what the maximums and averages and minimums are could encourage conservation. If, as a building owner, I saw that I was way above the maximum, I would call in my technical staff or an outside consultant to analyze what was going on. I would want to know what is happening, what can be done to bring consumption down, and what it would cost to make the correction. Then I could weigh the economics of doing it and take some action. If the action would reduce my operating costs by 25 cents per square foot, I would take that action."

Developer-owner Gerald Hines argued some basic economics: "In the market place, if the costs of conserving energy go beyond the point where the owner sees an economic return, he is not going to do it. We spend money on energy-saving techniques up to approximately 14 or 15 per cent internal rate of return. Past that point it is not a reasonable allocation. Under the present rules of the game, there are things you would not do unless it were required under a code. I think none of us in the marketplace are able to do much beyond what the codes are going to require; but we would live with what the code said." •

Opposition to standards was articulate and thoughtful

For example, said architect Karl Justin: "I'm suspicious of the long-term benefit of controls or legislative standards. There is a tendency of inflexibility, and a tendency to get the wrong effect. Minimum Property Standards were intended to raise quality to a certain level—but they act to hold quality down to that level. Standards of energy usage could act to make acceptable a level higher than is needed."

Said engineer Ian Grad: "I am opposed to any kind of government regulation by fiat or direct standard, be it a performance standard or a prescriptive standard. I think standards are great if they are *guidelines* to show people the direction to go on a voluntary basis. The only kind of motivation that works in the long run is economic—penalties, and incentives . . . .

"Standards are good in protecting the public safety, and that is their traditional role. But I think that anything that limits the design freedom and ingenuity of a design professional—architect or engineer—is wrong. If you give him a direction to go in, a goal to reach, and some economic incentive to get there, that is as far as we ought to go."

And said building owner-manager Arthur Diemer: "It seems to me there has to be some form of incentive to encourage a building owner to take conservation measures. Sometimes operating-cost savings are enough. But tax incentives or low-interest loans on retrofitting may be needed. I would prefer this approach to mandatory standards. Certainly it is to our advantage to operate our buildings as economically as possible, because we are competitors and we want to be able to offer a lower rental rate than the fellow down the street." •

ASHRAE 90P—the standard now closest to adoption, and much criticized before as a prescriptive standard—came in for much less criticism than expected. In fact it started sounding pretty good to many. . .

ASHRAE 90P has been in the works for about two years. Briefly: In 1973, NCSBCS (National Conference of States on Building Codes and Standards) requested the National Bureau of Standards to develop a document which could be used as a basis for state codes. NBS did—with a great deal of professional and industry input—produce a draft proposal in February 1974.

ASHRAE, early in 1974, took over this document and began revising it through the consensus process toward a national consensus standard—which is what NCSBCS needs. There have since then been three broad reviews. And since the Round Table (on June 26th) the 122-man ASHRAE 90P committee voted 107-5 to approve Sections 1 through 11 of the standard—those sections dealing with building design and equipment for conservation. ASHRAE'S standards committee then voted unanimously for 90P, and board of director approval is assured. (Section 12—establishing methods for evaluating energy use at its source rather than at the building line—will be re-studied and re-reviewed in view of criticism that this final section could discriminate against some forms of energy unless properly formulated.)

Commenting on 90P, Reese Achenbach of NBS began with two points:

"I would like to say rather positively that we do not regard either the document we prepared or 90P as a prescriptive standard. True, it has some prescriptive requirements in it, but for the most part it can accurately be described as a component performance standard.

"There are certainly two aspects of 90P which are important: What you do with the building envelope, and what you do with the system or systems inside. My observation is that 90P as presently drafted places more emphasis on upgrading the envelope of the building than on upgrading the systems, and I think continued effort is needed to take advantage of the opportunity for energy conservation within the building."

Bill Chapman, president-elect of ASHRAE added: "Our hope is that our work on 90P would forestall a rush into a series of local codes that might be less well thought out. We recognized that with the ASHRAE committee approach there would be compromises; but I think after the thousands of hours of discussion and review 90P can be considered a consensus.

"We certainly recognized the need for flexibility. We certainly realize that there will have to be changes. Some codes do tend to be cast in concrete, but that isn't the fault of the code—it is the fault of the body keeping it there. As we understand the technology better, we can upgrade 90P and improve it. Engineers have known for years that our present design considerations based on steady state equilibriums are overly conservative. With computers, we can begin to think of running transient analyses—though that will be a tremendous effort. But 90P will be a good start."

Manufacturer George Clark, past president of IES (the Illuminating Engineering Society) made the point that under the lighting section of 90P "we do have the opportunity to explore new technologies and new design concepts. 90P is not prescriptive in that sense . . . . There is no limit on doing better. We need to consider usage vs. design load; for we should be building for flexibility and not designing out of the system the possibility for flexible use and improvement to cut first costs, or because we don't know how to write flexibility into a code. Further, we should be careful not to trade off in the name of energy conservation other things like productivity. The emphasis should continue on the practices and uses that we can all agree are wasteful, and to not go beyond what is necessary in terms of usages which are beneficial in terms of productivity. We must not set a limit on what is good enough."

Other comments on 90P show the growing conviction that 90P will work:

Frank Coda of IES: "Our objective was to provide the engineer and architect with guidelines on which he could build an energy-efficient system, without being prescriptive in the end analysis. We feel we've done this. . . . And we think we have worked out a procedure to make the standard completely understandable."

Sheldon Cady of the National Mineral Wool Insulation Association: "90P ends up as a rather sophisticated component standard approach. We think it is highly satisfactory and we think it will work. And we are willing to look at it again in a year and see if it needs changing."

The summary reached after the Round Table by co-moderators Bob Fischer and Walter Wagner and reported in June RECORD: "ASHRAE 90P, frequently criticized as a prescriptive standard, does, it now seems clear, have some of the flexibilities of a 'budgetary' or performance standard built in. The lighting section is indeed performance-based. The skin section—while prescriptive with respect to U-factor and solar gain—does permit substitutions resulting in the same total as the U's; though the process for demonstrating equivalency does seem complicated. But 90P does ignore two important factors: 1) ventilation load (too big a load to be ignored) and 2) the huge variations in load resulting from inefficient operation or maintenance of our buildings. . . . Without being too sure about it, I [Wagner writing] think the best thing would be to accept 90P on the clear understanding that it is an interim standard to be revised—as soon as we know how—in the direction of an energy-usage budget." •

The alternate—or perhaps the successor to 90P—is the budget approach. A lot of panelists were for that approach —but there was general agreement we don't quite know how to do it

After the Round Table, again in the summary written for the June issue, Fischer and Wagner wrote: "A budget approach based on actual measured use of energy put into the building does take into account (and give credit to) efficient operation of a building, to efforts at heat recovery, and it does of course give the free trade-off of design options. . . . But there are three big questions: 1) What's the budget—55,000? . . . Wally Meisen agreed at the Round Table that 55,000 was at least semi-negotiable even for Federal office buildings [see below]. Question 2) What about budgets for other building types? Question 3) What about changes in energy usage caused by non-design factors—like a major change in occupancy, a major computer installation, or the fact of a very cold winter or a very hot summer?"

At the Round Table, engineer Larry Spielvogel opened the conversation on budgets by talking about some of the principles: "There are two kinds of budgets—one is the 'power budget' which limits the installed capacity of the systems and equipment in the building. [The power budget—based on calculations of connected load—was briefly discussed at the Round Table, but there did not seem to be much interested enthusiasm.] The other type of budget is the annual use budget—measured either in Btus/year or kilowatt hours. One of the great advantages of the energy-use budget is that it permits a great deal of flexibility; it offers a full range of design options. . . .

"But there are two philosophical questions: Doesn't it permit a great deal of buck-passing? And what would be the incentive to keep eliminating inefficient sys-

The engineers at the Round Table brought up a number of significant concerns about implementing any budget approach

tems once the budget had been met? Wouldn't it be better if you made everything efficient?"

Early in the conversation on energy-usage budgets, engineer Spielvogel brought up the fundamental weakness (at least for the present time) of the budget for energy: We don't know enough to set good standards.

"There is a great lack of data that is really meaningful, because there are so many things that go on in a building. Our buildings today are so incredibly complicated that just to meter the various uses of energy would create an enormous economic and technical problem, even forgetting the changes that inevitably take place. How do you take into account complications like computer rooms; or buildings that are partially owner-occupied and partially tenant-occupied? What happens when you go to two shifts in the building, or work six days a week, or want to move into a building that is already energy-intensive a small energy-intensive research lab? The way people use buildings is really a key in determining how much energy they use. How do you penalize the people?"

Wally Meisen of the Public Buildings Service, which is probably the world's biggest client for design services—as he described the way he established the 55,000 Btu per square foot per year budget that GSA is pushing for—argued that we don't need detailed technical data: "When we first started to try and set a reasonable energy-usage budget, everyone told me we didn't have the necessary data, and we don't know how to find it. I simply asked them to come up with numbers for our existing buildings—and we got figures around 100,000 to 250,000. When I asked how much we could save, they said around 50 per cent. And I said let us set the standard at 55,000 Btu per sq ft per year.

"Everyone asked me how I knew that was right, and I told them that I didn't . . . but we would find out in a hurry.

"The intent is simply to make the people who are paying for energy aware of how much they are spending. I cannot think of a simpler way of controlling energy usage. If a private owner decides he wants to pay for a 200,000 Btu building, be our guest. But if you don't know how much you are using, the incentive for conserving is not there.

"We now think that 55,000 is reachable if you are prudent in energy use. 75,000 may not be right for retrofitting older buildings, but to challenge that you have to find out how much you are using.

"In designing for the GSA, we want you to use our whole book of guidelines, ["Energy Conservation Guidelines for Office Buildings"] are available at $2.00 per copy from Business Service Centers in GSA's 10 regions. It suggests a lot of ways to save energy and it does not prescribe a single one. If you work with them, you will get within 55,000."

Asked what happens if a designer of a government building cannot reach 55,000: "If you don't make it, you have to be able to tell us why. If there are good reasons, fine . . . ."

Asked about budgets for other building types: "On the same basis that we established 55,000 for office buildings, I think any good engineer could come up with a target for a building type—except a process industry—within two weeks."

The desirability of collecting detailed data on energy usage vs. connected load was emphasized by two panelists:

Engineer Milton Meckler: "I think we should begin detailed metering within buildings. Some years ago it was mandated in the Los Angeles Code that oscillographs be installed in buildings because the structural engineers decided they simply didn't have enough data to design. Now when we get a shake, we can measure it and measure the response in a building. I see a complete parallel in the thinking concerning energy. A lot of the projected energy usage we hear talked about is based on connected load. With metering, we could get a good idea of what the utilization is—what the real usage is. Further, it would give us information going back to the power grid—giving the utility real information on standby capacity. And it would help us get a good look at energy flow in buildings—for example, the effect of lighting as heat. What we have to look at is the whole utilization of energy—the co-incident demand vs. consumption relationships."

IES' George Clark added: "We should not set budgets which penalize future flexibility—we should not penalize putting in systems that permit flexibility. Ultimate usage is really what it is all about.

"There is a lot of criticism, for example, of uniform lighting throughout a space. But the problem is that no one can tell the design engineer where the task is going to be and who is going to do it and when. We may find we need to install over-all lighting with sufficient switching so that what we previously gained by uniform lighting can now be accomplished by flexible lighting. The alternate is a commitment to constant remodeling. Admittedly there is no guarantee that someone won't use all the available lighting all of the time—except for the energy budget." ●

Said NBS' Wright: "One is the problem of laboratory or professional accreditation. How do you certify certain professionals or laboratories as being competent to determine prior to construction and occupancy that the energy budget has been met?"

Another question was whether and to what extent we should conserve energy beyond the cost-effective point. Larry Spielvogel suggested, "If a plain vanilla office building might ordinarily come in at 200,000 Btus per sq ft per year; application of 90P might bring it down to 90,000. If a design professional were further charged with designing cost-effective savings beyond the requirements of 90P, he might well get the building down to 60,000 or 70,000. If he had the charge to incorporate those things which would reduce usage further—but were not cost-effective—you might bring the figure down to 40,000 or 50,000 Btus."

NBS's Wright said at once: "90P is not an over-economic standard. It does not limit energy use to uneconomical levels."

On energy-usage budget levels, engineer Ian Grad thought Wally Meisen's 55,000 was not economic: "I'd say 68,000 to 80,000 Btus per sq ft per year is reasonable energy consumption. That is an easily achievable level with existing technology. . . ."

"If we are going to have an effective standard, it will be a tremendous amount of work to allow for all of the variations that can affect a building. You have to have a range of operation . . . You cannot have a fixed number. It has to vary with usage, with the part of the country in which the building is located, with climatic conditions, and so on and on.

"We may someday reach the point where we are rationing energy. . . . But until we get to that stage we have to have some kind of reasonable economic balance between what it costs to do something and how much energy it saves." ●

The AIA believes that a very different approach —a new kind of responsibility and a new kind of capital flow— would save far more energy than any of the proposed standards

Joe Demkin of the AIA staff spoke of AIA's very different approach to policy setting:

"When we started looking at what constitutes energy efficiency in buildings we wove a lot of things into that definition. Part of that definition was not only to reduce the waste, but also apply—to the degree possible under economic trade-offs—any kind of system that would recycle or utilize regenerative forms of energy. We included an array of not only physical techniques, but design techniques and methodologies. Using this whole array, we figured that under current technology a 30 per cent saving in existing structures is a feasible target; and on new structures we estimated that a 60 per cent saving is a possibility. Taking those two figures and aggregating the number of buildings that would be replaced and constructed up through 1990, we can talk about a much bigger saving than the government equivalent figure of 500,000 barrels of oil per day by 1985.

"We ran a financial analysis to show how much capital and how much money would be spent in wasting energy. What that really showed was a possible saving of 12½ million barrels of oil per day. If you run out how much capital that would be required to build the necessary centralized generating capacity to meet that equivalent if we don't save it, you are talking about big numbers—you are talking in terms like $415 billion in current dollars between now and 1990.

"The choice we see is spending huge sums on new generating capacity to produce energy that will continue to be wasted at the present rate; or spending much less than that on far more efficient buildings using a decentralized technology. That is going to take some hard decisions which have not yet been made."

The AIA has, of course, made a detailed and careful study of the energy situation, and the work of its task force, headed by Leo A. Daly, has been published and widely disseminated ("A Nation of Energy Efficient Buildings by 1990" available from AIA). But at the Round Table, Joe Demkin explained clearly AIA's bold proposal for using the money (or more precisely, the capital) that would be saved by its proposal:

"The utilities, as we all know, have a capital problem and they also have a resource problem. The AIA proposed that the utilities take over the whole energy system—in effect, become a new kind of energy utility. Specifically:

"Right now, the utilities' responsibility ends at the building line. Suppose, like the telephone company, they took over the whole system. Suppose they came into buildings or groups of buildings—with whatever engineers were needed—and by retrofitting, perhaps more extensively than an owner would under present economic incentives, reduced the energy consumption of the building. Their incentive: a big share of the savings. It might work like this:

"Suppose a building owner were using 100 units of energy and paying $100 for it. The utility would come in and retrofit the building so that it used only half as much energy. The next month the building uses only 50 units of energy. If the owner had done the retrofitting himself, he would pay only $50. But he did not put up the capital; the utility did. So the utility charges him $90—giving the owner some benefit. The utility gives itself a $10 profit and plows the remaining $30 in savings back in the [retrofitting] system. In short, the utility would be creating capital for itself."

"And that seems to us," concluded Demkin, "to be a system which creates, as the economists would say, a demand-pull rather than a push on everyone in the industry." •

The economist invited to the Round Table to discuss the role of taxation as an alternate to standards made a telling and evocative argument

Said Dr. Nina Cornell, Brookings Institution economist: "One of the interesting things about the energy situation is how little is known about what the future will hold. So I tend to prefer the tax alternative because it encourages more flexibility." Dr. Cornell argued that since we should never be convinced that today's techniques are the best of all possible techniques, standards are unnecessarily inflexible and hard to change; whereas tax policy can be changed overnight. Further, "Standards have a tendency to over-run economic justification, whereas a tax system of conservation does not have that effect."

Late in the Round Table, Dr. Cornell set a model:

"Set up a Btu tax by deciding what the average energy usage that you want to achieve in each type of building is. If you own a commercial building and the standard is set at 55,000 Btu per sq ft, the tax on 55,000 Btu per sq foot of your building is rebated to you. If you have used more, you lose the tax on all energy you used above that level; if you used less, you have gained.

"You can do the same thing on residential construction and industrial construction. You can have a non-profit section to take care of schools and hospitals. This would be a more efficient system . . . The more I listen to the complexities of energy budgeting with standards and advance certification and inspections to monitor compliance the more nightmarish it sounds.

"I don't think you would have anywhere near the same kind of problems deciding what the rebate level is going to be as you would in setting a standard—because you don't have to go through the same legal justification as you do with a standard. You know that if a standard is set that cannot be met, it is going to court; whereas a tax rebate can be set at any level—if need be, set arbitrarily. It can be set just to balance the budget; and if it proves wrong, it can be changed quickly."

Criticisms of this system, much excerpted:

Gerry Leighton of HUD: "In order to take a tax, and give it back, we have to establish a standard anyway. And we will then have to develop a bureaucracy to administer the tax—Internal Revenue instead of HUD. Further, the tax system is nothing more than a modification of life-cycle costing—which may not be energy-conserving."

And Mr. Leighton raised this point: "Under a taxation system you remain free to waste energy if you are willing to pay for it—waste it on the assumption that the energy will somehow be available. And that is a massive assumption. I don't think that because someone is willing to pay he can use all he wants, is the goal we should set for the country."

And Engineer Meckler: "Here we are thinking about what we pay at the meter—but what we really should be thinking about is the resource. Then you are reminded that in some places schools have had to close to keep jobs going—and that is something that limits the elasticity of usage. The tax mode—unless clearly identified with the process—may not have sufficient impact."

Near the conclusion of the Round Table, Dr. Cornell said: "I remain unconvinced that standards are the right way to go, and I remain unconvinced because experience in pollution and other fields has shown us it is not the right way to go." •

Panelists representing the manufacturers and producers understand their stake and their commitment to conservation is well established. For example . . .

Said Herb Gilkey of ARI: "Manufacturers recognize that standards like 90P could change the way they design and build products, and even result in changes in product mix. This may not result because of energy usage of individual products, but from the mechanical engineer choosing a different system because of energy considerations. Most of the manufacturers can, of course, design more efficient equipment; but they feel quite strongly, and I think rightfully, that while they have the responsibility to provide equipment that is as efficient as possible in using energy, the real key to the consumption of the system is the engineer's design, the contractor's installation, and the care with which owners or occupants operate that system."

Manufacturer Otis Mader, representing the Construction Action Council at the Round Table, reinforced the sense of concern by the manufacturers in the industry: "I think it is fair for me to say from the supplier's side of the building community, that the strongest possible incentive to energy conservation is to demonstrate the economic advisability of energy conservation. If it can be shown that adopting energy conservation techniques is good business, those techniques will be implemented much faster than they would under any standard. . . .

"The first incentive we would like to see is the setting of goals, the setting of objectives; along with an intelligent explanation of why they are required. We may need to get into incentives with dollar signs on them—tax concessions—and that would be our second-level preference.

"The third level of incentive is 'thou shalt' or 'thou shalt not' legislation—standards. Given a choice between prescriptive and performance standards, we would opt for performance standards. . . .

"The system needs to be kept as simple as it can possibly be, in order to keep the enforcement mechanisms small." ●

There were timely reminders that building operation is critical to conservation

Said PBS' Meisen: "One of the biggest problems is what we have taught people to expect. We have told them that they should have 74 degrees and 50 per cent relative humidity and at least 75 foot-candles of good quality non-glare light. I think we should remember that people are not instruments—I have always said that 74 degrees is where half the people are too hot and half are too cold . . . In the interests of conservation, we have to start looking at what we believe is a mandatory environment for people—and see if it can be changed."

Quality of life was raised as a consideration: Said ASHRAE's Bill Chapman, "Energy conservation will not necessarily optimize the use of energy. We could drop energy usage by going around unscrewing the light bulbs and relating the indoor temperature to the outdoor temperature and by piling on sweaters and overcoats—but this would not necessarily be the optimal use of energy."

Added IES' Clark: "It seems to me we ought to minimize imposing values; and let values be established by the owner-operator-designer of the building within whatever framework is established. . . ."

On building operation, the point was clear—we need simply to get on with more efficient operation. Ian Grad commented: "We are I think pre-occupied with the building envelope. You can design the most energy-efficient building, and it can all go down the drain because the operator does not maintain and control his equipment. . . . That's why I feel that the only solution is to measure the end result—the consumption of energy by a building for its operation on an annual basis." ●

Near the close of the Round Table, there was some thoughtful analysis of the true imperatives of energy conservation—the intellectual alternate to standards

Architect Lew Davis started the discussion with a quite moving comment: "If by some miracle I get back to my office and find that a new client exists, what will be the imperatives in conserving energy?

"We've heard about the problems and questions related to standards. There does not seem to be much consumer pressure, even though all costs are passed on the consumer. As long as the consumer is prepared to pay, there is no imperative there.

"Unless this country, or the informed government people, are prepared to say that our fossil fuels are vanishing, or there is another over-riding imperative, the only people who are going to be concerned are the good guys.

"Perhaps what has to happen now is what happened when we discovered the flying buttress; or when we got into steel. Once we had steel, we needed elevators; the elevator made the skyscraper possible. We have evolved a very beautiful product—but it is based upon structural achievement rather than mechanical achievement. We may now have to come up with a new style of architecture with different systems. . . .

"I think it could be an exciting time. We are presented with a real challenge; and I don't think the excitement and the challenge will necessarily mean more money for the user. I don't think it is going to cost more money to produce a building that uses less energy, but it is going to take a little time. It is going to take time for us architects and our engineers to understand what all our options are, for the user to understand them, and for the construction trades to absorb the new rules. But working with the consulting engineers, architects can produce the new forms."

Architect Karl Justin added: "While I spoke earlier in a highly negative way about standards, the truth is that if you did not have goals, you would have to create them for yourself. I don't think there is a 90P way or a non-90P way—there may be a smart way and a stupid way.

"Standards are probably a necessity—you cannot operate millions of square feet of building without some sort of supervisory standard or yardstick. I think what many of us are concerned about—having lived with things like urban renewal and OSHA and a certain amount of legislative over-kill—is applications of government power going beyond the requirements. . . . After a long period of unpardonable negligence we seem to be in a period of near-hysteria about energy. The negligence is unpardonable—we had a conference in 1971 [RECORD January 1972] on this same subject. But I would suggest the hysteria is probably unwarranted also.

"Some years ago, when we started to pay a lot of attention to advanced technologies, one of my designers asked me: 'Does that mean we cannot design anymore?' I said 'No. This is where design begins.'

"All we need to do is start with the facts . . . with a foundation in reality; and we can solve the problems of energy use in buildings." ●

These building-industry manufacturers and others audited the Round Table:

William J. Birch
Flat Glass Marketing Assn.

E. H. R. Blitzer
Lightolier Incorporated

Willard S. Cahill
General Electric Company

Mario J. Catani
Portland Cement Association

P. T. Coffin
Alcoa

Robert T. Dorsey
General Electric Company

George E. Drake, AIA
Sweet's Division
McGraw-Hill Information
Systems Company

Neal English
International Masonry Institute

C. A. Ernst
Armco Steel Corporation

Sidney Freedman
Architectural Precast Division
Prestressed Concrete Institute

Richard S. Funk
Grefco, Inc.

William E. Geidt
Inryco, Inc.

Thomas P. Giannetti
Scolite International Corp.

David Gogol
Energy Projects
National League of Cities
U.S. Conference of Mayors

Arthur S. Goldman
Arthur Sworn Goldman
& Assocs.

Eugene Gorzelnik
Electrical World

Ed Haggarty
Architectural Aluminum
Manufacturers Association

A. Risher Hall
C-E Glass Division
Combustion Engineering, Inc.

Frederic B. Hall, III
Control Systems Division
Robertshaw Controls Company

Charles Harris
ASG Industries

Harry R. Henke
Culligan USA

Frank W. Hetman
DeVAC, Inc.

Ernest D. Hunter
United States Steel Corp.

John Kemendo, Jr.
Naturalite, Inc.

Phil Kosch
ITT Reznor

Sheldon Licht
Federal Energy
Administration

Jack A. Marshall
Communications Division
Honeywell, Inc.

Robert W. McKinley
Technical Services
PPG Industries, Inc.

James H. Mitchell, Jr.
Kawneer Company, Inc.

William H. Morgan
Ethyl Corp.

Paul O'Neill
General Electric Company

Frederic L. Purtill
Architectural Products Division
Owens-Corning Fiberglas Corp.

Joseph M. Querner
Dunham-Bush Inc.

William M. Rogers
General Electric Company

Jack Schwellenbach
Real Estate Division
Walt Disney Productions

William C. Schwingen
GAF Corporation

Marvin K. Snyder
Butler Manufacturing Company

Roger D. Spencer
Glass Division
PPG Industries, Inc.

Richard L. Stafford
Moldcast Lighting Division
Weil-McLain Co. Inc.

George R. Stoltz
Aluminum Division
Anaconda

Robert V. Vanasse
Solar Division
International Harvester Co.

John Volker
Flat Glass Marketing Assn.

Vincent M. Waropay
United States Gypsum

Ron L. Warwick
Amarlite Division
Anaconda

Robert L. White
National Electrical Contractors
Association

Donald R. Willis
Rohm & Haas Company

R. A. Zimmerman
Westinghouse Electric Corp.

Dr. Solomon Zwerdling
Director of
Solar Energy Programs
Argonne National Laboratory

John Ashworth photos

KKBNA: ENGINEERING PRACTICED WITH ZEST

For last year's engineering issue, three impressive and diverse buildings were submitted by KKBNA, a Denver firm of structural engineers, or by their architect-clients. (We published all three.) This year, we got three more—again impressive, again diverse. In the course of reportorial conversations, the editors were also struck by the energy and perceptiveness seemingly common to all members of the firm, and by their unmistakable enthusiasm for their work. Our curiosity prompted us to ask Margaret Gaskie, an engineer by training and a former RECORD editor now working in Denver, to interview the firm's partners and associates, and some of their clients, to find out what accounts for the high quality of their work—and just why they have so much fun doing it.

The Denver-based consulting engineering firm of Ketchum Konkel Barrett Nickel Austin, with its New York affiliate Ketchum Barrett Nickel Austin/Besier, enjoys a widening reputation for sound, innovative solutions to tough structural problems.

That the reputation is earned is evident in the sampling of recent projects shown in these pages. That it is relished is evident in the partners' shoptalk, which is laced with terms like "challenging," "exciting," and, pervasively, "fun."

That it is no accident is also evident. KKBNA's fruitful collaborations with architects spring first and last from a reservoir of exceptional engineering talent. But they flow too from organizational policies and patterns well calculated to nurture that talent.

These, say its beneficiaries, are a legacy of the firm's founder, Milo S. Ketchum, who now teaches at the University of Connecticut but who continues to serve the firm as consultant, and his long-time partner, the late E. Vernon Konkel.

Michael H. Barrett, KKBNA's president, speaks of Ketchum as a teacher at heart, who saw the "practice" as just that: an ongoing effort to learn and hone skills. Believing that little learning derives from rote solutions to routine problems, Ketchum steered the firm instead toward the pioneering work in new methods, systems and products that is its stock in trade today.

Barrett is quick to point out that, for every structural tour de force, the firm engineers a dozen relatively unexceptional, and unsung, projects, adding that the firm's reputation for tackling the difficult and unusual can be a mixed blessing.

"It's discouraging," he says ruefully, "when a potential client hands a nice straightforward high-rise to another firm and tells us, 'There's nothing special about it. When I want a 500-foot free-form clear span, I'll come to you.'

"Sure we like the hard jobs, but even on ordinary jobs we have fun coming up with imaginative ways to save money, or speed construction, or do better justice to the architect's design."

Underlying KKBNA's openness to new concepts is a genuine empathy with the firm's architect-clients. The partners take pride in a cultivated ability to attune themselves to the architect's thinking and problems. And while convinced of the propriety of the architect's role as head of the design team, they do not see the role of the structural engineer as thereby reduced to "just a matter of designing connections and telling the client why he can't do what he wants to do."

Barrett likens the relationship between structure and architecture to a marriage, observing that while such elements as mechanical and electrical services can to an extent be divorced from—or appended to—the total design concept, structure and architecture are indissolubly wed.

. . . it is in the conceptual stages that the partners' time and talent yield the client the best value for cost. "A few clients have learned to get the most out of us, bringing us in early to explore all the possibilities, so the structure can really become a determinant part of the design. This, we love."

A similar analogy is drawn by long-standing KKBNA client William Muchow of Muchow Associates. "I use them for all my projects, right down to a creak in my living room floor," he says. "We work as if we were one office. . . My architecture is as much their structure as it is anything I put into it."

Such happy marriages don't just happen, however. Muchow emphasizes the value of continuity in his collaboration with KKBNA, believing that both parties gain by familiarity with the other's thought processes.

G. Cabell Childress, another self-described "old shoe" client, concurs, but inserts a practical note. At least in its work with frequent clients, he says, KKBNA encourages loose arrangements under which the firm undertakes the structural design on all of a given architect's project—large or small, simple or complex—for the same fee. "That way, if the architect really wants to go way out, KKBNA can afford to fly right along with him, and hope to make up any extra costs on future jobs."

Childress, himself not averse to the odd creative flight, likes to bring in KKBNA "as soon as I've determined 'what wants to happen' in the building, so we can work together to make sure what happens is contained in the simplest, most direct, most economical way."

Muchow agrees: "The best architecture comes from a team relationship where we stimulate each other to think creatively about basic objectives," but emphasizes that this is a process best begun in the beginning, before key design concepts are frozen.

To which KKBNA would add a hearty amen, pointing out that it is in the conceptual stages that the partners' time and talent yield the client the best value for cost.

"A few clients," Barrett says, "have learned to get the most out of us, bringing us in early to explore all the possibilities, so the structure can really become a determinant part of the design. This, we love."

Even so, KKBNA gets its fair share of problems posed in the mode of "the span is 327 feet and it has to be flat," as well as frequent commissions specifying structural forms—notably thin shells and space frames—that the firm has successfully executed in the past.

The partners accept the constraints of working within such pre-established design concepts philosophically. "Depending on how good the architect is—and a lot of them have a real feel for structure—things can often be done as well as if we'd been included at the beginning. An architect like Jim Ream, who has that innate sense and collaborates to the *n*th degree, winds up designing more of the structure than we do," Barrett says. "Our job isn't to originate design, but to refine the architect's concept and make it work."

At the same time, the partners are persuaded that too rigid parameters set too soon often add needlessly to the costs of a project. "We can figure out how to do almost anything if there's enough money," Barrett comments. "But we'd rather figure out how to do something better for less."

Fee schedules being what they are, KKBNA's appetite for adventure is not without impact on the firm's own finances. Barrett tells with a certain perverse pride of a recent "challenging" project entailing three stories and thirty-nine different floor levels. "On that one, our costs were two and a half times the fee," he relates, "plus twenty years of my life." But he adds, "If our main motive were to make money, we'd none of us be engineers to start with. There are all kinds of compensations."

The firm's official posture toward the profit motive is considerably less cavalier. While insisting on the superior satisfactions of creative work, KKBNA is also at considerable pains to maintain the efficient, productive—and profitable—organization needed to produce it.

Though formally a corporation, KKBNA operates as a partnership—and sometimes, says Barrett, "more like a commune." Of a staff of sixty, eleven are partners, who share equally in decision-making, and nine more are associates or project engineers, who also have a voice in the firm's management.

The resulting ratio of one chief for every two Indians, the principals admit, is sometimes unwieldy. But it reflects their conviction that clients hire people rather than firms, and that the firm should therefore afford the people within it the fullest possible scope for action and initiative. KKBNA believes its relatively large number of relatively independent principals enables it to offer clients the best of two worlds: the personalized attention of a one-man shop, backed by the combined experience and resources of the firm as a whole.

Accordingly, every project is overseen by a principal from start to finish. On comparatively small jobs, the partner-in-charge may also act as project manager—and often project engineer and chief draftsman as well. More usually, though, the task of project manager is delegated to an associate or project engineer, with the remainder of the project team drawn as needed from a pool of engineers, junior engineers and draftsmen. In either case, the partner in charge retains full responsibility for over-all management.

Given the autonomy KKBNA partners enjoy, there is little rigid specialization within the firm. In principle, a deliberate effort is made to distribute work so that all firm members have opportunity to gain experience on a variety of project types. In practice, though, since jobs coming in do not always oblige by lending themselves to a random match with the people available to work on them, some of the firm's engineers have acquired more experience with certain types of structures than have others. And since some also have more interest in particular structures than do others, a certain amount of concentration has evolved among them.

Except in the case of the civil engineering department, however—which now accounts for some 35 to 40 per cent of the firm's business—such specialization can be attributed more to happenstance than to planning.

The flexibility KKBNA espouses in its professional functions extends also to the management of the firm, which boasts no "business" partner as such. Rather, each principal is first a practicing engineer, and secondly a proprietor with administrative responsibility for certain aspects of the firm's operations.

President Michael Barrett, for example, also has major responsibility for long-range planning and business development. Donavon Nickel, trained in business administration as well as engineering, manages personnel and finances, while David Austin handles general operations. And so through the roster of partners.

Since divisions of labor are based less on organizational logic than on the propensities and proficiencies of the several partners, KKBNA's smooth functioning is perhaps in some degree serendipitous. But it can also be credited to a shared philosophy that overrides the principals' individual differences in approach and emphasis. "We've all grown up together in the firm" Barrett explains. "We've learned to do things pretty much the same way, and we see things pretty much the same way."

Not surprisingly, in light of the import the principals place on their common heritage, KKBNA's policies toward its younger members are geared to produce similar opportunities for fruitful apprenticeship and ongoing association.

"When you get down to it, the only way to get business is to do a superlative job. We all seem to grow by taking on challenges. . . . We like to think we add to the profession by doing it—and we have our share of fun."

"Ketchum," Barrett says, "looked at the shop almost as a prep school. He'd bring guys in fresh out of school, train them in the real world for a couple of years, and then suggest they go on for more experience. Well, we feel for people to operate at maximum efficiency for the firm, they almost have to grow up with us, so now when we've got good people trained, we do our best to keep them."

KKBNA, with its long tradition of learning while doing, regards the postgraduate education of young engineers as its proper province, but is sometimes less than happy about the extent of in-office training these new engineers sometimes require.

Because many teachers, however brilliant academically, have had little practical experience, "in some cases, they just don't know whereof they speak," Barrett observes. Moreover, engineering curricula are becoming increasingly theoretical. "The kids have so little time for applied courses, they never learn what all those theories are for. When they get out, they can't design a simple beam."

On the other hand, in hiring experienced people, "Either the experience isn't quite what you want, or you can't be sure it's what you want, or it's so limited you can't tell whether the man can do anything else. With recent graduates, their capabilities are a matter of record. Because they've learned to learn, it's easier to teach them our quality standards and ways of doing things. And it doesn't take all that long—in about a year we begin to get real productive work from them."

Thus while KKBNA occasionally takes on experienced engineers "out of necessity to get the work out," its preferred practice is to train–and retain.

KKBNA's emphasis on encouraging promising engineers to "grow up in the firm" is expressed in the variety of ways by which the principals contrive to give their younger colleagues ample growing room.

Among these, the team approach to project management is significant in that it enables engineers at all levels to participate meaningfully in a variety of projects. "We don't believe," says Barrett, "in sitting a man down to grind out the same calculation for three years. We like to move people around, give them all the experience they can handle, as fast as they can handle it."

Equally valuable is the obverse: the freedom allowed any staff member with a strong bent in a given direction to ride his particular hobby as far as it will take him. "If someone has a real desire to do something, we generally encourage him—and we don't ask for an economic feasibility study first."

Finally, the latitude for professional development that the firm tries to provide is backed by an open-door policy toward advancement within the firm. Barrett's assertion that "anyone who wants it and can do it can have my job" may be overstatement, but it is not lip service. KKBNA does in fact actively encourage its outstanding engineers to share ownership in the firm—as is borne out by the multiplicity of partners.

This open-endedness in organizational structure sustains KKBNA's goal of one-to-one relationships with clients, but the accompanying top-heaviness is not without drawbacks. "You can spread profits pretty thin," says Barrett, "and we sometimes have a problem finding new opportunities for people coming up."

As a result, KKBNA makes an active effort to grow steadily—without becoming muscle-bound in the process.

For example, while the firm's first branch office in Connecticut was opened largely because KKBNA (in the persons of Milo Ketchum and Rudi Besier) hoped thereby to work with some of the outstanding architects in that area, its metamorphosis as the present New York City office was seen as a way both to amplify that goal and to afford increased scope for the firm's upcoming professionals.

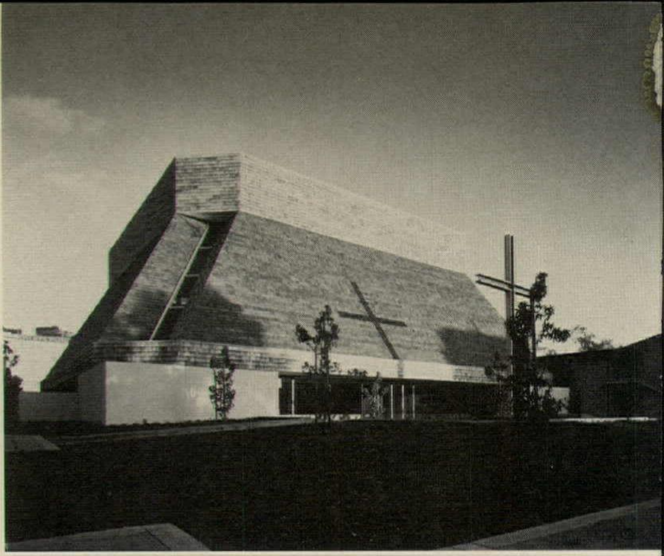
Similarly, KKBNA is now joining forces with other consultants to provide industrial engineering services on a team basis; anticipating the establishment—again with other specialist firms—of a design-build company in the mid-East; and exploring other possibilities for growth in capability.

The primary focus, however, remains on expanding KKBNA's traditional consulting practice, to which end the firm encourages all members in those pursuits—competitions, publications, teaching, professional and civic activities—which, with the standard promotional tools, add up to effective business development.

As such pursuits also contribute to the personal and professional growth of the firm's individual members, their fostering can perhaps be viewed as yet another example of KKBNA's penchant for enlightened self-interest.

"When you get down to it," Barrett sums up, "the only way to get business is to do a superlative job. We all seem to grow by taking on challenges, learning something new. We like to think we add to the profession by doing it—and we have our share of fun."

Fred Lyon photos



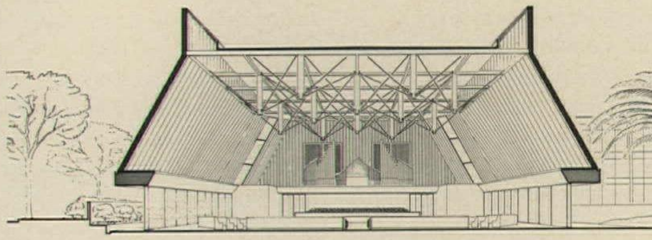
1

KKBNA AN AIRY SPACE TRUSS ROOFS A CALIFORNIA CHURCH AND AT ONE STROKE PROVIDES LIGHT, HEIGHT AND ORNAMENT

For the First Presbyterian Church in Berkeley, architect James Ream wanted a roof structure that would emphasize vertical height without overwhelming the intimate character he sought for the 670-seat sanctuary, and that would at the same time serve as a major decorative element for the room.

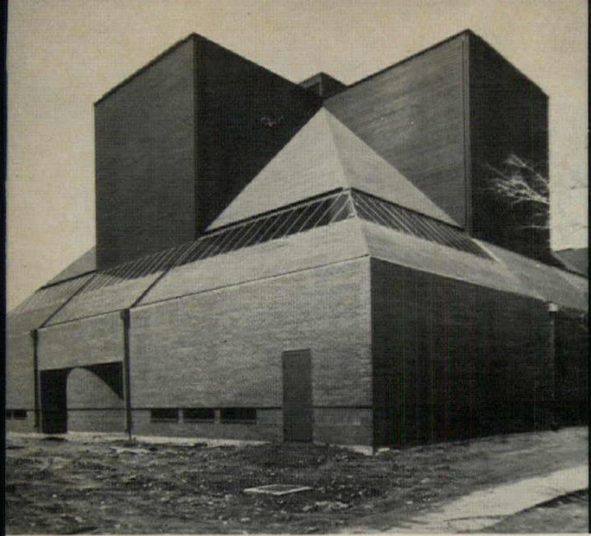
The 75-ft-square space truss that covers the sanctuary is described by the engineers as "a mesh of overlapping queen-post trusses with the bottom chords turned 45 deg to the top chords." Four steel wall trusses support the space truss around the perimeter; the wall trusses incline to extend the total roof span to 105 ft in both directions.

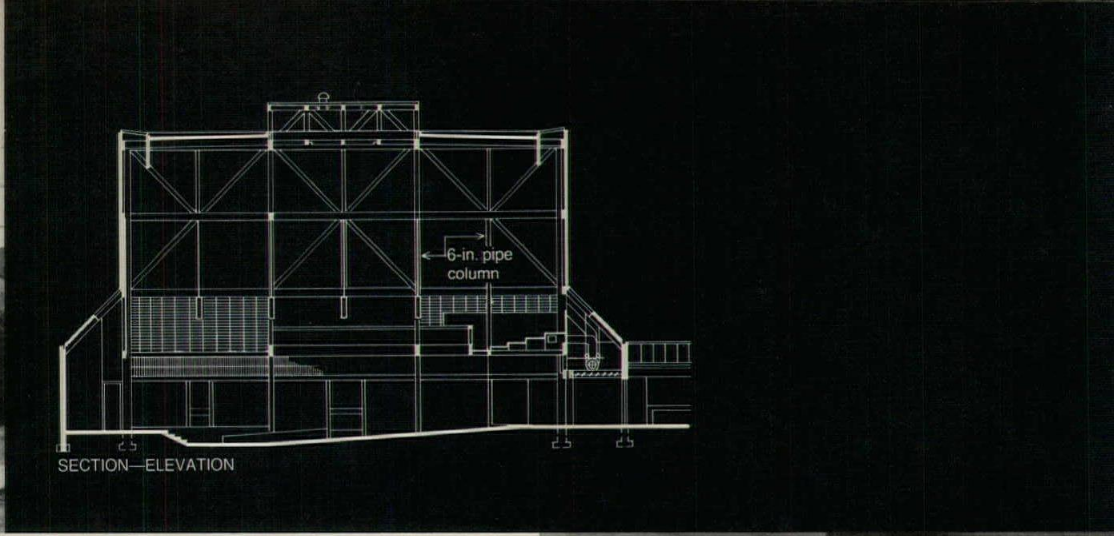
From the base of the vertical compression pipes, four tension rods, forming the bottom chord of the truss, run to the tops of adjacent compression members. These rods transfer gravity load from the center of the roof to the four steel wall trusses, and thence to the square concrete corner supports. (The oversized vertical members house lighting fixtures).



The top chord of the truss is a grid of wide-flange sections, made continuous to resist vertical seismic force. The metal-deck roof diaphragm and diagonal corner beams transfer horizontal seismic forces to the corner supports via the wall trusses. Acoustical, rather than structural, needs determined the pyramidal shape of the ceiling panels.

FIRST PRESBYTERIAN CHURCH OF BERKELEY, California. Architects: *James Ream and Associates, Inc.*, Engineers: *KKBNA* (structural); *G. M. Simonson and T. R. Simonson Consulting Engineers* (mechanical/electrical). Contractor: *C. Overaa & Company.*





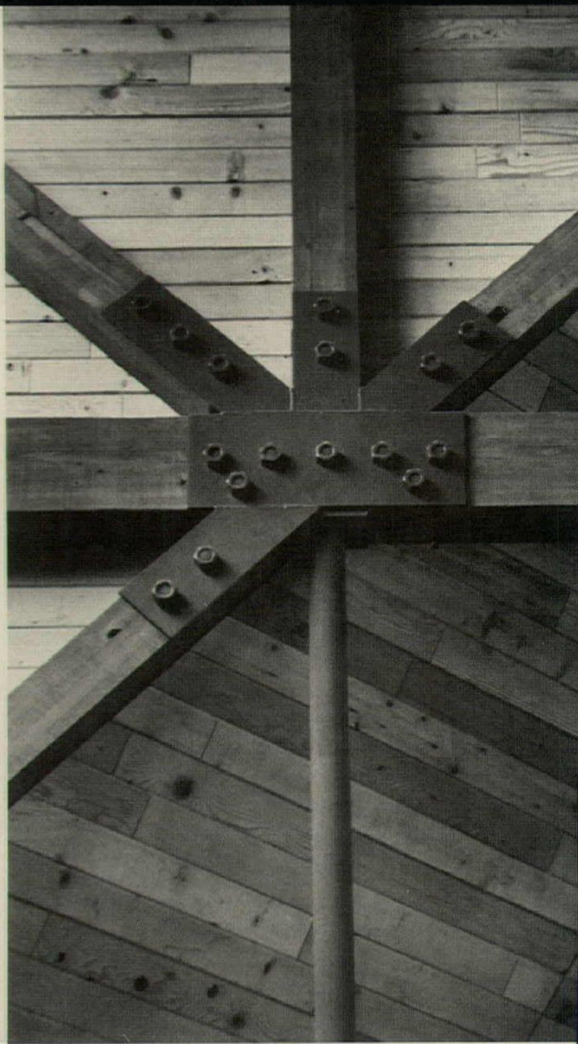
2 KKBNA RUGGED TRUSSES DEFINE THE SANCTUARY OF A CRUCIFORM CHURCH IN THE ROCKY MOUNTAINS

The wood trusses at the First Presbyterian Church of Boulder, Colorado, represent something of an architectural about-face: the original scheme, which exceeded budget, was for a cast-in-place concrete structure with beams spanning 72 ft on each side. What eventually emerged from a series of conferences, models and design studies undertaken by architect William Muchow and structural engineers KKBNA is an exposed laminated wood-truss system that combines ruggedness with suavity.

The cruciform roof with its hipped corners is supported by two pairs of intersecting trusses, 12 ft deep and 72 ft long. The effective span, however, is only 48 ft; near the ends of each truss, a diagonal member extends past the bottom chord, somewhat in the manner of a knee brace, to reduce the length of the span and to act as a ridge beam for the hip roof. These beams span from the top chords of the trusses to a 13-ft-high masonry wall at the outside of the building, and supports the skylight over a corridor that circles the sanctuary. (Fixed louvers in sanctuary filter the sunlight.)

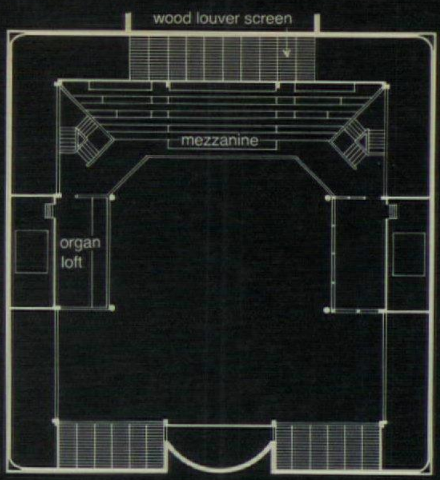
Interior surfaces are finished with 2-in. wood decking. In a mountainous area where heavy wind loads can be expected, this sheathing acts as a stiff diaphragm, transferring lateral load to the foundation.

FIRST PRESBYTERIAN CHURCH, Boulder, Colorado. Architects: *W.C. Muchow Associates.* Engineers: *KKBNA* (structural); *McFall & Konkel* (mechanical); *Swanson-Rink & Associates* (electrical). Contractor: *Wilkens Co., Inc.*

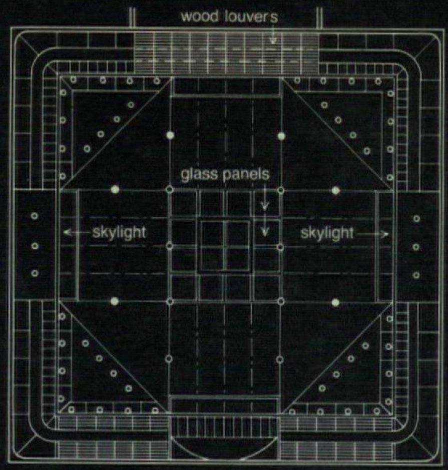


Robert E. Fischer photos

All truss connections have ½-in. plates on each side of the truss, fastened with 1½-in.-dia. bolts. Because different junctions required different connections—one joint receives 10 intersecting members—and because all connections are exposed, architects and engineers took special care in designing gusset plates for effective detail and pleasant proportions. Elements shown in the photograph above include one of the diagonal ridge beams and a vertical pipe, hung from the truss, that supports corner of organ loft.



SECOND FLOOR AND PARTIAL ROOF PLAN



REFLECTED CEILING PLAN

10

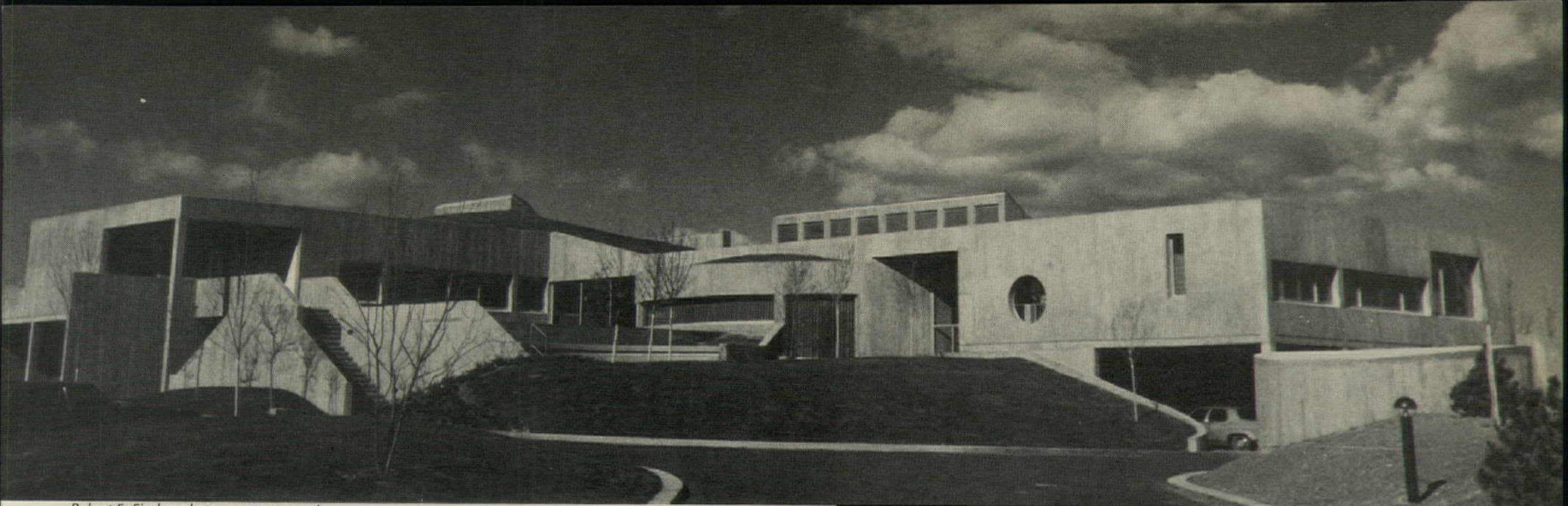
3
KKBNA IN DENVER, AN OLD-WEST SOD ROOF TOPS AN ENERGY-SAVING CONCRETE STRUCTURE

The mellow warmth of the rough-formed concrete walls in the offices of the Gary Operating Company stems, indirectly, from the owner's request for an energy-conserving building (the firm operates oil fields on contract). This request suggested thick concrete walls, which with their mass would retard heat gains and losses. Additional mass is provided by earth berms around much of the lower floor and by an old device of the frontier: a sod roof. (The grassy roof, clean of mechanical impedimenta, also offers an attractive view for a high-rise motel planned for a nearby site.)

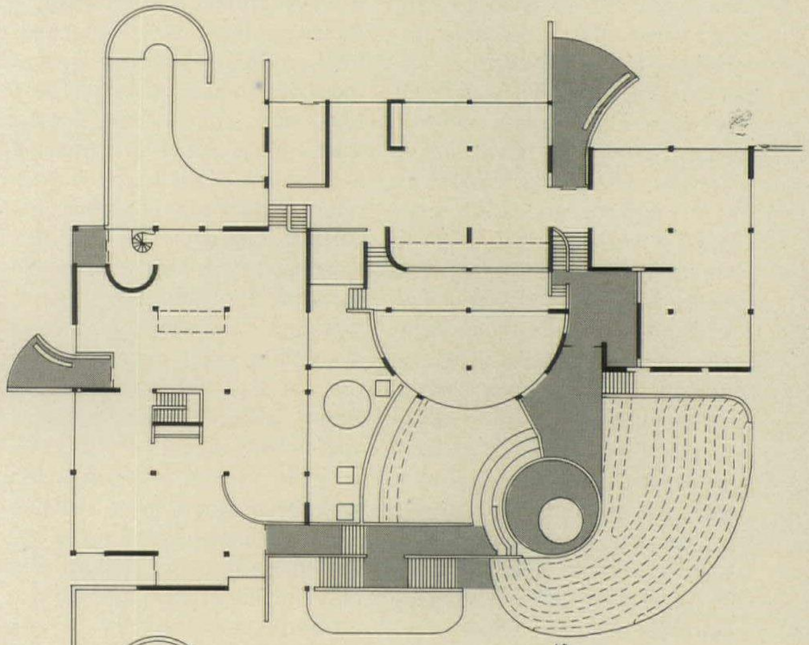
An irregular plan resulted partly because architect Cabell Childress adopted an open plan, and partly because the building houses two related but autonomous firms (the second company appears here only in the exterior photographs). Although the plan dictated some irregularity of column spacing, as well as several curved and straight bearing walls, the structural system consists essentially of a 20-ft-square grid of columns supporting flat slabs.

In answer to an overburden of expansive clay on the site and to the heavy column loads—the roof comprises a 14-17-in. flat slab and 2 ft of earth—the structure is founded on straight-shaft caissons drilled down to clay bedrock.

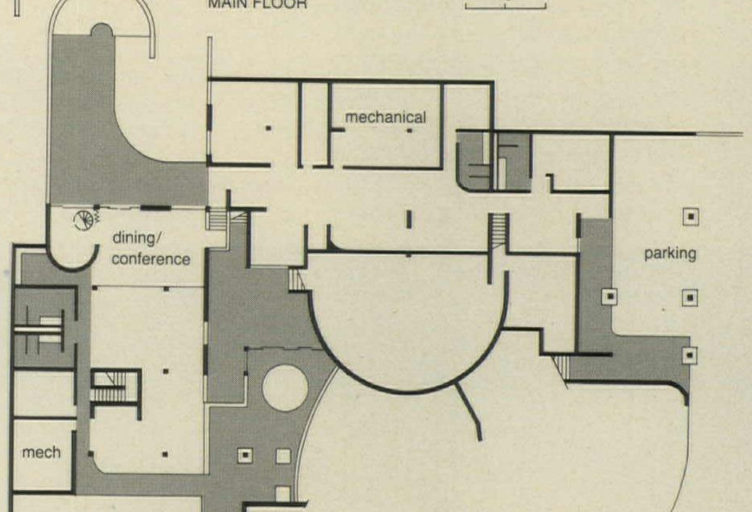
OFFICES, GARY OPERATING COMPANY, near Denver. Architects: *Cabell Childress Associates*. Engineers: *KKBNA* (structural). Consultants: *Richard Weldon, AIA* (concrete). Contractors: *Al Cohen Construction Company* (general); *United Materials, Inc.* (roof construction).



Robert E. Fischer photos exept as noted

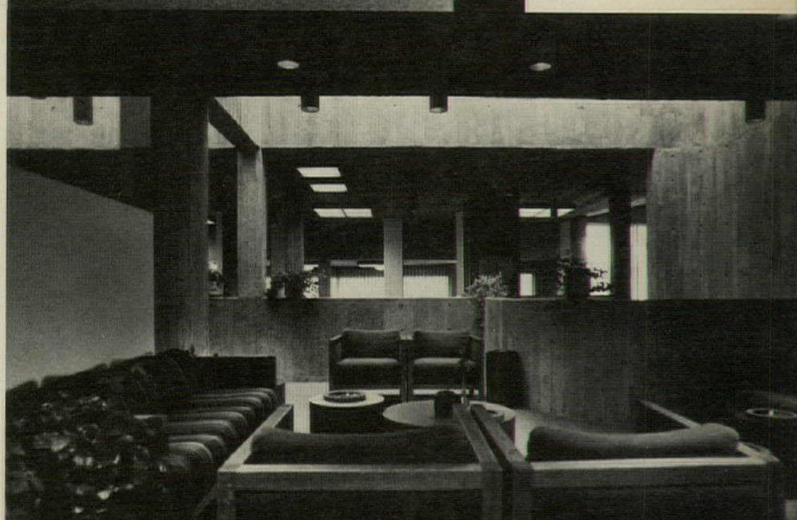


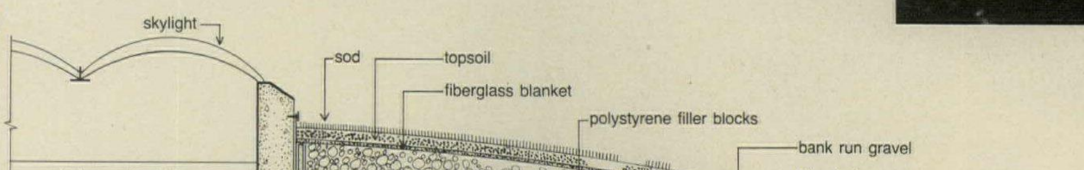
MAIN FLOOR



LOWER FLOOR

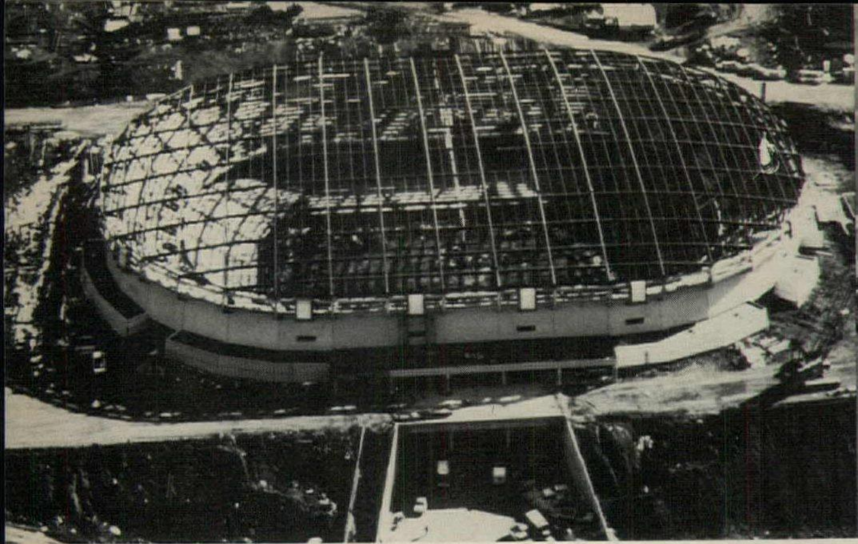
Jack Weatherby

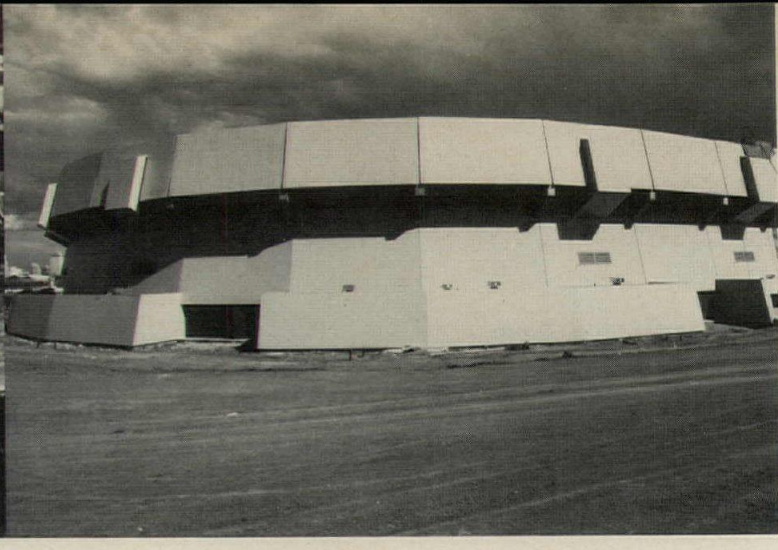




TYPICAL SECTION AT BUILT-UP AREAS

Roof construction is a flat slab designed to support a superimposed load of 300 psf, which includes 2 ft of saturated earth and a 30-lb snow load, as well as suspended mechanical and electrical equipment. Slab thickness varies from a minimum 14 in. to a maximum 17 in. to allow drainage. Around the skylights, where the sod roof is shaped into hillocks, lightweight polystyrene blocks provide extra thickness with minimal extra load.





4

KKBNA ABOVE DENVER'S NEW ARENA, A TWO-WAY CABLE TRUSS SYSTEM SPANS AN AREA 300 BY 420 FEET TO ROOF BASKETBALL AND HOCKEY FANS

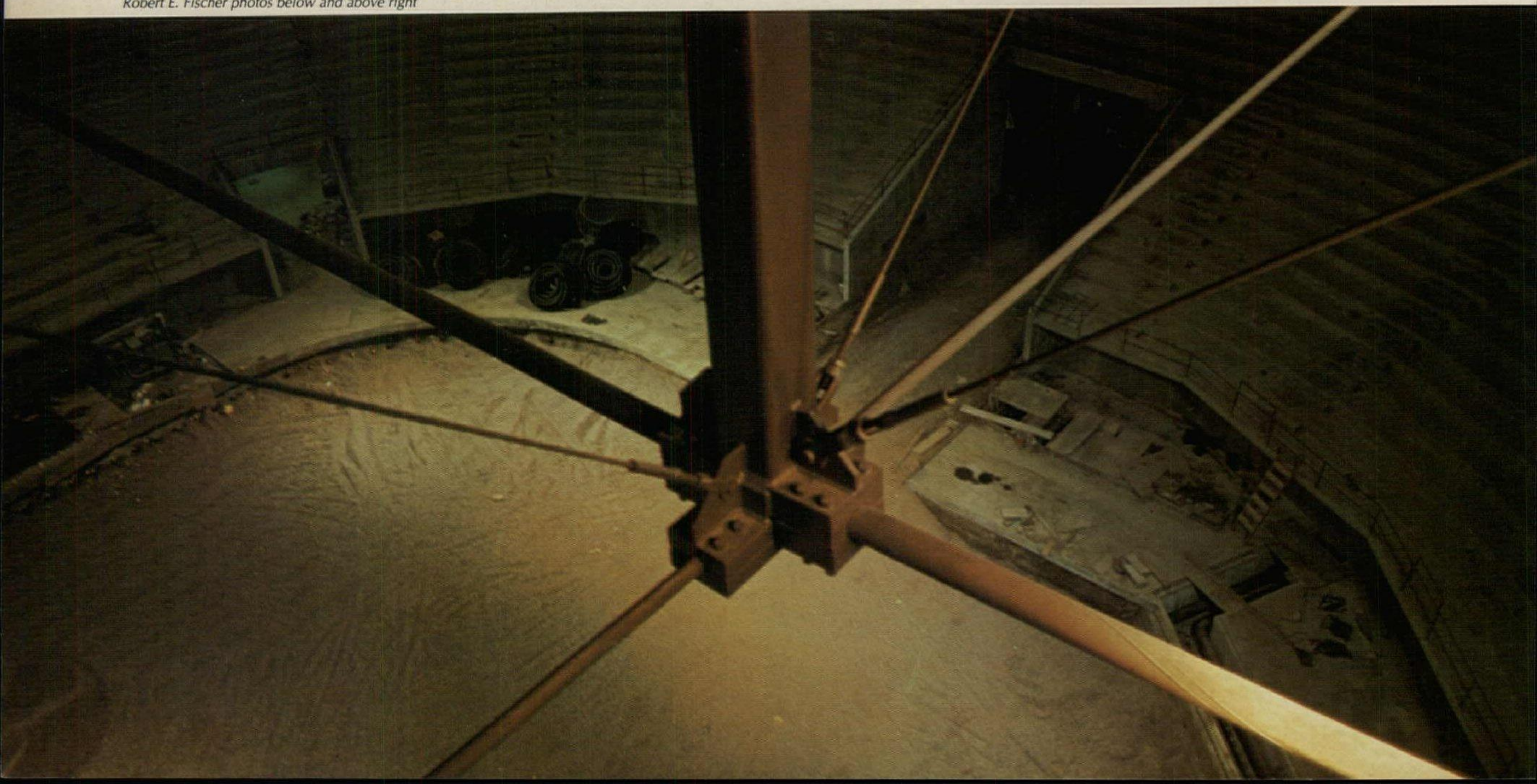
The structural engineer's contribution to building design is nowhere more evident than in the large, unobstructed spaces needed for athletic events and their attendant spectators. For Denver's new McNichols arena, which will seat as many as 19,000 for basketball, hockey and concerts, KKBNA designed a two-way truss system to support a 300-by-420-ft roof. The trusses have 24-in. wide-flange top chords, 8-in. square tube verticals, and steel cable diagonals and bottom chords. Erection of the trusses went forward in three stages. First, the short-span trusses, including the diagonals, were positioned, and then the members of the long-span trusses were "woven" into place. Finally, the cables were tuned to bring the roof to its proper elevation. During erection, only short-span cables, which were over-tensioned, accepted load; the long-span cables were then tensioned to take load in the other direction and to relieve the extra tension in the shorter cables.

So that the building maintains a low profile on a prominent site, its lower portion is below grade, a condition that carried structural implications. Ordinarily, the basement slab in such cases acts as a horizontal strut to take lateral loads. Here, successive freezing and thawing of the hockey rink required that a continuous ¾-in. expansion joint circle the area. This in effect left a large hole in the center of the slab. The caissons that support the retaining wall and the seating bents were therefore designed to act as cantilever beams, taking horizontal forces as well as vertical.

The arena's exterior, sided with metal panels, takes its shape from the upper seating bents, which cantilever beyond the building line to form a broad rim around the roof. The hoods spaced around this rim house hvac ducts.

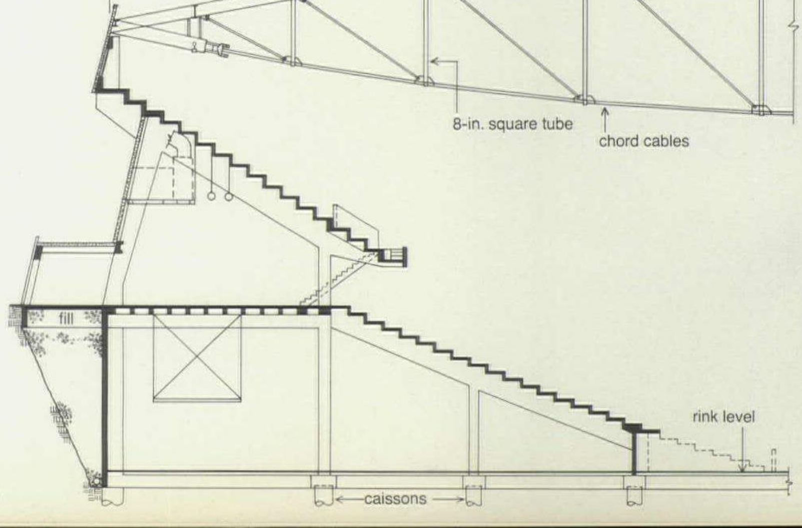
McNICHOLS SPORTS ARENA, Denver. Architects: *Charles Sink & Associates*. Engineers: *KKBNA* (structural). General contractor: *Centric Corporation*. Steel fabricator: *Zimmerman Architectural Metals*.

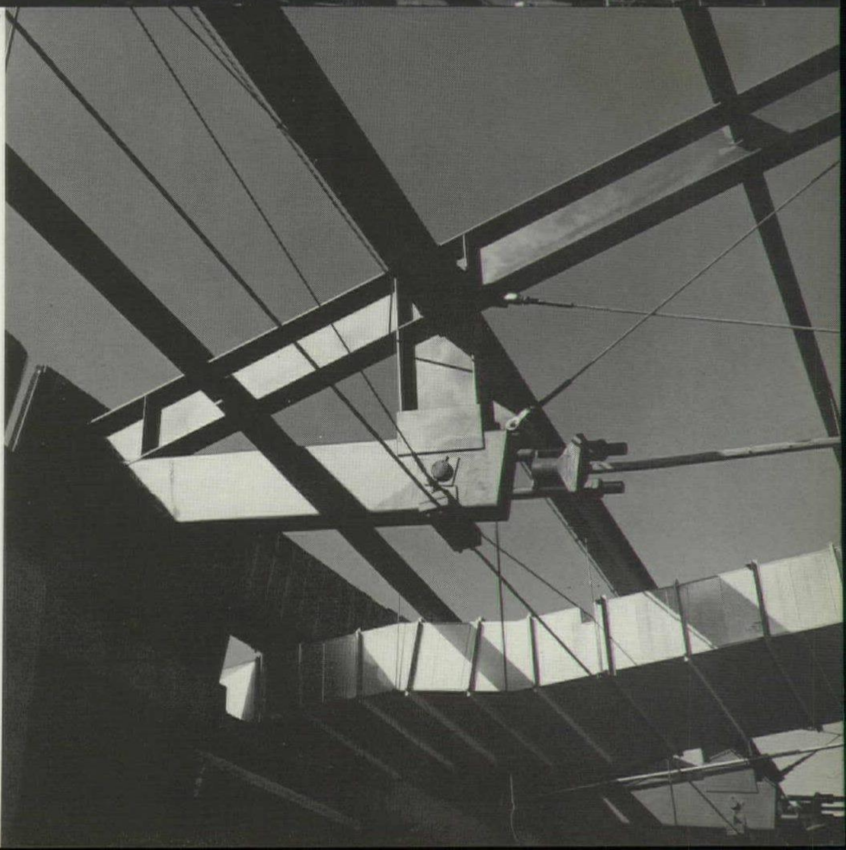
Robert E. Fischer photos below and above right

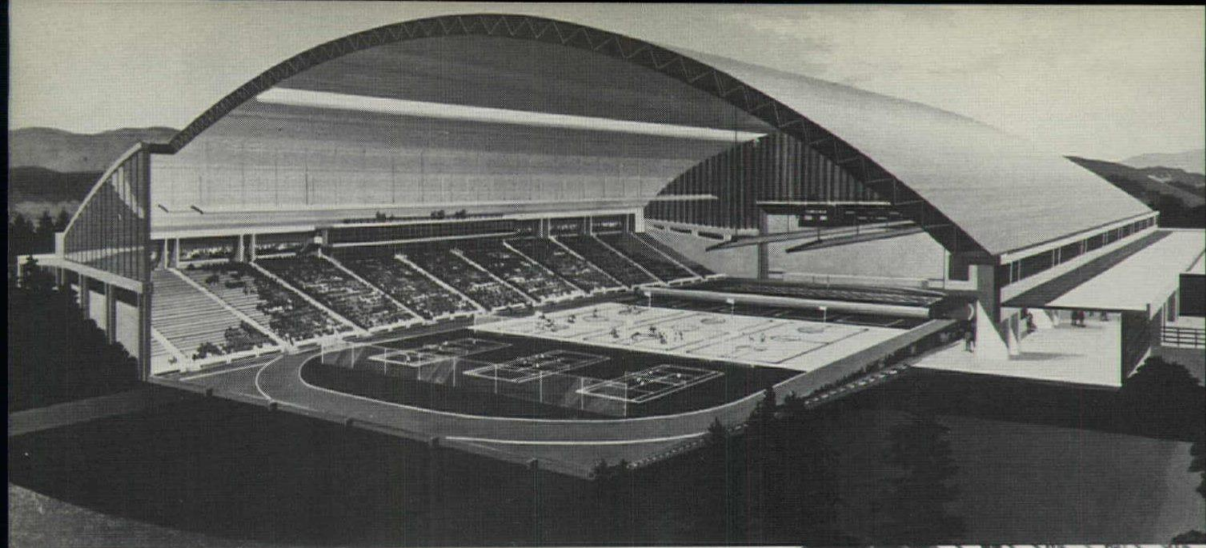


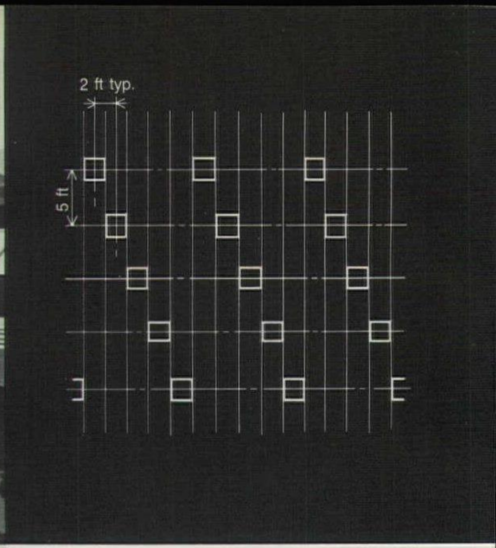
Rush McCoy photos this page

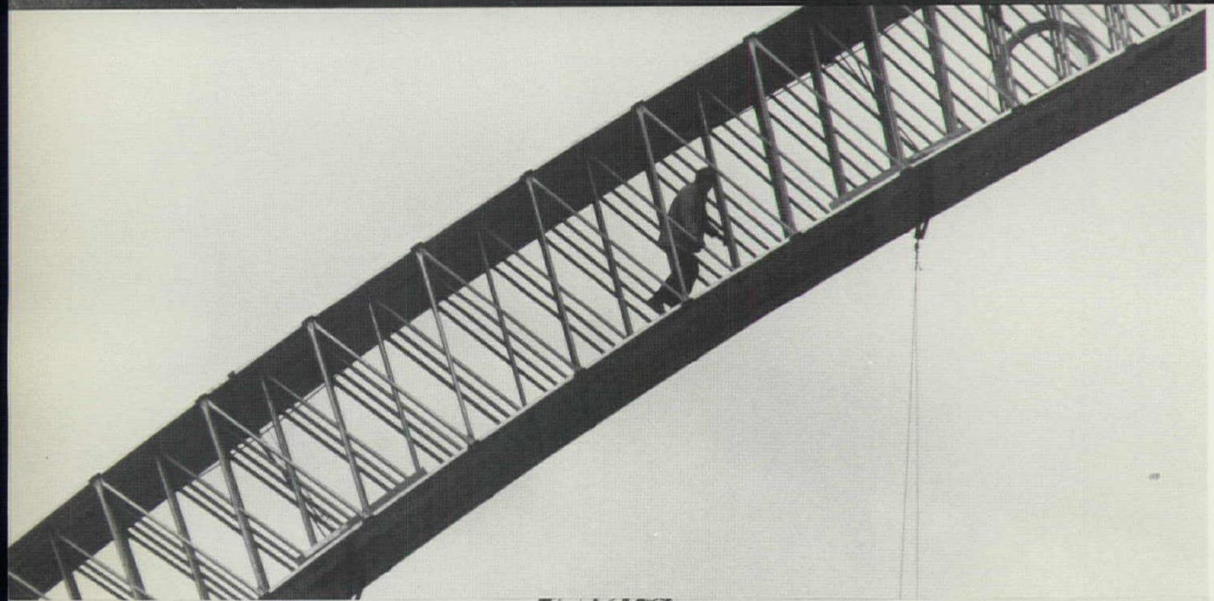
Diameter of lower cables varies according to load from 1 in. to 3¾ in. For the same reasons, welded steel-plate cable connectors vary in length, the largest being 2½ ft long. End pieces of the trusses rest on sliding bearings to accommodate deflection up to 12 in. for snow load.









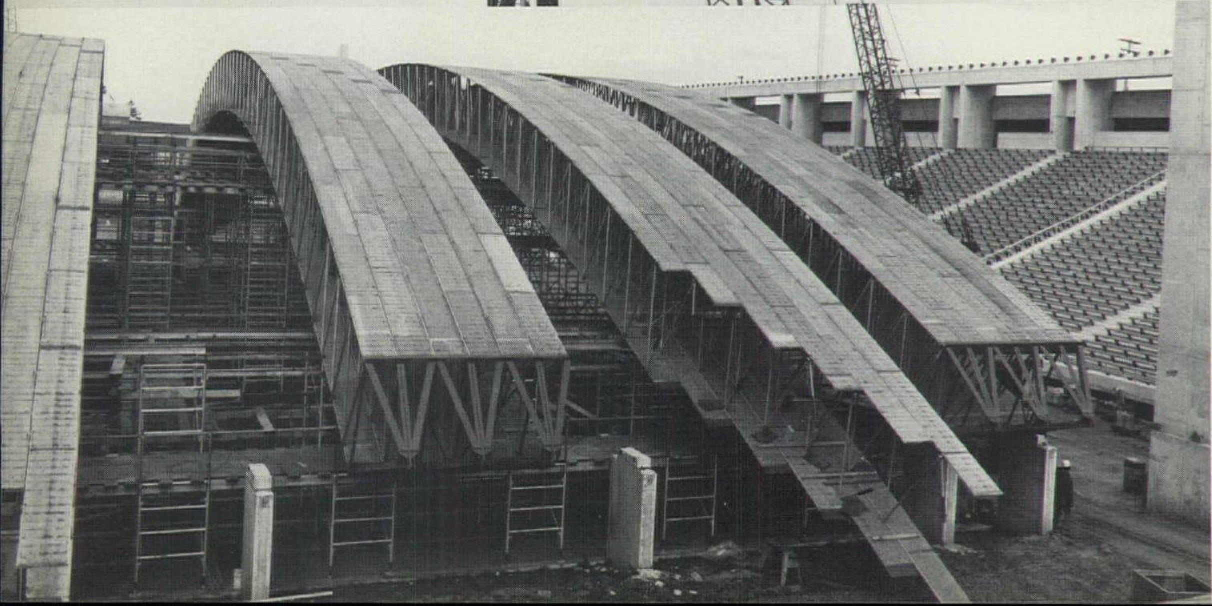


5 KKBNA IN IDAHO, TRUSSED-ARCH ROOF SPANNING 400 FT ERECTED IN 26 DAYS

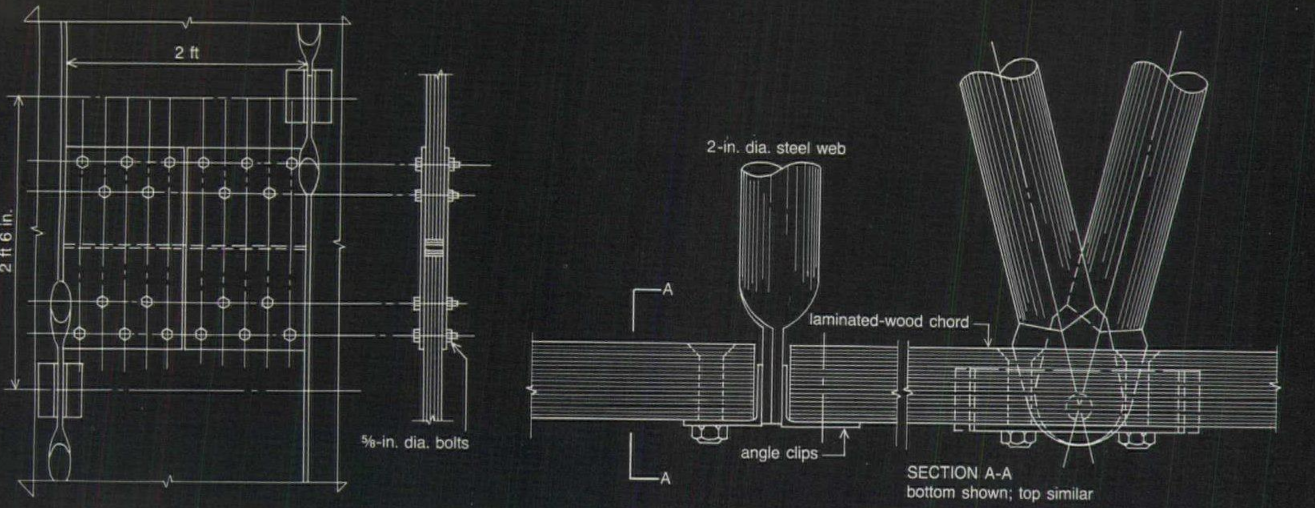
Erected in only five weeks from start to finish, the stadium roof at the University of Idaho uses a wood and steel trussed-arch system developed by KKBNA and the Trus Joist Corporation. The two-hinged arch spans 400 ft with a rise of 100 ft from the spring line to reach a maximum height of 160 ft above the playing surface; the building is 400 ft long.

The basic structural element consists of a steel-pipe web with top and bottom chords of *Micro-Lam,* very thin (⅛-in.) wood laminations. Six of the 2-ft-wide segments are bolted together to form an erection unit 12½ ft wide, 7½ ft deep, and 225 ft long from anchorage to the top of the arch. The segments are separated by 1-in spaces between clips, gaps that later serve as exhaust vents in the ceiling at the lower face, while the open-webbed arches serve as return-air plenums. Web members are typically 2-in. 16-gauge steel pipes set on 60-in. centers along segment seams, and staggered 30-in. for each segment within erection units.

UNIVERSITY OF IDAHO, Stadium Roof, Moscow, Idaho. Architects: *Cline, Smull, Hamill & Associates.* Engineers: *KKBNA* (structural). Contractors: *Trus Joist Corporation* (roof design-construct); *MacGregor-Triangle* (roof erection).



Dave Alts photos



Chords are spliced with 20-by-24-in. bolted plates in a staggered pattern along the length of erection units (far left), while steel-pipe web members also overlap at the splice (details second left). Pipes, flattened at top and bottom, are held by bolted angle clips on 5-ft centers along each chord unit and staggered 2½ ft from segment to segment. A 1-in. space is left open between clips on the lower surface; a urethane insulation and elastomeric weather barrier seals the top surface.

QUALITY LIGHTING WITH FEWER WATTS

Electric energy consumed by all forms of lighting is substantial—as much as 20 per cent of the total usage. So it is no wonder that government, owners and architects, and engineers are scrutinizing lighting design for energy savings, even in the absence of a coherent Federal energy policy. It is also no secret that significant savings are achievable. Logically, no single approach has been seen as an answer to all clients' needs. Fortunately, too, the simplistic advocacy of markedly lower footcandle levels has not taken hold. In seeking rational approaches, architects and lighting designers are giving a lot more attention to the different requirements of different spaces, to obtaining a greater appreciation of what quality means in the range of tasks to be lighted, and to whether the objective is "light to see" or "light to see by," or both.

This article is devoted to the main approaches that have developed to obtain quality lighting with fewer watts: 1) less reflected glare from tasks achieved by (a) location of luminaires geometrically with respect to tasks, and/or (b) control of light distribution of luminaires themselves; 2) use of luminaires with high efficiencies and improved light distributions; 3) electrical power distribution arranged to permit flexible lighting arrangements; 4) switching to turn lights off when not needed, and diminished lighting for janitorial services; and 5) use of lamps with higher efficiencies.

▪ Many ways for designers of lighting systems to cope with the need to use energy prudently are suggested by the lighting studies and case histories discussed here and on the following eight pages. One trend readily apparent is design for the discrete lighting of tasks—putting the right light in the right place.

If task locations can be predetermined, and will remain fixed, ceiling luminaires can be arranged to put more light on the task than on the surrounding areas; furthermore, the luminaires can be located to minimize reflected glare on the task. Or, conversely, the tasks can be located in areas with least reflected glare, hence, better vision. These principles are illustrated on the following two pages in the article by Louis Bello of Syska & Hennessy:

With task-oriented lighting, if desk locations will change frequently, then the luminaires will need to move with the locations. This can be accomplished in two ways. First, the luminaires may be relocated in the ceiling. Second, the luminaires can be incorporated in office furniture and the lighting moved with the furniture. (See RECORD, March 1973 and mid-August 1974.)

Several methods are possible for relocating ceiling luminaires. To a limited extent this is possible with the 6-ft length of flexible metal conduit allowed by the National Electrical Code for making a connection between rigid conduit and luminaires in accessible air-handling plenums. Flexibility is greatly enhanced, though distribution costs may be increased, by providing means for plugging in luminaires on a modular basis. Two Toronto buildings (pages 118-120) will take this approach. In the first case a checkerboard grid of electrical raceways has plug-in capability, and also supports luminaires and acoustical panels. Furthermore, the grid conceals sprinkler piping and has openings for air outlets.

In the second example, outlet boxes are provided in the bottoms of concrete floor slabs that allow luminaires in the ceiling below to be plugged in on a modular basis. Luminaires are supported by acoustical louvers that also shield the fluorescent lamps.

If the lighting needs to be fixed in the ceiling, and task locations will change, then the only solution is to provide uniform illumination in spaces where the tasks occur—though circulation, storage, and other ancillary spaces can have reduced lighting levels.

Even at that, very good general lighting can be obtained for slightly less than 2 watts per sq ft to 2½ watts per sq ft, as is demonstrated in the examples on page 116. In both examples, the luminaires are louvered, parabolic-reflector, twin-beam types. These luminaires have high visual comfort values, and they are designed to reduce reflected glare, the preferred viewing direction being parallel to the length of the luminaires.

There has been a lot of flak about the Illuminating Engineering Society's recommended footcandle levels. While the presumed rigidity, and also the magnitude, of these levels have been questioned by a lot of people, in many cases their alternative proposals have had questionable or limited technical support. The trouble is that scientists in the field have not integrated all the psychological and physiological factors that affect human performance and well-being to arrive at numbers that are valid in every respect. Obviously this is a gargantuan task that seemingly has no end, though some researchers, such as architect John Flynn, professor at The Pennsylvania State University, are trying to whittle it down. Flynn, for example, has used people as test subjects to rate lighted room appearances according to their preferences (when quantity and patterns of light are varied) for certain types of space usages. Dr. H. Richard Blackwell has proposed adjustments to illumination levels to account for eye adaptation factors, and his wife has done research on the effect of aging on visual acuity.

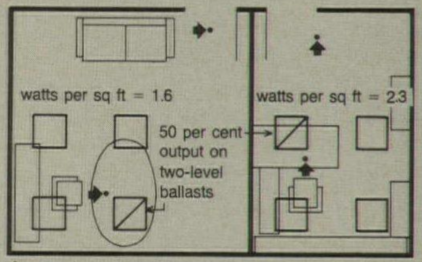
In response to its critics, the IES emphasizes that their recommended levels always did apply to task illumination. That they were many times applied indiscriminately across the board, can be attributed, among other things, to: 1) the public's lack of concern in the past about energy; 2) the requirement for space-use flexibility, real or imagined (or perhaps the owner will not commit himself); and 3) the greater amounts of thought, time and skill required to design task lighting properly. Not to be ignored is the fact that *more* came to be equated with *better,* even though sometimes it could be worse. Owners in competitive rental situations usually met their competition's footcandles, and more often than not put in more.

From an energy-usage standpoint, the IES recommendations, properly interpreted by the lighting designer, with cooperation by the owner, need not result, at all, in high energy consumption, even though these recommendations undoubtedly were originally derived from some judgmental decisions, including economic acceptance by owners, along with Blackwell's and other research.

With offices, for example, recommended levels are 30, 70, 100, or 150 footcandles, for a range of tasks from easy to difficult (but not most difficult). At roughly 25-35 footcandles per watt from general lighting systems, this could mean about 1 to 5 watts per sq ft for the areas involved. One example in this article shows that 65 footcandles of general illumination can be achieved with 1.8 watts/sq ft.

One factor affecting design is that people have to some extent become accustomed to the bright-appearing spaces in office buildings and schools. (But would people prefer desk lamps, or the equivalent, if they could have them?) Though space brightness is not necessarily related to footcandles of general illumination, it takes more thought, skill and experience to dispose illumination in the most advantageous ways for desired room brightness and task illumination.

In achieving owner and occupant satisfaction with room and luminaire appearance—i.e., the light one sees, which, more often than not is the basis upon which people appraise lighting—there is no substitute for experience in regard to what footcandle levels will be satisfactory. In a room with dark finishes, lit from ceiling luminaires, 80 footcandles of illumination may result in a room that seems dingy. In a room with nearly white fin-



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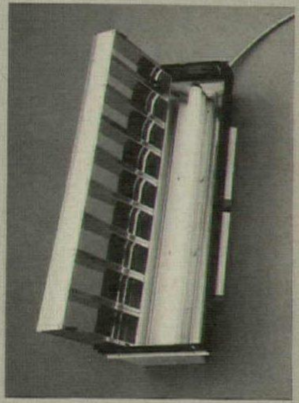
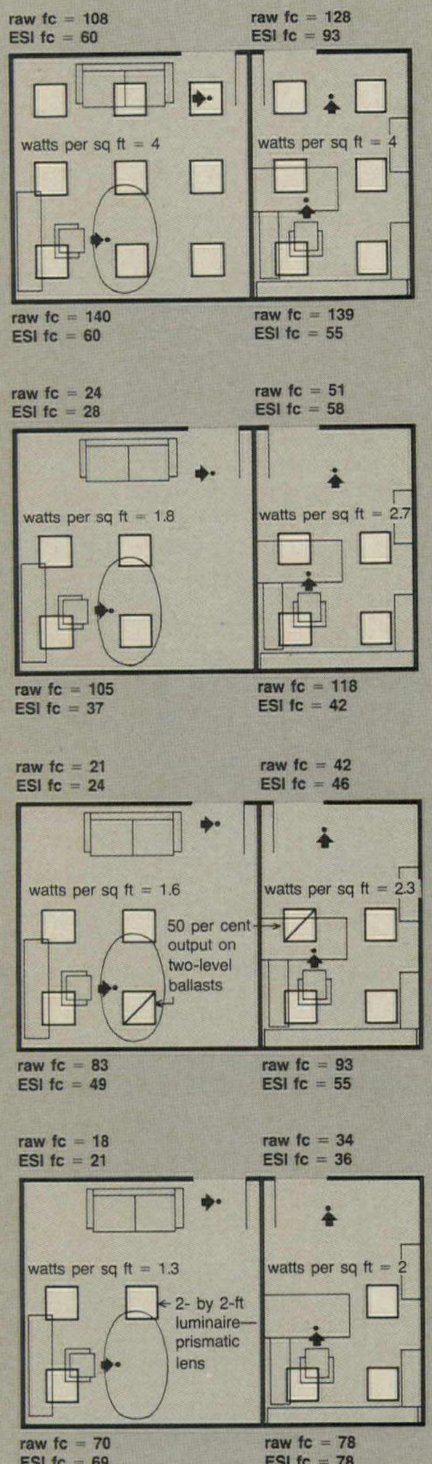


B

C

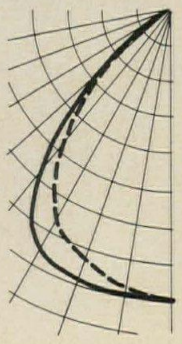
D

A. Improved visibility of reading tasks through optimum location of luminaires leads to less energy use (pages 114 and 115). B. Visibility can be enhanced through use of twin-beam-type luminaires. One lamp of this two-lamp unit can be switched off for energy savings (page 116). C. Task-oriented illumination, which allows more efficient utilization of luminaires, is possible with plug-in distribution systems (pages 117-120). D. Higher efficiency lamps mean more light for fewer watts (page 121).



Figures 1 through 4

This series of luminaire layouts shows the effect of different geometries of luminaires on reflected glare at desk tasks. The output of luminaires resembles the curve, right. The newly introduced measure of quality of illumination with respect to reflected glare is the ESI footcandle: the higher it is vis-à-vis raw footcandles, the better visibility is. ESI footcandles are higher when light strikes the task more at angles away from the viewing angle to avoid mirrored reflections.



ishes, 50 footcandles may seem overly bright. Thus designers following solely the IES footcandle recommendations, irrespective of other influences, have no guarantee at all that room appearances will be satisfactory—or, for that matter, pleasant. As a matter of fact, in helping people to perform visual tasks such as reading, absence of reflected glare on the task can be more important than quantity of illumination per se.

A proposed government fiat of 50 footcandles for office lighting means nothing except that 50 footcandles *might* take less energy than 100 footcandles—but how much less depends upon the design, the lamps, luminaires, ballasts, etc.

Greater assurance of comfort can be obtained by following IES recommendations on brightness contrasts and on the visual comfort probability (VCP) of luminaires. The VCP numbers, however, are not useful unless the architect or lighting designer has a mental image of what these numbers imply in context.

SOME INVESTIGATIONS INTO REDUCING ENERGY USAGE WHILE ACHIEVING QUALITY ILLUMINATION

by Louis A. Bello,
chief electrical engineer and vice president,
Syska & Hennessy

▪ Any intelligent savings in lighting energy obviously contributes beneficially to energy conservation. Furthermore, there are related economic benefits such as reduction in air-conditioning requirements, and perhaps lower electrical installation costs.

Until recently, raw footcandle levels were the popularly recognized criteria for designing and calculating illumination for tasks. Usually this was an average *over-all* level of general illumination. After Dr. H. Richard Blackwell showed that visual acuity could be radically affected by reflected glare, the Illuminating Engineering Society introduced the Equivalent Sphere Illumination (ESI) concept, which is an incomparably better index of the quality of illumination from a contrast standpoint. It is contrast between printed letters and their background, for example, that enables one to perceive the image readily.

ESI footcandles may be defined as *the illumination that will permit a level of visibility at a point in a given lighting environment, equivalent to that in preferred lab-instrument reference sphere.* Light emanating from a spherical surface strikes a task at all angles: from 180 degrees of arc in a vertical plane, and from 360 degrees of azimuth, which means that very little of the total is reflected from the task (as from a mirror) at typical viewing angles (generally assumed to be 25 degrees). Because raw footcandles in a given environment essentially are a measure of the quantity of illumination, irrespective of direction, and ESI footcandles are a measure of illumination with respect to direction and, hence, to veiling glare, ESI footcandles are more nearly an indicator of visibility, the goal of sophisticated lighting practice.

Design based on ESI footcandle illumination has had only limited application so far because of:

1) The lack of a method, up to now, for determining ESI footcandles. Even now the available method is complex. Accurate predetermination of ESI footcandles can only be accomplished via computer calculation. Furthermore, extensive photometric data (more than the usual) must be available on the luminaires being considered;

2) The popularity of general modular lighting over task-oriented lighting due to its regularized appearance and greater flexibility.

Energy savings and improved visibility are generated by task-oriented lighting

The combination of properly applied task-oriented lighting and recommended levels of ESI footcandles can result in energy conservation as well as superior illumination.

Needless to say, the number, type and arrangement of luminaires will be significant factors in energy consumption. Task-oriented illumination is often non-modular, producing a variable lighting fixture pattern with fewer luminaires, creating an interesting environment all its own, especially when augmented with supplementary highlighting of interesting space.

A common notion that task-oriented lighting is inflexible for application to constantly changing furniture arrangements, and therefore not feasible, can be refuted if the designer makes use of the following:

a) Integrated ceiling systems with integral air and partition tracks, and interchangeable components capable of accepting variable plug-in lighting fixtures or blank tile sections to facilitate lighting fixture relocations and removals,

b) Flexible above-the-ceiling wiring distribution systems,

c) A variety of lighting fixtures (1 by 4 ft, 2 by 4 ft, 2 by 2 ft, with from one up to six lamps),

d) Multiple lamp types: 4-ft standard and 2-ft U-tube fluorescents; varieties of standard incandescent, tungsten halogen; color-corrected mercury and metal halide,

e) Variable ballasts (standard, multi-level and low-output types),

f) Various light-control media (standard and twin-beam lenses, twin-beam reflectors, parabolic-type louvers, etc.),

g) Furniture-integrated lighting, perhaps fortified by daylight, permitting reduction or elimination of ceiling lighting,

h) Lighting controls (dimmers, photocells, standard and low-voltage switching).

The simplest energy conservation measure is to extinguish lighting when it is not required and to optimize its use through efficient work scheduling.

Two examples show how the most can be made of energy by minimizing reflected glare

Design A: Figures 1 through 4 show designs for 150,000 sq ft of offices similar to those in a recently designed building. The initial concept called for a conventional, single 2-by-2-ft recessed fluorescent fixture in a 5-by-5-ft module requiring approximately 4 watts per sq ft (see Figure 1), and produced the indicated initial raw and ESI footcandles shown at the task and at a remote location.

Subsequent schemes (Figures 2 through 4) indicate the descending order of power requirements and raw footcandles for the task-oriented lighting layouts. However, as one can observe in Figure 4, which shows the lowest level of power and raw footcandles, the ESI footcandles (quality lighting, maximum visibility) are actually highest. (These ESI values were determined by computer program based upon the layouts shown.)

It is not certain whether the client will actually use the design in Figure 4 instead of a more conventional layout as in Figure 1, but if he should, he will realize an energy saving of 830,000 kwh (equal to $30,000) per year. It should be remembered, however, that these rooms do not "look the same." There will be more "focus" at the task locations, and areas with ⅔ to ¾ less illumination will be noticeably less bright.

Design B: Solutions for open-plan lighting are not clear-cut because of varying individual task locations and orientation, and the potentially greater reflected glare contributed from the greater number of lighting fixtures, as compared with Figures 2-4. However, if modular furniture locations (properly oriented between rows of lighting fixtures) can be established as indicated by Figures 5 and 6, optimum ESI footcandle levels can be obtained resulting in more efficient energy utilization.

Local switching and variable output ballasts can reduce energy consumption significantly

Prior to the 1973-74 energy crisis many office buildings were designed with centrally located switching, primarily to minimize initial installation and subsequent relocation costs in an era of cheap energy. The situation has of course changed, and local wall switching is back in vogue.

A recently completed analysis of existing projects illustrates the effectiveness of such revised thinking.

Project: Tenant occupying 661,250 sq ft on 25 floors in an existing office building.

Lighting: 125 footcandles, 4.5 watts per sq ft.

Original lighting control: Floor quadrant control by contactors and remote control switches.

Initial Phase of New Lighting Control: Added one 24-v low-voltage local wall switch for each of 36 offices occupying the perimeter space of one floor (26,450 sq ft).

Results:

1. Energy savings (based on 75 per cent lighting usage)

Lighting	70,200 kwh per yr
Heating & air conditioning	36,240 kwh per yr + 126,000 lbs of steam
TOTAL SAVINGS	106,440 kwh per yr + 126,000 lbs of steam

2. Dollar Savings ....

(based on $.07 kwh and $8/1000 lbs of steam)...	$7,450/yr Electricity $1,008/yr Steam
TOTAL SAVINGS	$8,458/yr

3. Cost to implement $5,300
4. Write-off period ....7½ months

(Note: The cost for installing 265-v switching in the beginning for local control is approximately $50 per location, including the in-place cost of conduit, wire and switch.)

The standard, rapid-start ballast for 4-ft T-12 lamps is rated at 430 milliamperes. There are many applications in energy conservation where the flexibility of variable output ballasts can be utilized. A recently completed study indicates their application:

Project: 14,100 sq ft of office space

Original lighting: 288 3-lamp (40-watt) luminaires, 2-by-4-ft lighting fixtures with 430 milliampere ballasts producing 90 to 110 footcandles of illumination.

Proposed lighting: Replace 2-lamp 430 milliampere ballast with low-output 300 milliampere ballast producing 75 to 90 footcandles.

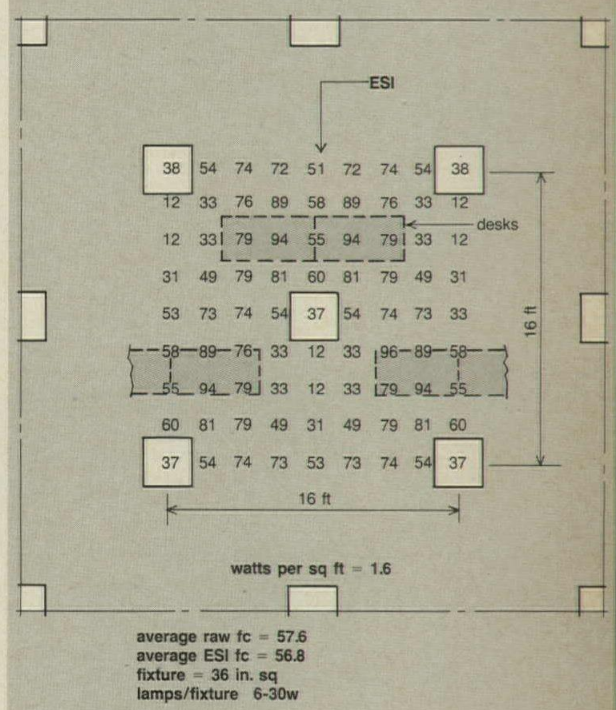
Results:

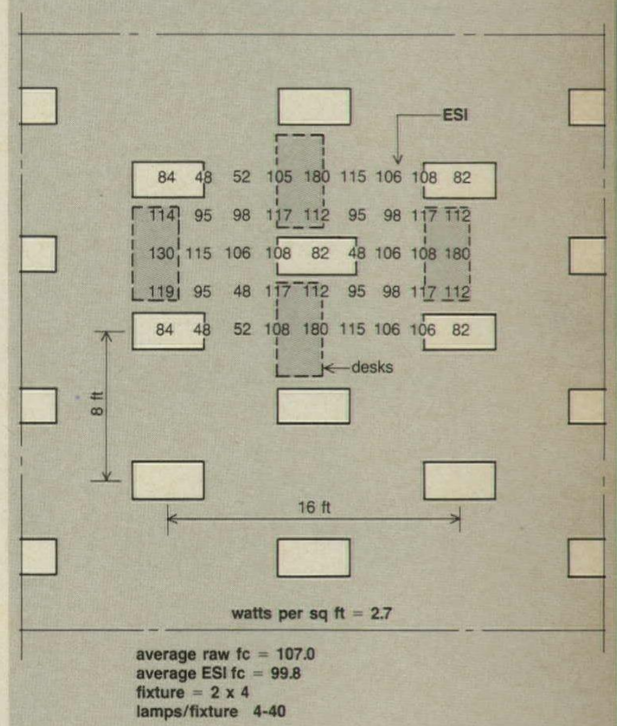
1. Lighting energy savings 17,300 kwh per yr

2. Dollar savings (based on $.06/kwh)	$1,032/yr for Energy $216/yr in ballast replacement
TOTAL SAVINGS	$1,248/yr

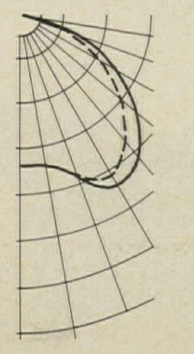
3. Cost to implement $5,200
4. Write-off period ....4 years plus

Although not considered in the evaluation, the existing ballasts were approaching the end of average life of 15 years, offering an added incentive for re-ballasting.

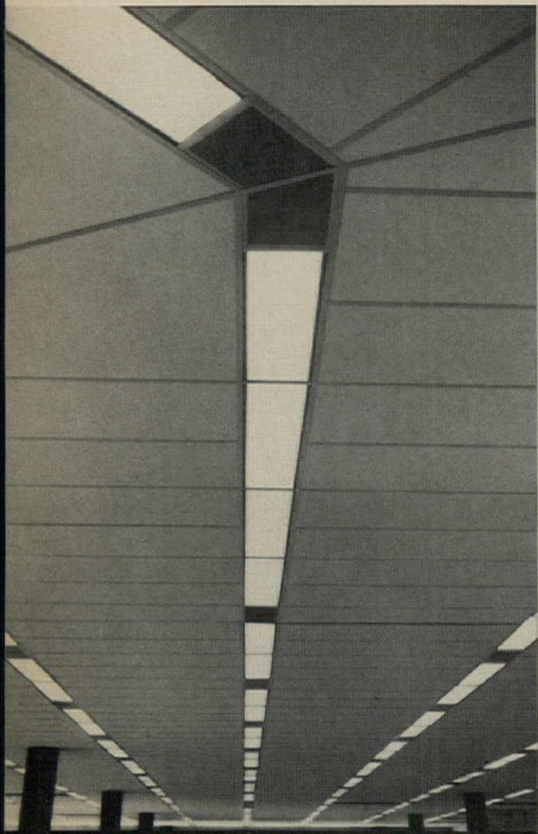


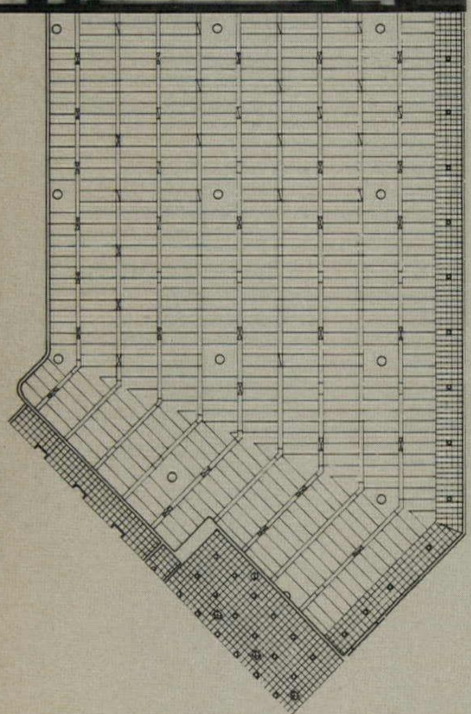


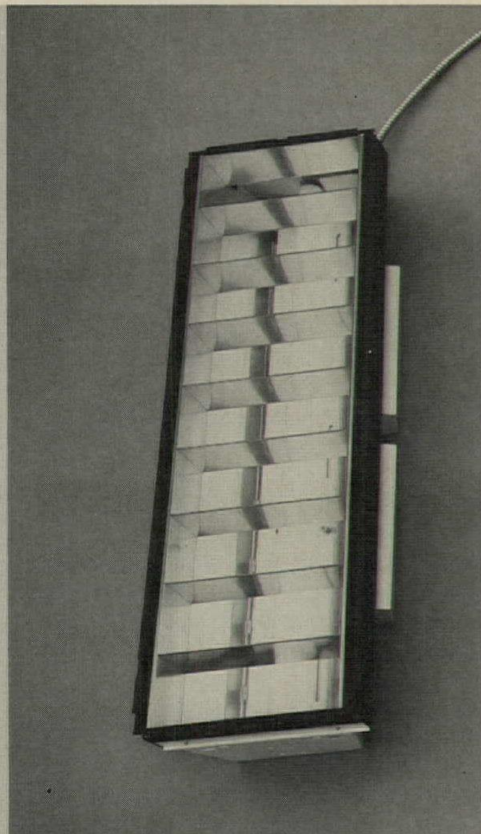
Figures 5 and 6

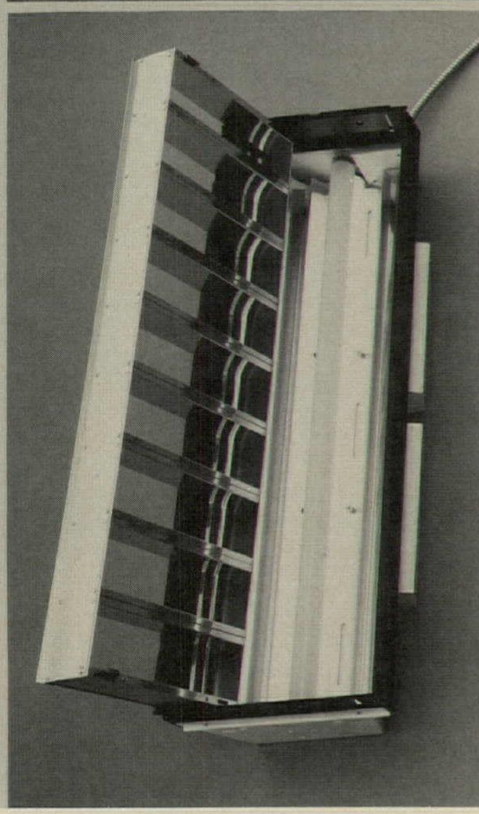


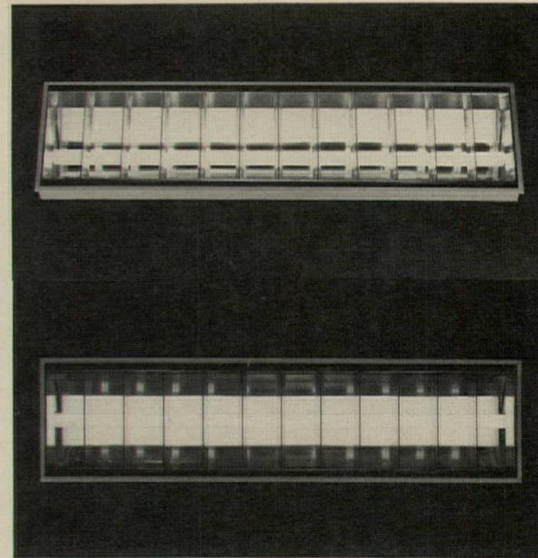
When luminaire geometries are fixed, it may be possible to position desks in an arrangement to take advantage of the best quality illumination for visibility. The drawings above show staggered arrangements of 3- by 3-ft and 2- by 4-ft luminaires. The light output from the lensed luminaires is similar to the curve, left; the lens was designed for less light output in the 0 to 25 degree sector, where reflected glare is of most concern. The ESI values were determined via computer.



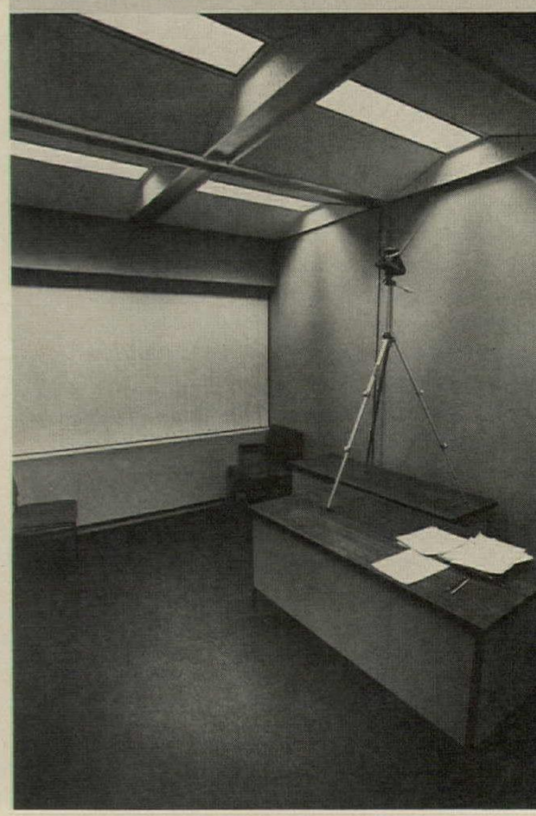








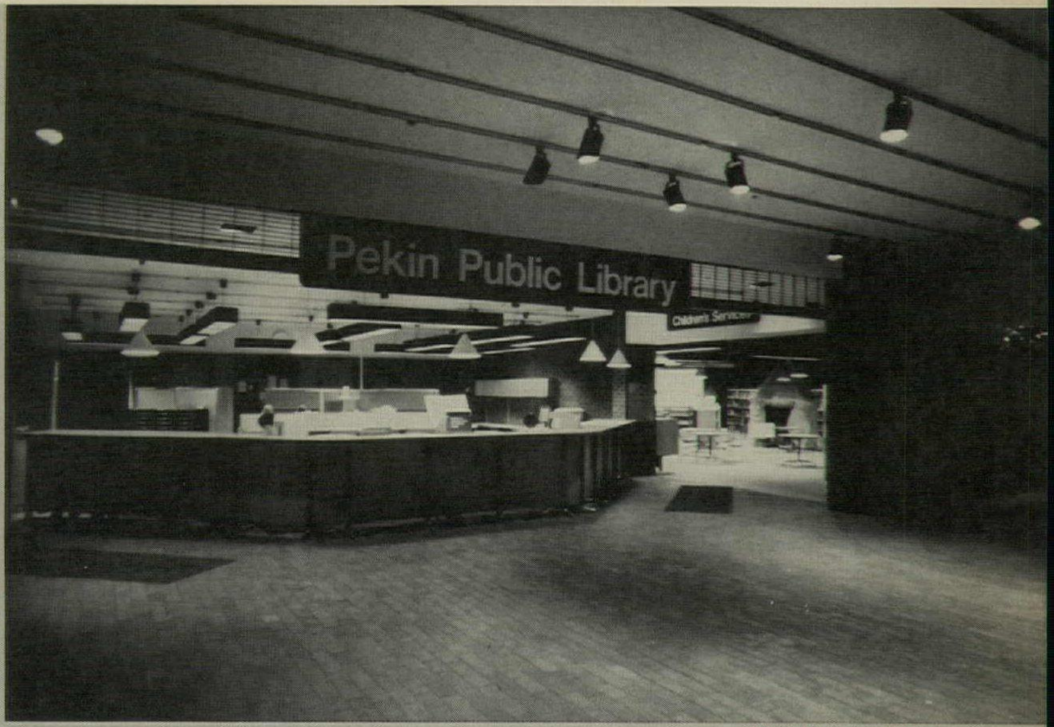
The two luminaires on this page are twin-beam types, designed to reduce reflected glare. The two-lamp luminaire, left, for Nabisco headquarters can have either of the lamps switched off for reduced lighting. The one above and below for Air Products and Chemicals headquarters has more output in the 0 to 10 degree zone to increase total illumination.



■ While owners want buildings to be more energy-efficient, they still ask for high-quality lighting. In these two examples, lighting consultant James D. Kaloudis, of Meyer, Strong & Jones, P.C., has used twin-beam-type parabolic-reflector luminaires to achieve high-quality illumination with low power consumption. But also he had to be mindful of the esthetic qualities that the architects envisioned for the ceilings and the spaces.

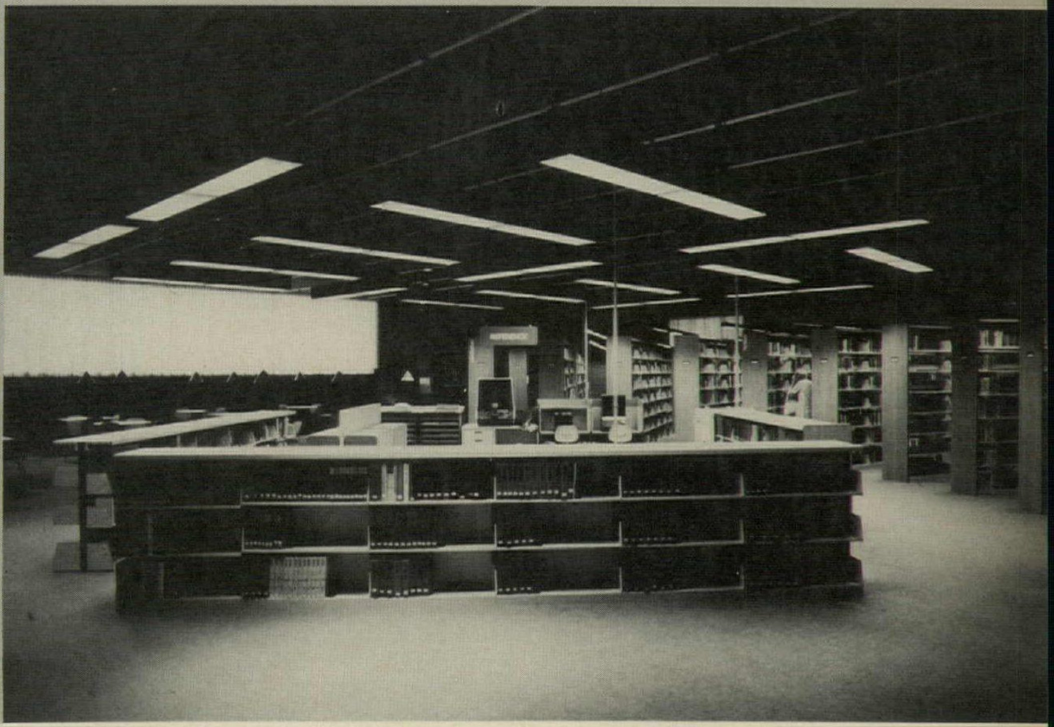
In the new Nabisco national headquarters, East Hanover, New Jersey, designed by The Grad Partnership, either lamp of the 2-lamp luminaires (one lamp above the other, rather than two side-by-side) can be switched off from a central panelboard. This provides for diminished lighting for cleaning, and allows reduced power in case of a brown-out emergency. With both lamps, illumination is 85 footcandles at 2.4 watts per sq ft; with one row off, these values are halved.

The other example is a new office building for Air Products & Chemicals, Inc., in Allentown, Pennsylvania, designed by The Eggers Partnership. A new one-lamp, parabolic-reflector luminaire, set in a ceiling coffer, was designed for the building, providing 65 footcandles of low-reflected-glare illumination at only 1.8 watts per sq ft. The luminaire was designed for more output in the 0-10 degree zone than is usual for this type of luminaire to get a high enough illumination for small, as well as large, offices.



Electrified track in the ceiling of the Pekin library will allow luminaires to be easily moved to accommodate additions to the book stacks, to allow exhibit lighting to be changed in the lobby, and to permit rearrangement of furniture such as carrels and tables.

Robert E. Fischer photos



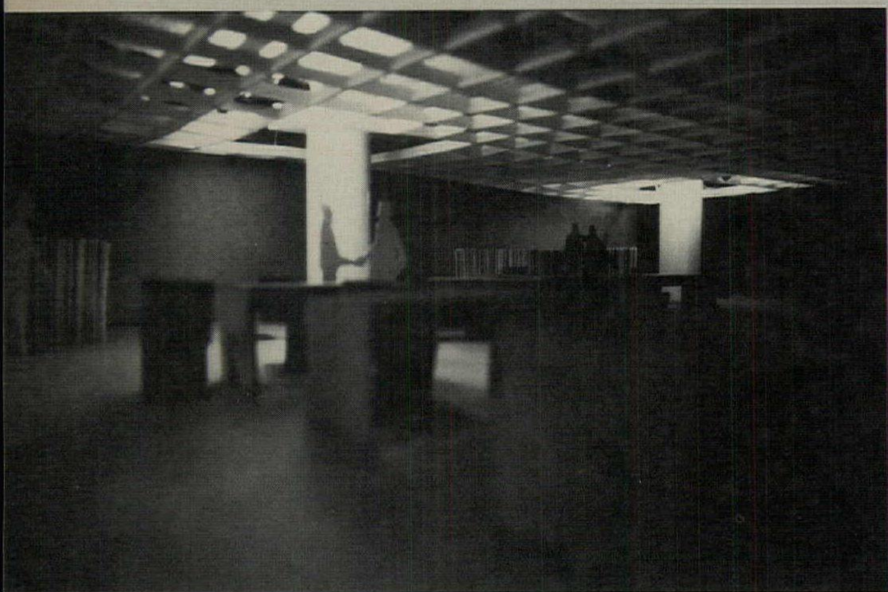
■ Lighting flexibility—putting it where it is needed—was required in the new Pekin, Illinois Public Library for several different reasons. John Hackler and Company, the architects, and their mechanical/electrical consultants, Beling Engineering Company, met the requirement by providing electrified tracks, surface-mounted on the ceiling, in parallel rows 5 ft apart.

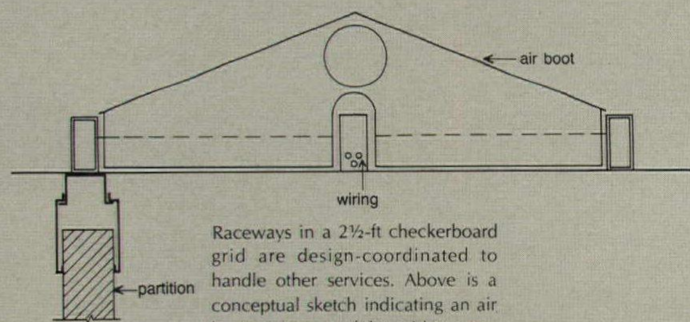
At present the stacks in the adult services section are in a radial pattern so that control can be handled by only one person at the central desk. Single-tube, parabolic-reflector luminaires are suspended from the track midway between stacks. But this area is programmed for a three-fold expansion over 20 years, which means that stacks will have to be rearranged in parallel rows, and the lighting will have to move along with them. Two lengths of fixtures are used, 8 ft 10 in. and 4 ft 7 in. Also, carrels and reading tables can be relocated as pattern of library use changes.

Because the entrance lobby serves also as an exhibition hall, a plug-in type of flexibility was wanted there for incandescent luminaires to light various displays.

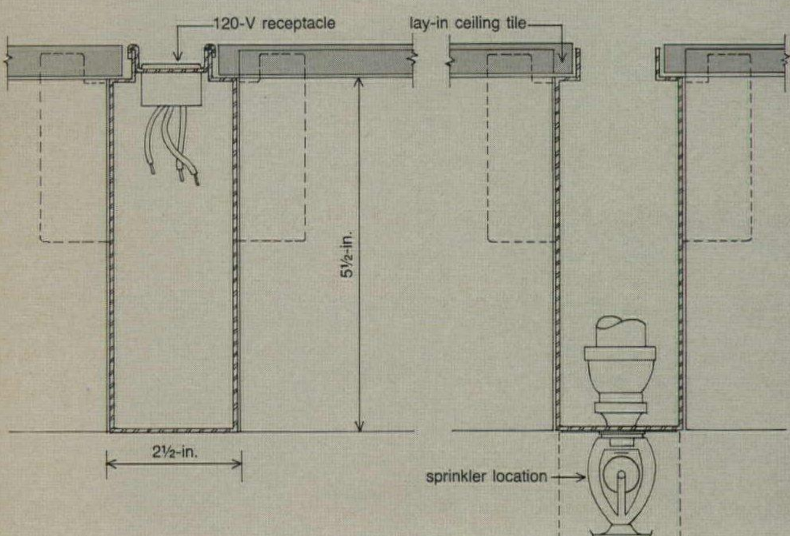
Still another approach to lighting flexibility will be taken in the adjoining Dirksen Research Center, for which the interior design has yet to be determined. Named for the late Senator, the Center will contain his papers, those of other Congressmen, and also the Senator's memorabilia.

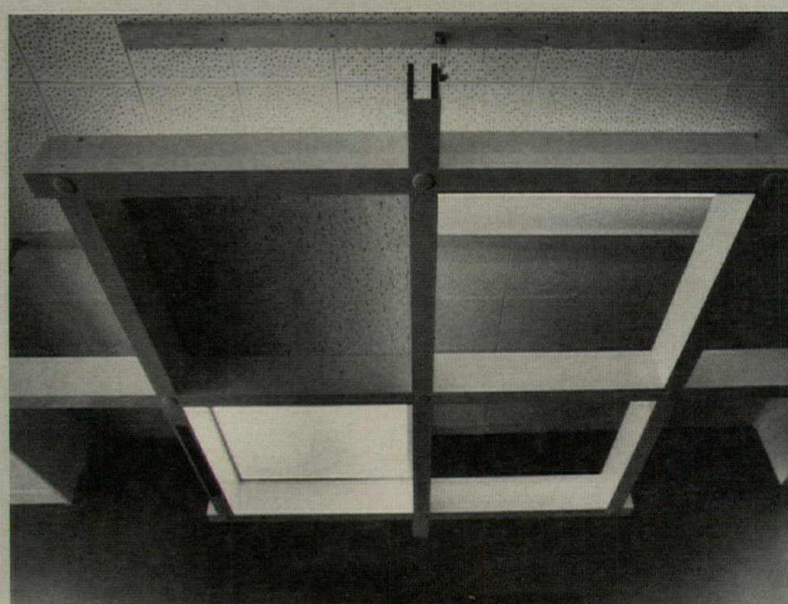
An exposed, multifunctional electrical raceway provides lighting flexibility





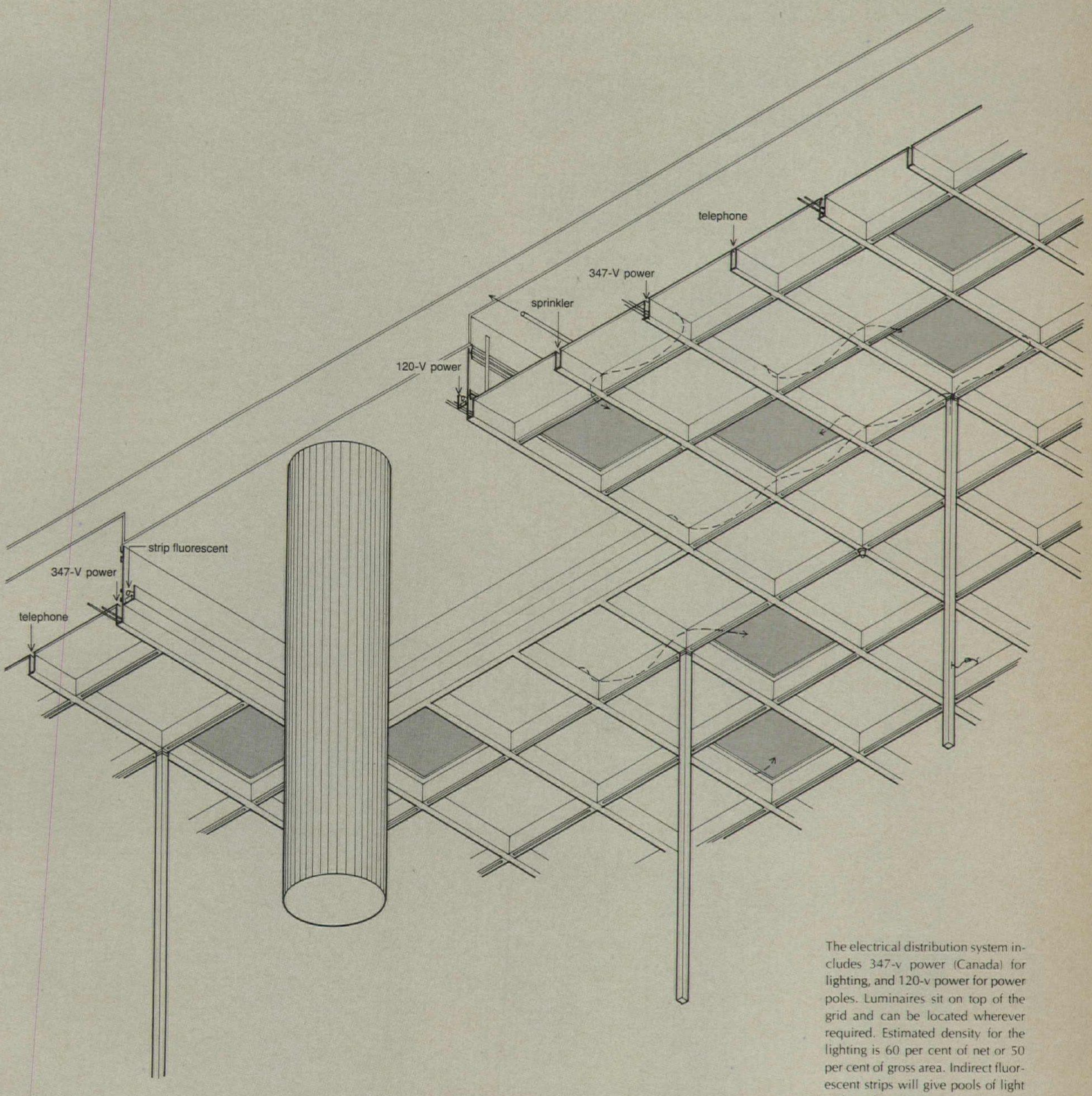
Raceways in a 2½-ft checkerboard grid are design-coordinated to handle other services. Above is a conceptual sketch indicating an air boot set on top of the grid to serve diffusers. Sprinkler piping also will be coordinated with the raceway grid. The small mock-up below shows a diffuser slot and plugged holes for potential installation of power poles.





■ Though Canada has not felt quite the same pressures to cut back on fossil-fuel consumption as the United States, nonetheless their concern is reflected in energy-saving features showing up in their building designs. The Government of Canada Building in North York Borough of Toronto, for example, will have localized lighting to reduce power consumption. The approach, developed by architect Macy DuBois and electrical engineers Jack Chisvin and Associates, Ltd., uses a checkerboard of exposed aluminum electrical raceways that supply: 347-v power to 2-by-2-ft luminaires supported by the grid; 120-v power for power poles; and telephone communications. The grid also will conceal sprinkler piping and will have slots for diffusers. The mechanical consultant, Engineering Interface Ltd., is working with industry to develop a diffuser that will be narrow enough to fit the grid, and that will at the same time provide the proper throw and mixing of air. Air to the diffusers will probably be supplied via a boot, similar to the conceptual sketch shown above, to which flexible ductwork is attached.

In the beginning, the associated architects, Fairfield+Dubois and Shore Tilbe Henshel Irwin, and their electrical engineers proposed 30 footcandles of ambient illumination plus task lighting. The government would not accept this, however, because federal office workers have 100 footcandles on the work plane specified in their union contracts. The



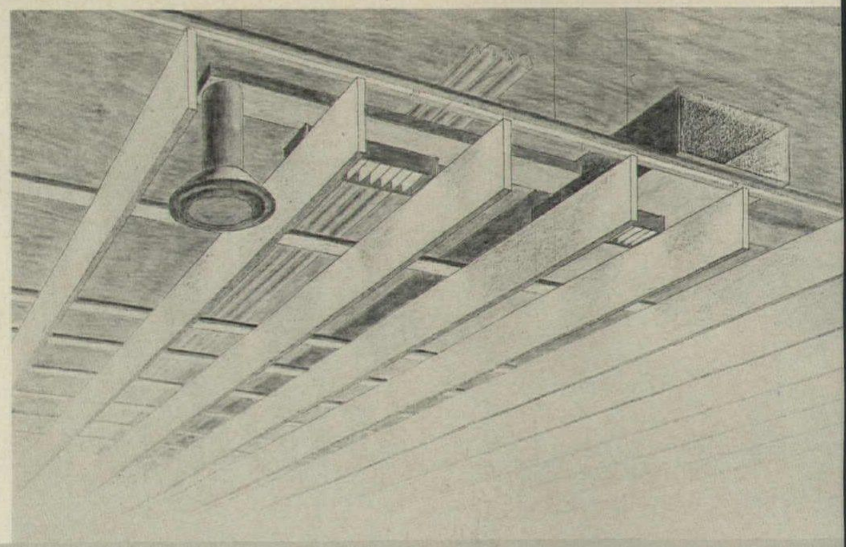
The electrical distribution system includes 347-v power (Canada) for lighting, and 120-v power for power poles. Luminaires sit on top of the grid and can be located wherever required. Estimated density for the lighting is 60 per cent of net or 50 per cent of gross area. Indirect fluorescent strips will give pools of light at the columns.

solution, then, was to design the system shown, which will allow 100 fc for areas wherever tasks are located. The designers estimate that 50 per cent of the gross floor area will be occupied, which means about 2 watts per sq ft of power for this system. No specific luminaire patterns were developed by the architect, the arrangement of luminaires being left to the government agencies occupying the building. Receptacles will be provided in the top of the raceways on 5-ft centers, and 10-ft lengths of plastic-jacketed cable with special plugs at one end will connect luminaires to them. Switching of lighting will be by low-voltage relays.

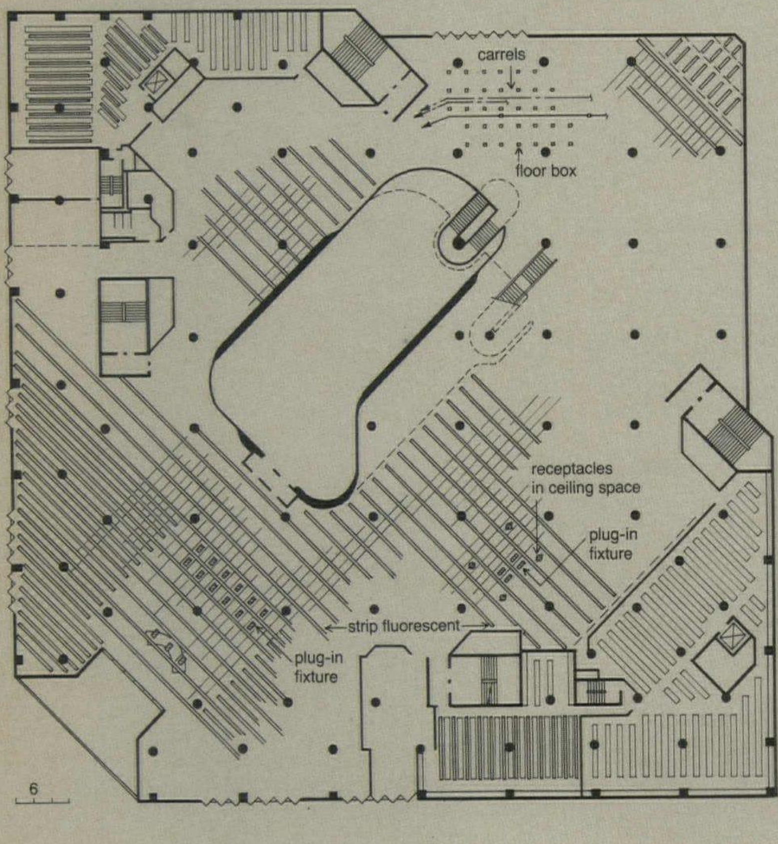
Indirect fluorescent strips will be installed around the four sides of the column capitals to give lighted accents at the columns, and to provide for emergency and nighttime lighting.

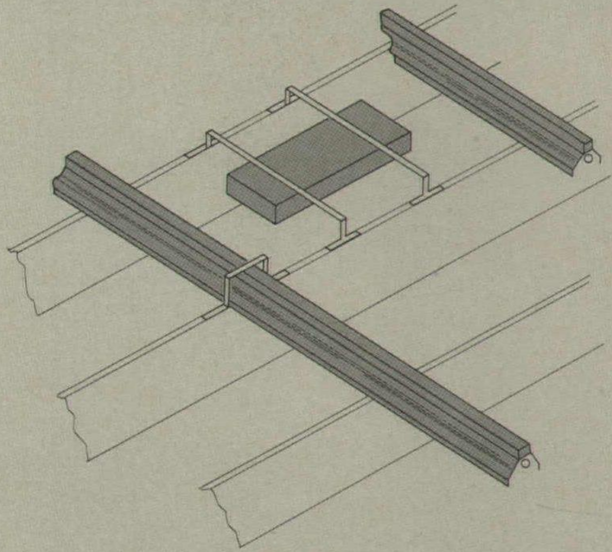
Though the idea of a grid with open spaces was esthetically appealing, for several practical reasons, it will be filled in with acoustical panels wherever there are no luminaires: the space above can serve as a return air plenum (using return-air luminaires); more sprinklers are required with an open ceiling; the acoustical panels provide more sound absorption. The Canadian Department of Public Works, which will lease space to federal agencies, also was concerned about occupant reaction, feeling that the exposed mechanical and electrical equipment above the grid might connote a status downgrading to the federal office workers.

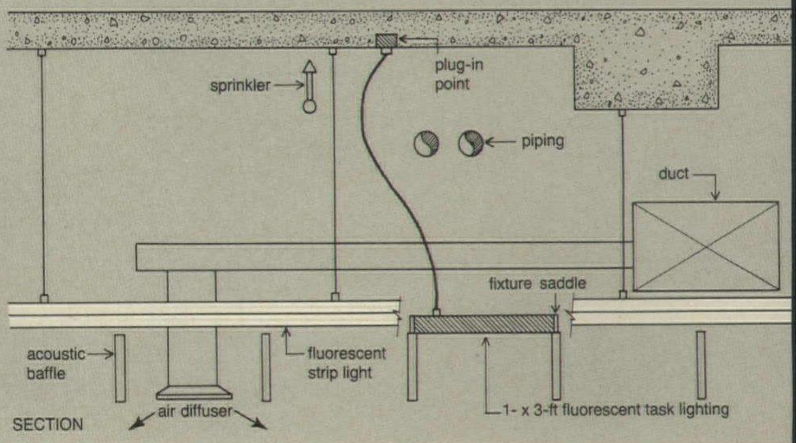
Lighting levels will be higher at the stacks and desks in the Toronto Library



The library is open horizontally and vertically to encourage circulation. Lighting levels are varied according to function. The stacks have a higher density of fixed luminaires. Work stations and desks will be illuminated by movable luminaires that can be located wherever the tasks are. Carrels have floor receptacles.





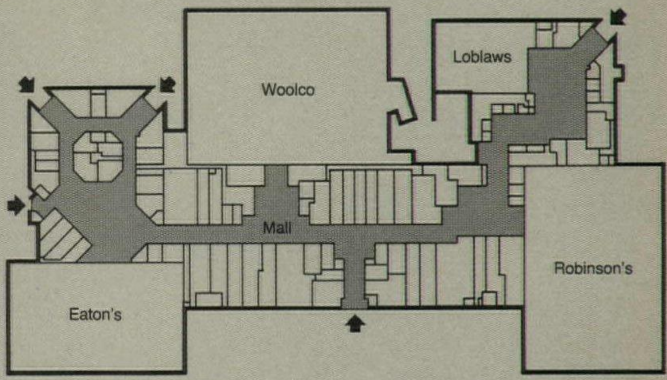


■ Variation in task lighting in the Toronto Central Library, designed by architect Raymond Moriyama, will be accomplished by both fixed and plug-in-type fluorescent luminaires. The interior layout will be as open as possible with maximum accessibility and ease of movement, both horizontal and vertical, to encourage self-help. At the same time, intimate, personal spaces are desirable. The lighting system, designed by consulting electrical engineers Jack Chisvin & Associates Ltd., addresses itself to both of these architectural requirements.

A reasonably uniform light level of 30 footcandles is provided throughout, supplemented by higher levels where required. This will be accomplished in either of two ways: 1) the spacing of single-lamp fluorescent strip lighting, ordinarily 7 ft on-center, can be halved to double the lighting density over stack areas; 2) movable, plug-in fluorescent task luminaires can be mounted atop the ceiling baffle system wherever required for desks, work stations, etc. The 16-in. acoustical baffles support the luminaires and shield them visually in one direction. The portable luminaires will be connected to outlet boxes set in the underside of the concrete slab. Outlets are set in the top side for carrels.

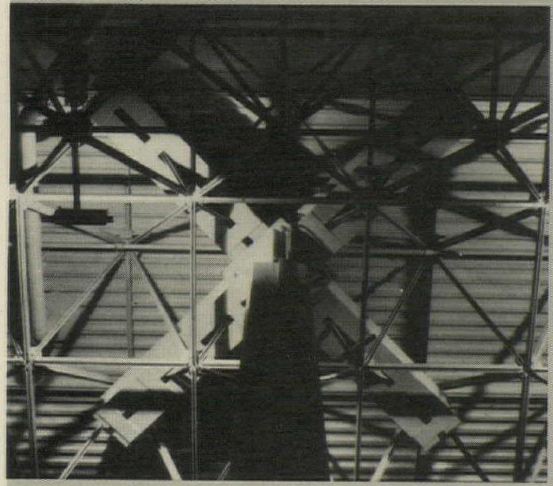
The anticipated installed electrical capacity for the lighting is about 2.3 watts per sq ft. The ceiling cavity containing the mechanical services, designed by G. Granek & Associates, Ltd. is completely accessible.

High-efficiency lamps in high-efficiency luminaires bring "day" to a mall



Special-profile luminaires direct light within narrow angles to illuminate broad areas of structural framing in the high-bay areas and ceilings of the strip mall.

Robert E. Fischer photos



In the large, open, high-bay areas, four 1000-w luminaires are mounted on each column to indirectly light the space (top). At some other locations where the space frame can be seen, it is accented by luminaires suspended from the framing (left). Signs along the mall are highlighted by suspended incandescent luminaires.

■ Taking the obverse approach to much shopping-mall lighting, consultant Sylvan R. Shemitz sought to convey a daylight-type feeling at Eastgate Square, Hamilton, Ontario, rather than the subdued lighting so often used. To do this he designed the system using high-pressure sodium lamps in Elliptipar® luminaires that punch out the light in a narrow pattern across the ceiling planes. At the high-bay areas these luminaires etch out the space-frame members of the roof, and at the strip malls they bounce light down from the lower flat ceilings.

At the narrowest portions of the strip malls, luminaires, using 250-w lamps are mounted 12 ft on center along a fascia above the stores. Where the strip widens, suspended luminaires are used to fill in. These luminaires are shielded by baffles suspended from the ceiling.

The high-pressure sodium lighting power requirement is 1.37 watts per sq ft in the mall and 1.3 in the south court. Incandescent for the strip mall takes 1.14 watts per sq ft.

Suspended incandescent fixtures highlight the designs of store signs along the mall. These lights, signs and baffles can be installed wherever needed through the use of structural channels, approved for carrying power wiring, attached to the ceiling.

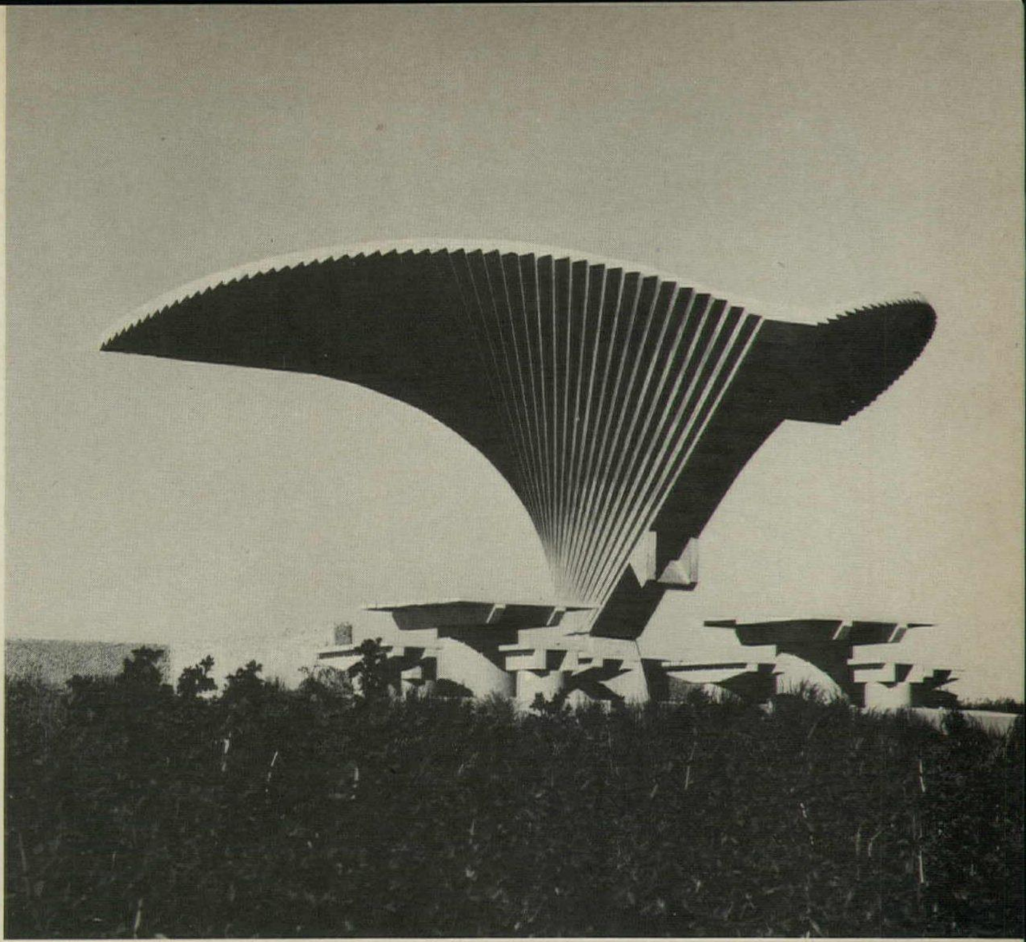
Architects for Eastgate Square were Petroff & Jeruzalski, and architects for the interior were Design International. The owner is Cadillac Fairview Corporation.

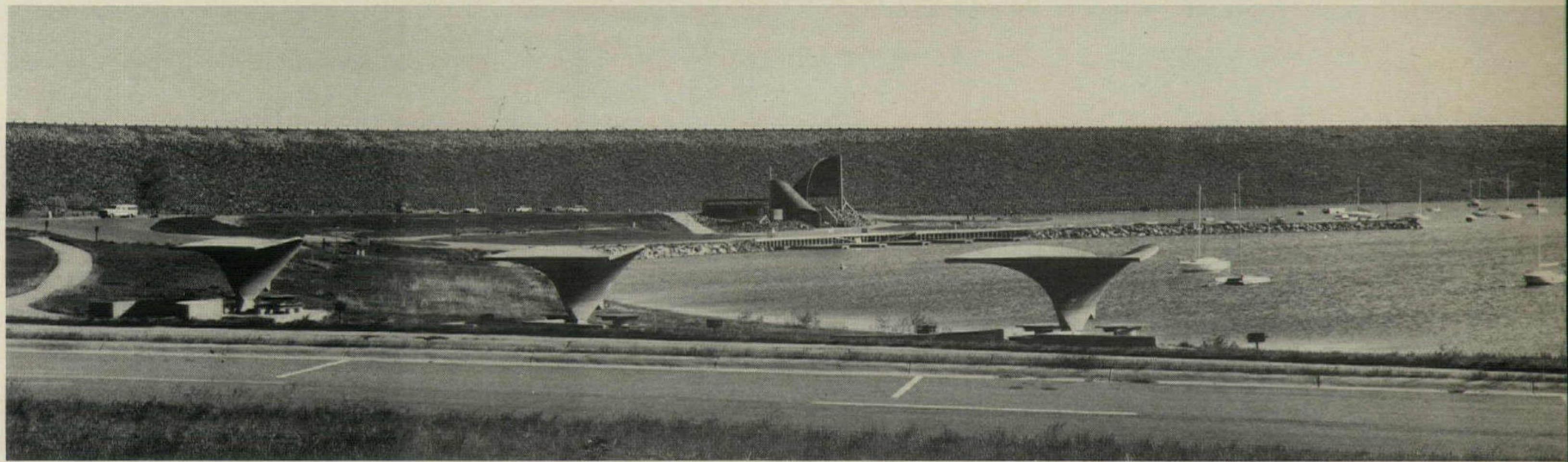
IDEAS

INGENIOUS, BOLD, PLAYFUL

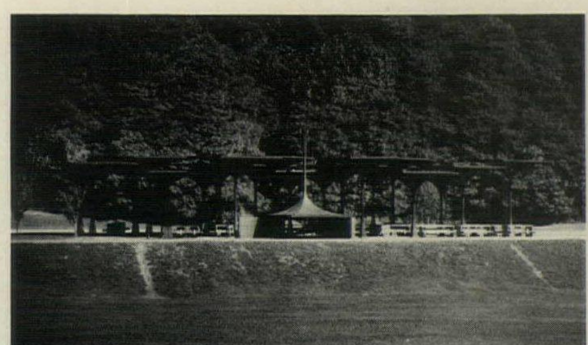
The ten projects shown on these pages, the kind of stories journalists call "short takes," are all buildings that the editors couldn't stand *not* to publish, even though space was limited. Some impressed us with their inventiveness—an unexpected application of a common material, say, or unusually adroit integration of structure and services. Others we found downright amazing—see the incredible unfolding apartment house on page 124. In any case, the collection demonstrates, if further evidence was needed, the remarkable range of designers' ingenuity.

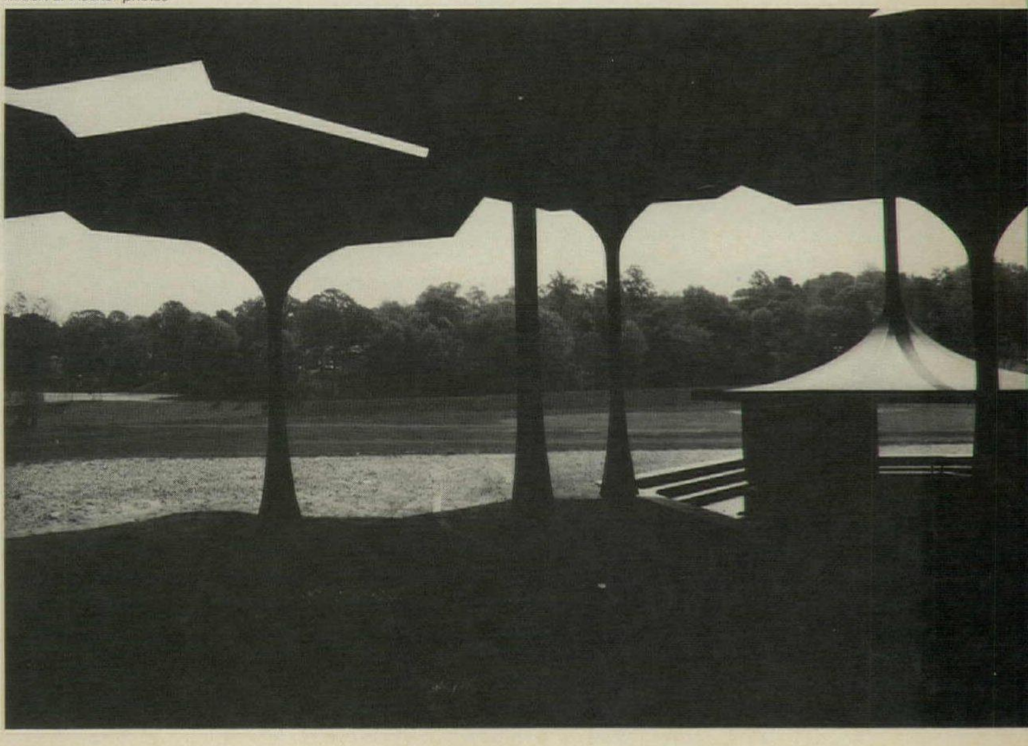
1 The graceful concrete picnic shelters at Denver's Cherry Creek Reservoir were cast in a singular forming system of fanned timbers. Architect Cabell Childress, inspired by Robert Behrens's sculptures and assisted by structural engineers KKBNA, devised a reusable form composed of stacked 3-by-6 timbers, threaded near the base on a pipe. The upper edges were then splayed like a Japanese fan. Rainwater drains through outsize scupper on the fan's spine. Because the recreation area is subject to floods during the spring run-off, picnic shelters and other structures in the park are submergible, needing only hosing and painting to ready them for visitors.



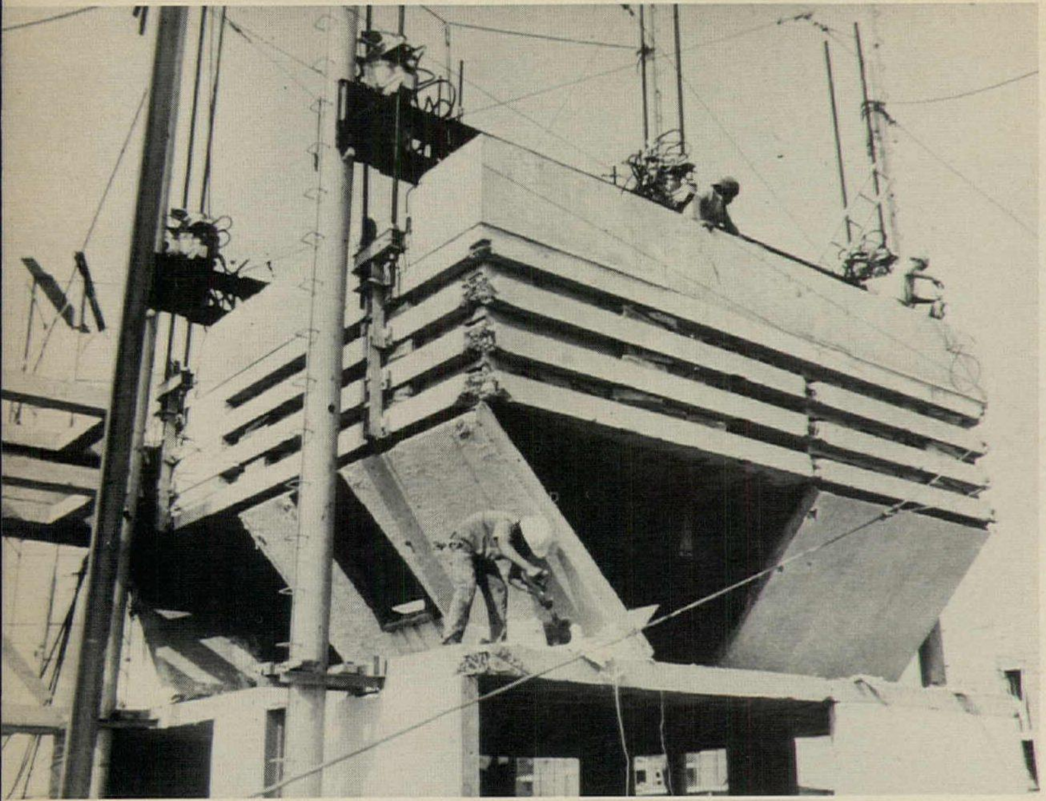


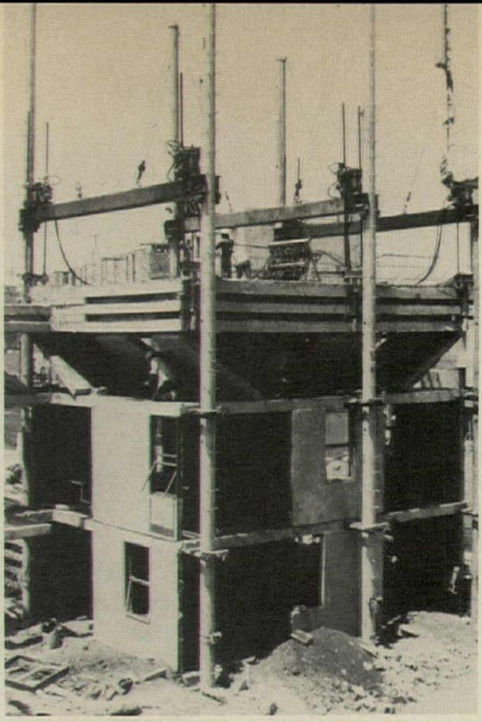
Robert E. Fischer photos

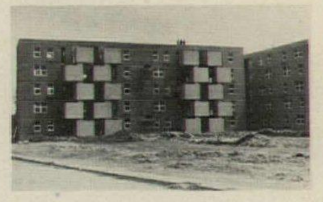




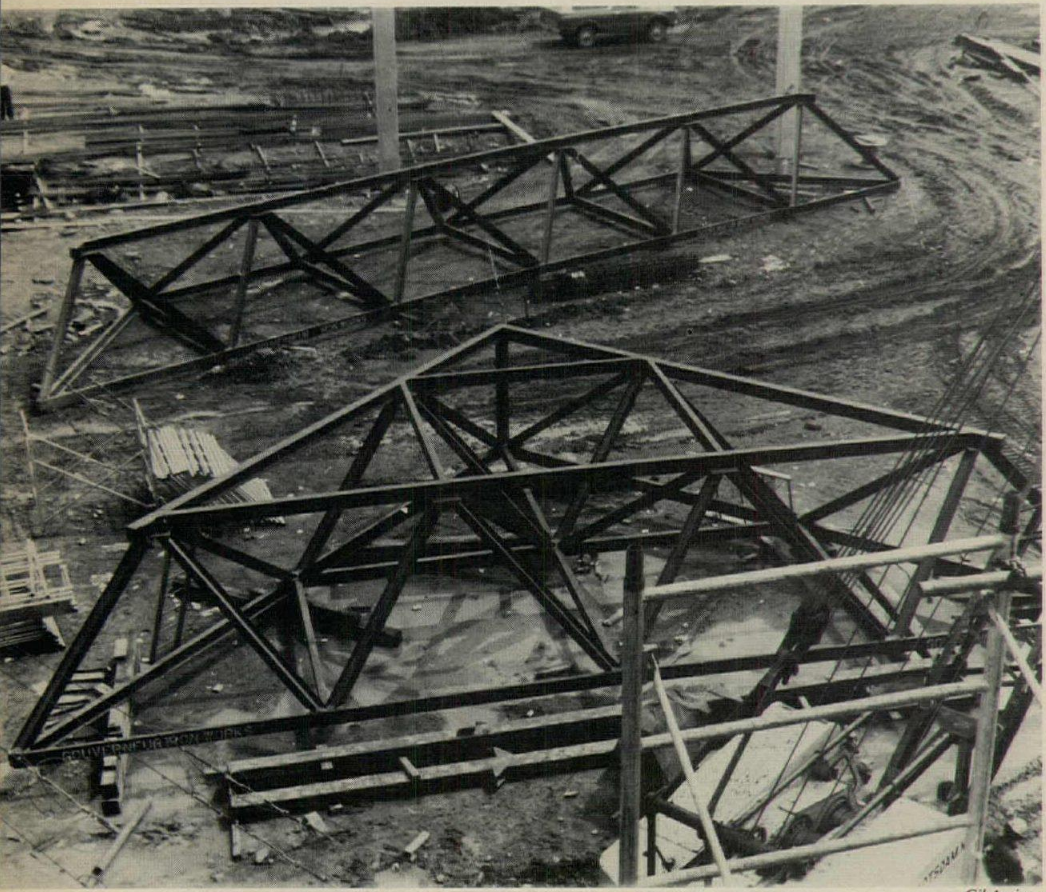
2 The facilities of a boilermaker's plant were employed to shape the ¼-in. weathering steel plates above park shelters at Yonkers, New York. The prefabricated hexagonal "flowers," designed by architect Joseph Roth and structural engineer Robert Silman, rest on flared hexagonal "stems." Each flower has six identical segments joined by continuous welds. Welding rods were also weathering steel, rendering seams virtually undetectable when ground smooth. Inverted flowers become fireplaces, stems become chimneys. Fabricators were United Iron Inc.



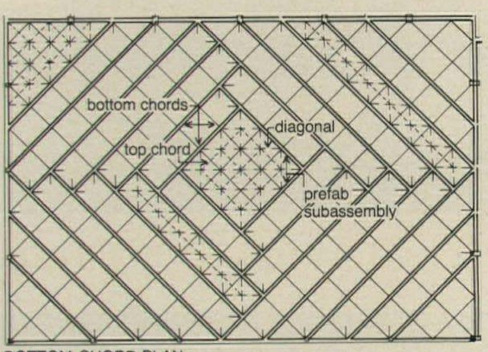




3 Unfolding like a cunning Chinese toy, a stack of sandwiched concrete slabs and bearing walls rises from ground to fifth floor in about ten hours. The stack is cast-in-place, the ground slab serving as the bottom of the wall forms, the finished walls serving as the bottom of the next slab form, and so on. When the stack is complete, jacking lifts hoist each slab into place, and the walls swing out on special hinges. The walls are then plumbed and wedged, the slab is lowered until it bears on the walls and—*voila!* Bricks, covered with light mortar, fill the spaces between wall forms and are later used for interior construction. The Cortina Building System was invented by Mexican engineer Pablo Cortina Ortega.

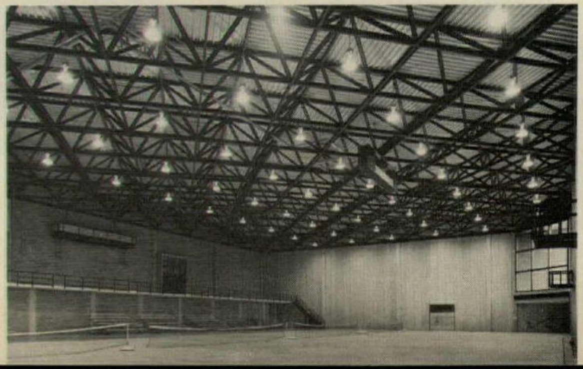


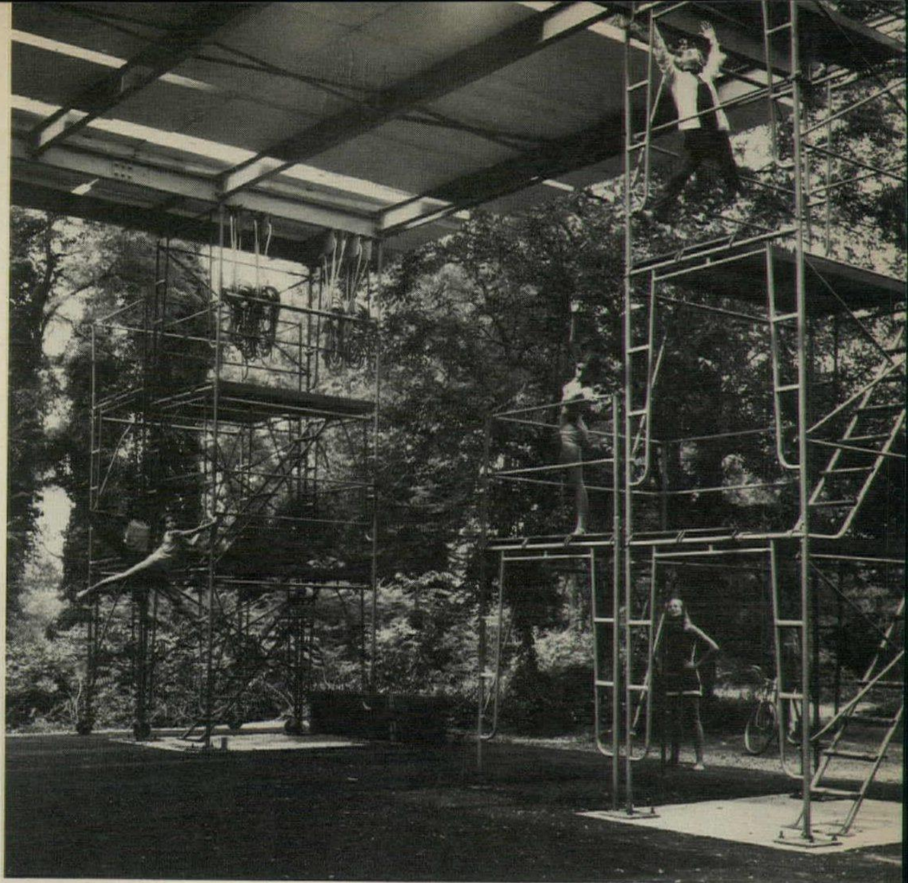
Gil Amiaga



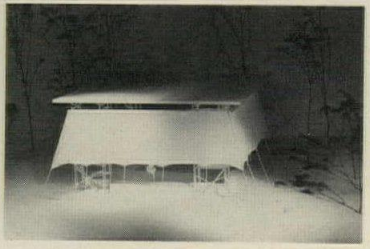
BOTTOM CHORD PLAN

4 While space frames are efficient in the use of steel, cost of making connections has to be held down for the frames to be economical. Engineer Paul Gugliotta does this, in a system he has patented, by prefabbing shippable-size space-frame units in a fabricator's shop, to be bolted together later on site. The photos and plan are of an athletic building for SUNY at Potsdam, New York, by architect Richard Moger (see RECORD, March 1975). With skewed arrangement (in contrast to an orthoganal one), the corners are stiffer than the center, which means that stresses are equalized between structure members.

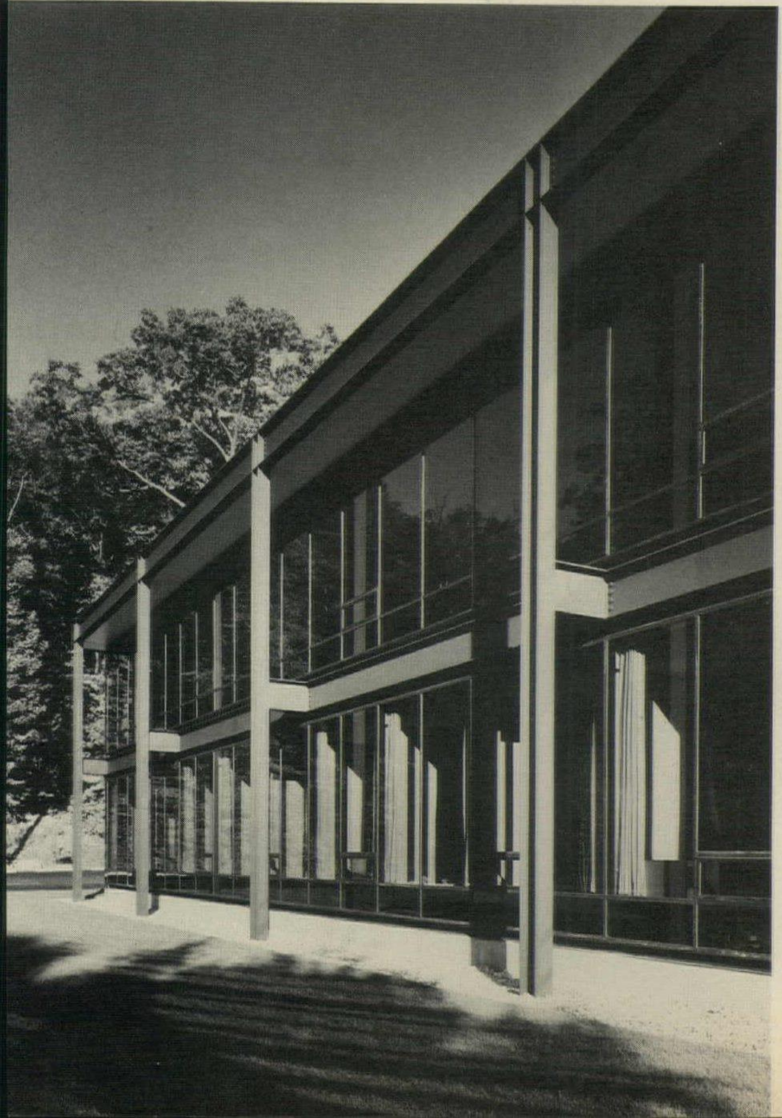


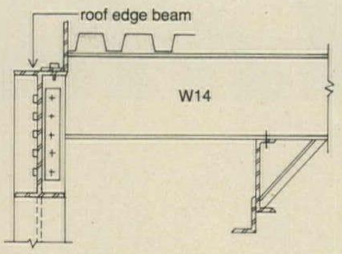


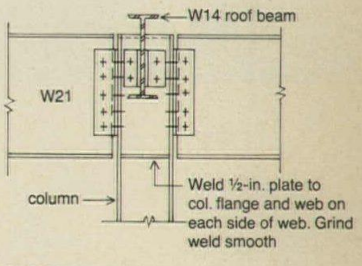
5 Standard scaffolding, commonly a temporary affair, becomes permanent structure for a dance and drama pavilion at Croton Point Park, New York. Architect Robert L. Rotner, who designed the pavilion for the Westchester Performing Arts Camp, intended to give young actors, musicians, directors and stage managers a flexible space with easily maneuverable elements—performance platforms on four corner towers are lightweight plywood panels, and rigging, which travels on roof beams and joists, is simple. Sailcloth curtains provide protection from sun and rain. Contractor James Hamilton, whose usual job is building scenery, brought the building in at $20,000.

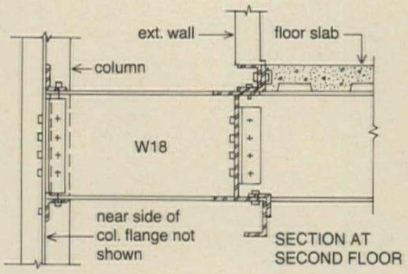


Joseph W. Molitor photos

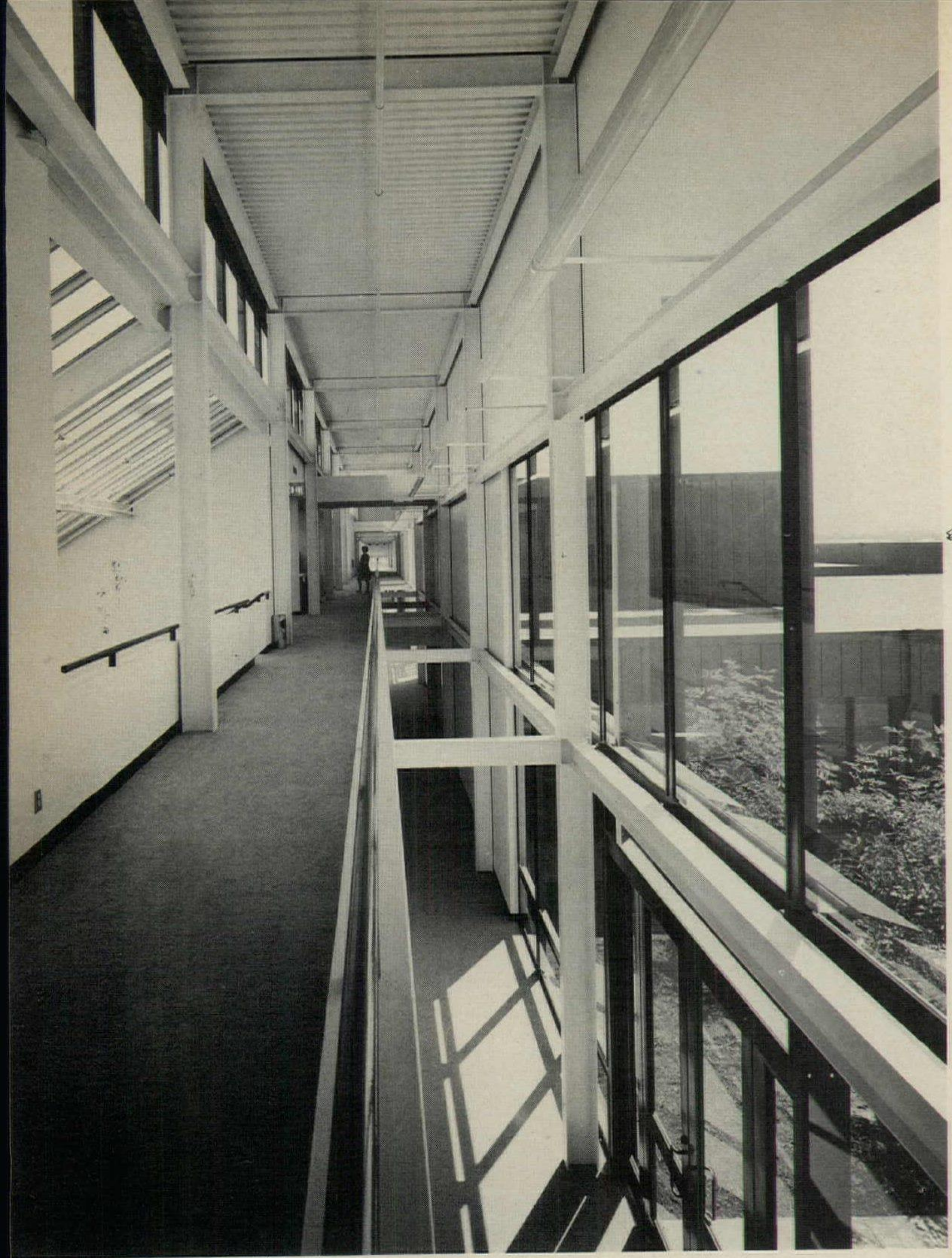


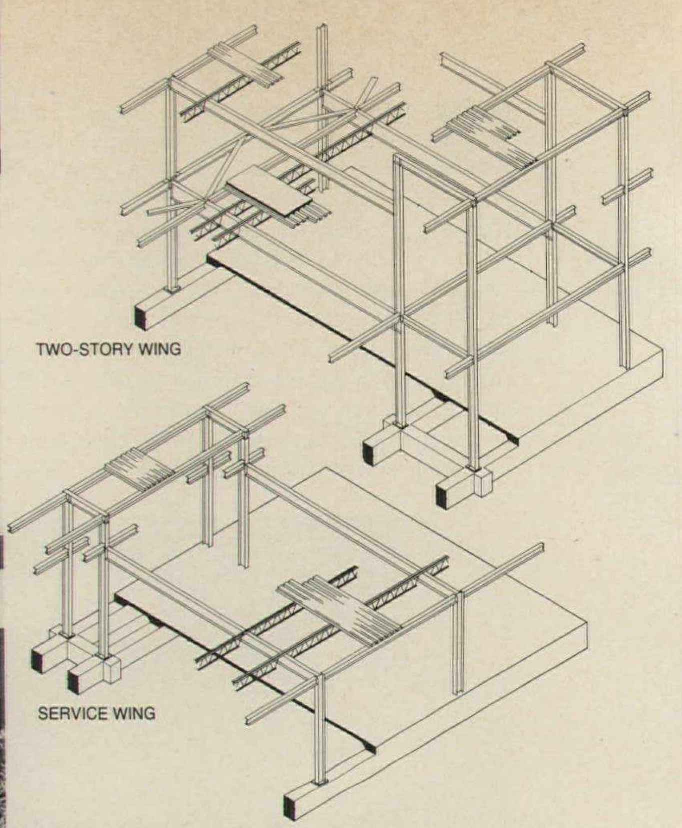






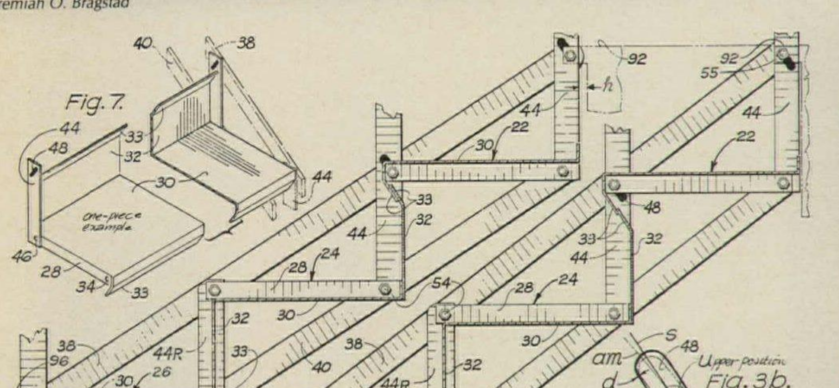
6 Courtesy to its affluent residential neighbors in Briarcliff Manor, New York, and respect for the natural beauty of its wooded site obliged the Frank B. Hall office building to assume a low-key, high-class manner. Architects Fleagle & Kaeyer wanted the appearance of "mature" weathering steel. Because this material matures slowly in clean country air, however, the architects and structural engineers Throop & Feiden designed an elegantly detailed steel exoskeleton and painted it dark brown. To foster an appearance of smooth integrity, all corner joints are mitred and shop-welded. The exposed bolted connections were carefully designed for symmetry, and odd bolts were concealed.

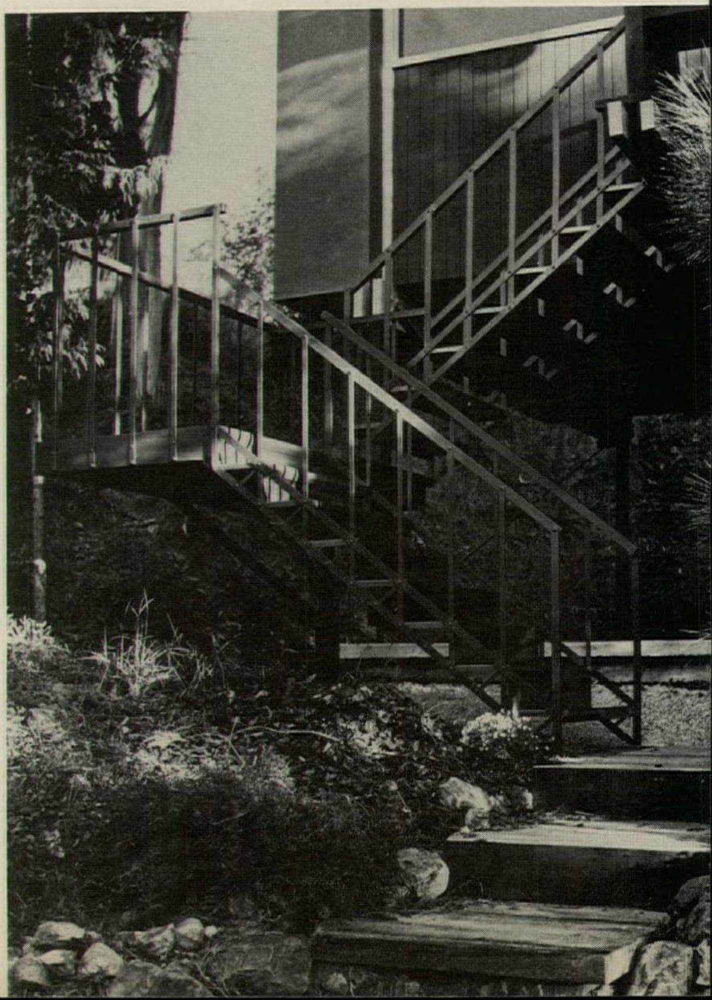




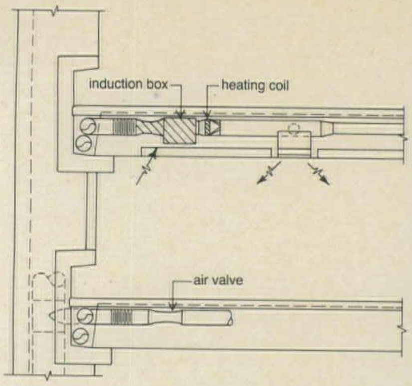
7 GRT Corporation is a fast-growing recorded tape company whose new headquarters needed the capacity to expand as fast as its business. Indeed, the area of the building increased 20 per cent during the working drawing stage "with no fuss at all," according to structural engineers Hirsch & Gray. The repetitive forms and a high degree of prefabrication—all welding was done in the shop—minimized erection time. The structural system comprises two patterns of prefabricated rigid-frame bents: one-legged frames with beams spanning to pinned connection at outer columns, and two-legged frames (the wickets in corridor). Brown/McCurdie/Nerrie were the architects.

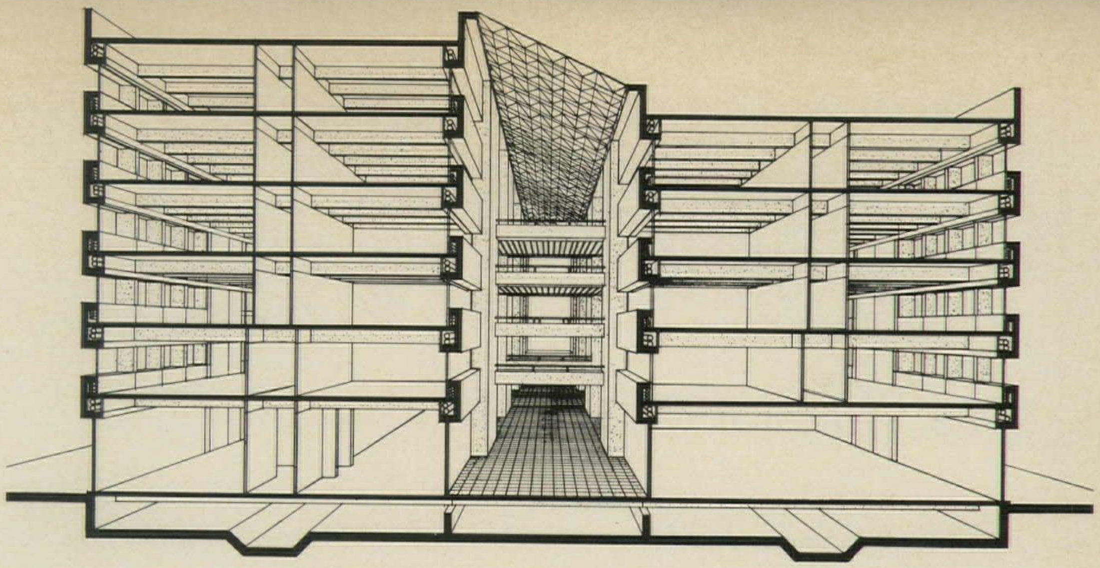
Jeremiah O. Bragstad





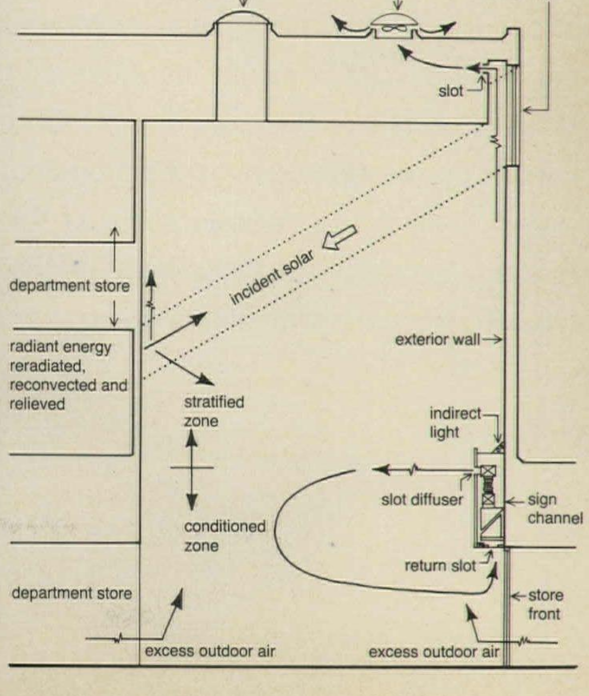
8 Treads and risers of this ingenious stairway "self-adjust simultaneously and cumulatively to fit either the total rise or total run," according to the patent granted architect-inventor Joe Warren Cox. Stair edge is a "kinetic truss" composed of a two-part stringer, horizontal tread carrier and vertical tread spacer, linked by pin through slot in top stringer. Risers and treads are always at right angles, and proportion of height to depth is always correct.





9 When the heavy mechanical loads inevitable in laboratories combine with an energy crisis, design problems proliferate. At Texas A&M's agronomy lab, architects Harrell & Hamilton oriented the building's two wings so that, wherever the sun, one wing always shades the other. Chenault, Brady & Freeman's carefully designed hvac system (see notes at left) is housed in structural risers outside the building and distributed laterally in spandrel beams; open side of these precast members offers easy access to services.

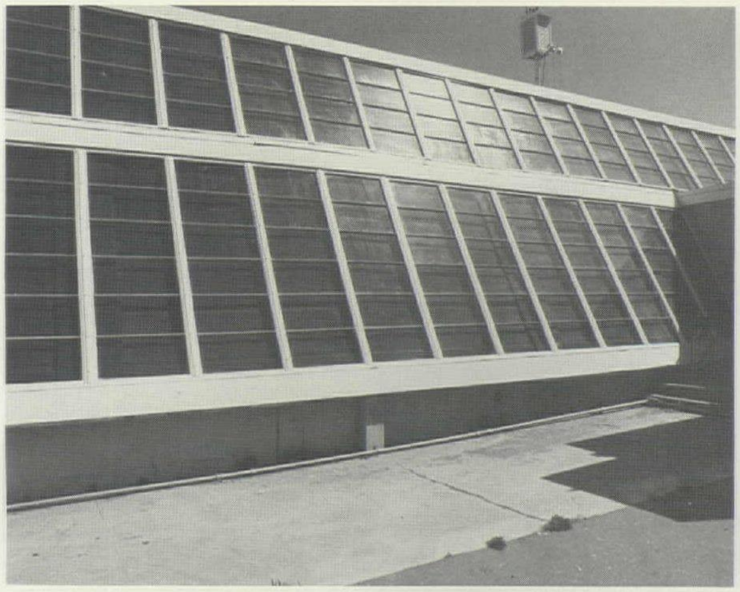
10 At the Saks Fifth Avenue shopping mall in Houston, mechanical engineers Chenault & Brady took advantage of naturally occurring air stratification to relieve load on the hvac system and conserve conditioned air at pedestrian level, and then added a little persuasion to ensure that stratification would be maintained. Exhaust fans draw heat through ceiling slots. In addition, however, the entire mall acts as a relief air plenum for the flanking stores, and excess pressurized air forces waste air upward. Beyond that, solar radiation from the skylights and clerestory is re-radiated from walls and reconvected upward rather than being absorbed into the air system. And finally, stratification is encouraged by specially designed slot diffusers concealed at the top of the sign channels, which have a return slot at their base. The mall was designed by architects Neuhaus & Taylor.

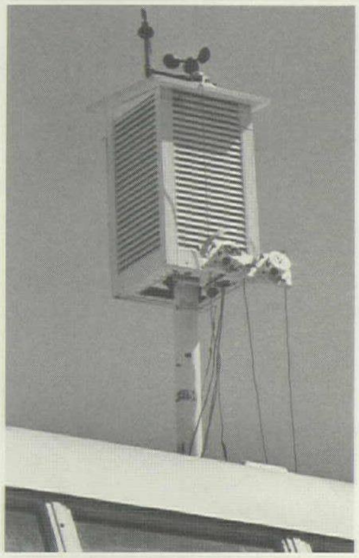


SOLAR ENERGY SYSTEMS: THE PRACTICAL SIDE

In the 1974 engineering issue, we showed how engineer Frank Bridgers has been putting solar energy to good use in buildings for 20 years. His latest endeavor is the preparation of a design procedure for solar-assisted heat pump systems for the National Science Foundation and ERDA. To validate the procedure the solar system in the Bridgers and Paxton office building (across page) has been revamped and highly instrumented to get the kinds of data needed. The information is sent over leased wires to Penn State, where Professor Stanley Gilman is analyzing and plugging it into a computer model that he programmed of the Bridgers and Paxton system. This article reviews some of the current attitudes about solar systems, some of the developments on the solar front, and then describes what Bridgers and Gilman are doing.

Data is being taken on this solar building to validate a design procedure for solar systems



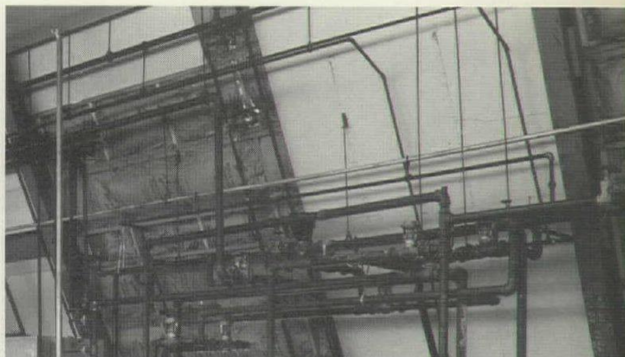


Data from a weather station and from instrumented equipment in the Bridgers and Paxton building is acquired by computer and sent to Penn State for analysis.

Frank Bridgers' comment that he has had more inquiries about solar heating in the last year than in the previous 15 is hardly surprising. What is different about now and 20 years ago, when Bridgers and Paxton built their own solar building, is the escalated cost of energy, for one thing, and the considerable dollar backing for solar-energy research by the Federal government, for another. Of the 138 solar-heated buildings reported by William A. Shurcliff in his May 1975 survey,* nearly 100 of them were initiated after 1970. As might be expected, most of the buildings are houses, though several schools and office buildings are listed (including a pilot project for a 10-story office building).

Solar-heated buildings that work well have been and are being constructed. Technology is not the basic question. The question, really, is how do the economics work out? Solar-heated buildings are capital-intensive because solar radiation is "low-level" energy. Large areas of collectors have to be provided to collect it, and some means has to be provided to store it to make up for nights and cold, cloudy daytime weather. Even so, solar-heated buildings are competitive now with conventionally heated ones at present energy costs when there is low-interest financing, as with public buildings. The really tough question is what is going to happen to the cost of electricity, gas and oil in the next 10 years. In 1973, engineer Bridgers estimated a 300 per cent increase in the cost of natural gas by 1990, and a 125 per cent increase in the cost of electricity. Now, he views these figures as very conservative.

Though the completeness and accuracy of weather data (solar and temperature) leaves a lot to be desired; though there is no commonly accepted design procedure (right now) for solar-heated buildings; and though, strictly speaking, the economics are far from simple, still a pretty good evaluation can be made of owning costs for solar-energy systems right now. The costs of owning a solar heating system include the amortization of the collector, the storage unit, the pumps and piping (or fans and ducting), and the cost of associated controls. Frank Bridgers reports that the increase in construction cost for buildings with solar-assisted heat pumps in the Mountain States is about 10 per cent for large commercial buildings, and about 20 per cent for small commercial buildings and for houses. A $60,000 house, then, would cost $72,000 with solar heating. Operating costs include the power for pumping fluid or moving air in the system, and maintenance of the system including any repairs to the collectors.



Solar Heated Buildings, A Brief Survey, ninth edition, W. A. Shurcliff, Cambridge, Massachusetts.

One of the major cost items for a solar-energy system is that of the collectors. Some published economic studies on houses have used collector costs as low as $2 to $4 per sq ft. Yet, bids based upon a performance specification—and recently received by Bridgers and Paxton on collectors for a 25,000-sq-ft building at New Mexico State University—ranged from $8 to $22 per sq ft. Though there are several well-known companies, including a large glass company, making collectors, most of the 60 some companies in the field are small—which means they have no mass-production capability. However, the market still has to justify mass production.

Bridgers feels that the only way there will be a serious market is if the government requires solar systems on their buildings wherever technically feasible. A market can then be developed on the basis of low-interest appropriated funds. If collector costs come down, then, he says, the private sector might get interested.

Automatic controls for the solar energy system are a significant premium cost over the controls required for conventional systems. The proper control system is very important, says engineer Bridgers, and he emphasizes that the consulting engineer must work with his peer at the controls company who will understand what the consultant is trying to accomplish.

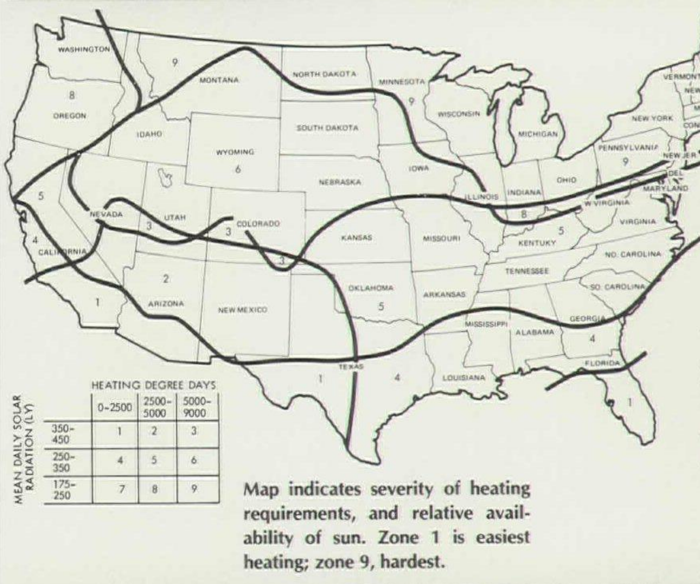
In an energy-supply study for a major new town now under construction in South Carolina, consulting engineers Flack and Kurtz recommended that only heating of domestic hot water by solar collectors be investigated for direct use of solar energy. They also suggested that use of water-to-air heat pumps using sun-heated water from a pond through a secondary water piping system (serving fire protection, lawn sprinklering, etc.) might have economic merit.

Integration of solar systems and architecture is achievable

By now, most architects realize that a large area is required for the collector. Many recent designs and proposals exhibit skillful handling of this problem. In the hands of a good architect, the design can be both attractive and interesting.

An excellent example of a building in which the solar-collector system is well integrated into the building fabric is the design for the Shiprock Comprehensive Health Facility in Shiprock, New Mexico (see page 134). The building will be a major addition to an existing facility and will be designed with a 150-bed inpatient capacity, expansible to 210 beds, and with complete outpatient facilities. The facility, designed by architects Flatow, Moore, Bryan, and Fairburn, will be owned and operated by the Indian Health Service, a branch of HEW. Consulting mechanical engineer is Bridgers and Paxton.

A grant from ERDA (Energy Research and Development Administration) covers the additional cost of design, construction and installation of the solar energy plant, i.e., above the normal cost of a conventional heating plant. The IHS gets a heating system that will save energy and costs, and ERDA will be able to use the facility as a "test vehicle."



Map indicates severity of heating requirements, and relative availability of sun. Zone 1 is easiest heating; zone 9, hardest.

Graphs reprinted with permission of ASHRAE, Inc. from Proceedings of the Workshop on Solar Heating and Cooling of Buildings. Copyright, 1975 by ASHRAE.

The original central plant did not have sufficient capacity for the addition, although there was enough steam available for sterilizing and for domestic hot water. Whenever the temperature of the solar storage tank drops below 60F, heat from the domestic water system is taken to elevate the temperature during nighttime only, when the requirement for domestic hot water is very low.

The various bed wings (surgical patients, children, postnatal, etc.) are square in shape and tipped on corners in relation to a long corridor. This corridor, which prevents congested and undesirable circulation through the wings, serves advantageously as a location for solar collectors.

Architects Burt, Hill & Associates suggest that if space heating and domestic hot-water heating are the principal solar-system requirements, it is desirable to tilt collectors to favor the wintertime sun angles. This is done by adjusting the tilt from the horizontal to an angle from between 10 and 20 degrees added to the degrees of latitude. Thus in the Southwest, the collector tilt might be between 50 and 60 degrees.

If solar cooling is the primary consideration, then the latitude minus 10 to 20 degrees would tend to maximize collection during summer months. The firm notes that collector tilt is more sensitive in the higher latitudes, and that, in some instances, a vertical wall collector would not be out of the question.

Solar cooling takes more collector area and hotter water

When a building requires cooling, the heat pump, of course, operates like a conventional air conditioner, rejecting its heat to an evaporative cooler or to a cooling tower. And running the compressor takes electrical energy. So for this reason, solar cooling with absorption refrigeration arouses interest.

Absorption refrigeration uses lithium bromide salt solution or aqueous ammonia solution to create an evaporative effect that results in cooling. As these solutions become more dilute in the receiver, they have to be reconcentrated in the generator by means of heat so that the process can continue. This usually is accomplished using steam or high-temperature water over 200F.

Some investigators have examined the potentialities of absorption refrigeration cooling in the heat generation range of 140F to 180F, considering the use of flatplate solar collectors. The coefficients of performance are reduced, and particularly, the capacities of available equipment are a great deal lower than when the heating source is 200F and higher. Capacity may be cut by 25 to 45 per cent of the rated capacity. If the temperatures are to be kept in the 200F plus range, then either a high-performance type collector is required, or an auxiliary energy source (a boiler) must be available to maintain the temperature.

Having to oversize an absorption refrigeration unit for a commercial or institutional building is not too important a factor, however, because refrigeration represents only about 10 per cent of the total hvac system cost. It would be more significant for a house, however, where the cooling unit would represent a higher fraction of the total.

The engineering analysis of a solar design for a 25,000-sq-ft building at New Mexico State University by Bridgers and Paxton showed that nearly three times as much solar collector area was needed for solar cooling as for heat-pump-assisted solar heating, and also a pressure-type water tank would be required for the higher-temperature water.

Frank Bridgers has said that solar cooling should be considered when the cooling load is predominant, as in Texas and Arizona and Southeastern states. Where the building is above 35 degrees latitude, and the heating load is significant, he feels that the heat-pump assisted solar system is the most economical.

Flat-plate solar collectors can produce summer water temperatures of 180F or so, but achieving 200F or more is difficult, unless high-performance types are used. A high-performance collector is one using two sheets of glass over a non-selective black surface, or one using one or two sheets of glass over a selective surface. (A selective surface is one that has a high efficiency in absorbing solar radiation, but a low efficiency in re-radiating heat to the sky; in technical terms, a high absorptivity for solar radiation, and a low emissivity for low-temperature—200F—radiation.)

Corning has developed a high-performance tubular solar collector that incorporates a selectively-coated flat absorber plate housed within a highly evacuated glass tube. Corning says that working temperatures of 250F to 300F are possible with good efficiency. (With conventional flatplate collectors, heat losses increase greatly at higher temperatures because of edge and back losses.) The Corning collector is being produced in only limited quantities for experimental and demonstration purposes. Its cost now is about $20 per sq. ft.

Survey shows the public's interest is tempered with concern for cost

In their Phase O study for the RANN program of the National Science Foundation, the Special Systems division of Westinghouse Electric Corporation surveyed seven groups—architects, builders, labor, manufacturers, energy suppliers, financiers, and potential consumers—in regard to solar systems. Results indicated a broad spectrum of reaction, they say, ranging from interest and acceptance to skepticism. Following are some of their findings: Builder reaction ranged from skepticism to qualified acceptance. None is anxious to pioneer with an untried and unproven system.

Energy suppliers are the least enthusiastic. Their objections center on cost, complexity, and the constantly fluctuating demand on their services.

Manufacturers reacted quite favorably. Several said they were engaged in assessments of the feasibility of solar energy usage.

Consumers indicated a decreasing acceptability with increasing costs.

Architects favored considering all types of buildings in introducing solar heating and cooling.

Financiers believe that a solar supplement would have no direct or adverse effect on financing.

Environmentalists endorsed solar systems with some reservations concerning esthetics.

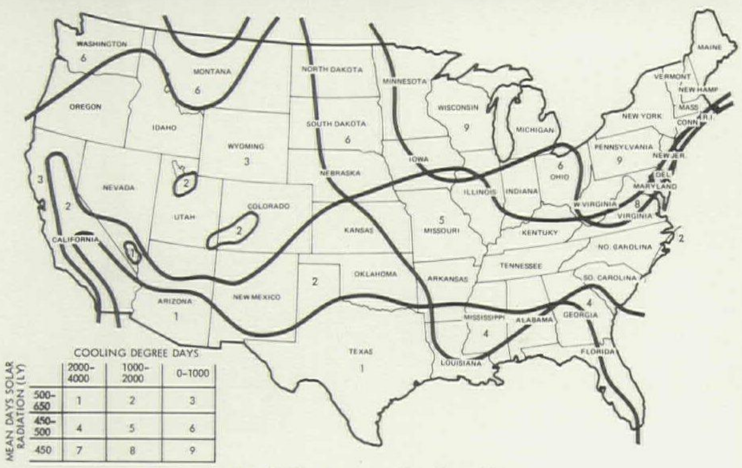
The Westinghouse group also noted that demonstration programs by the government can accelerate solar-system use, and they also can serve to help assess the extent that further government assistance will be necessary.

In its study for the same program, the TRW Systems Group suggested that a much more extensive effort is required to integrate the solar-system design with the building design in order to reduce the incremental capital costs.

TRW also states that the financial community must be educated to consider the operating savings associated with solar energy: "Unless the financial community recognizes the capital payback which results from lower operating costs, the market for solar energy will be restricted to the higher income segment of home buyers."

A new design procedure will be validated by data analysis

Because there are a number of uncertainties in the data available for the design of solar systems, engineers tend to be somewhat conservative in their approach. An example might be the provision of a larger water tank than experience might show to be necessary. In the past about the only measure of adequacy of a system was whether it met the load imposed upon it—or whether it didn't. Observations were made of storage water temperatures and the like, but instrumentation was meager, as was availability of correlated data.



Map indicates severity of cooling requirements, and is similar to the one across page. Effect of humidity is not considered.

For that reason, the National Science Foundation initiated a project (now being supported by ERDA) with The Pennsylvania State University, Bridgers and Paxton, consulting engineers, and the University of New Mexico for the development of a system design manual for solar-energy assisted heat pump systems that will be applicable to all geographical areas and all types of commercial and other non-residential buildings.

To do this, the Bridgers and Paxton office building in Albuquerque—the first commercial building to be solar heated (1956)—was taken as the test facility. The principal elements of the system for the 8,300-sq-ft building are: a 750-sq-ft solar collector, a 6,000-gallon underground water storage tank, one 7½ ton water-to-water heat pump, and five small-tonnage water-to-air heat pumps. The collector has single glazing, is tilted 60 deg. from the horizontal and faces due south.

The original collector system was composed of tubular aluminum plates painted black. Plain water was used in the collectors, which were drained and vented from time to time in freezing weather. Shortly after the system was put in operation, leaks occurred due to corrosion of the aluminum panels. The problem was circumvented by soldering ½-in. copper tubes on 6-in. centers to the back of the plates. An epoxy cement was placed in the crevices between copper tubes and the plates with the hope of increasing heat transfer.

A secondary problem was the deterioration of the rubber hose connectors between the collectors and the steel piping collecting system. The hose connectors were replaced with copper.

During the first year of operation, Albuquerque had the cloudiest January in weather bureau history. Yet the building required only 8 per cent of the total yearly heating requirements in electrical energy (via the heat pump) for the entire heating season.

In 1962 the building was nearly doubled in size, and use of the solar system was terminated. Then in 1974 the system was reactivated. The collector fluid was changed to water and ethylene glycol (antifreeze). In order to minimize the amount of ethylene glycol required, a heat exchanger was installed to transfer heat obtained from the collectors to the ordinary water in the 6,000-gallon storage tank.

(Engineers know now that precautions must be taken in the heat transfer fluid used with aluminum-tube collectors. Engineers Flack & Kurtz are using a special industrial heat transfer fluid—similar to a light oil—for the system they designed for the 10,000-sq-ft science facility for Madeira School outside Washington, D.C.).

The major steps involved in preparing the design manual are: 1) determine actual performance by analyzing collected field data; 2) correlate the results with computer-predicted performance; 3) develop and refine a computer model of the building and system; and 4) use the computer model to generate information for the system design manual. The computer model was programmed by Dr. Stanley F. Gilman and his associates at Penn State.

The Bridgers-Paxton system has several different operating modes. The solar collector circuit operates only when solar energy can be collected. The first mode is in operation when the storage water system can satisfy the space heating requirements. The air-handling unit is fed hot water directly from the storage tank, and the water-to-water heat pump is off. The second mode is in operation when storage water temperature cannot satisfy the heating requirement; then the heat pump operates with the storage water as the heat source, and delivers higher temperature water to the air-handling unit. The third mode is a cooling mode, when the occupied space requires cooling during the winter. Then the water-to-water heat pump shifts to cooling. The heat removed from the building is rejected to the storage tank as an additional heat source.

The "heart" of the data acquisition system is an IBM System 7 Computer. It measures some 70 points of data and sums or averages values over a basic six-minute cycle. Data collected include: 1) measurements from a "weather station" on the roof, 2) solar radiation on the plane of the collector, 3) indoor conditions, and 4) kwhr consumed by all electrical devices (compressors, pumps, lights, etc.). The frequency of measurement depends upon the variable involved: solar radiation is measured every half second; indoor dry-bulb temperature, which is nearly constant, is measured only every six minutes. The data is stored on a disc and, once a day, is sent over telephone lines to the Penn State computer facility where it is subjected to the analysis program. Results are computed on an hourly basis from the six-minute data. If closer scrutiny appears to be warranted, the six-minute data can be printed out or graphs generated (see page 133).

Data collection shows that the Bridgers system worked well

The data acquired over a 100-day period between last December and this March shows that the solar system, itself, was the primary source of heat on 51 days, and on the other 49 days there was heat-pump-assisted heating. Over the 100-day period, the over-all system coefficient of performance (COP), which is the total energy output divided by the electrical energy input, was about 7.0 with intermittent heat pump operation. This means that the heating was accomplished with only 14 per cent of the electric power consumption that electric resistance heating would have required. The average COP during heat-pump operations was 4.0, including the power consumed by the water pumps.

Solar collection performance on a clear day (January 4, 1974) is shown in the graph on page 133. Collection efficiency is 44 per cent, which is only fair, indicating the possibility of some poor tube-to-plate bonds. Nonetheless, on a very cold January 4, when temperature dropped to 7F, 721,000 Btu were collected, which amounted to 73 per cent of the day's requirement.

This summer the system cooling energy is being measured and correlated with computer predictions. Infiltration, a significant cooling load, will be measured by a tracer-gas technique.

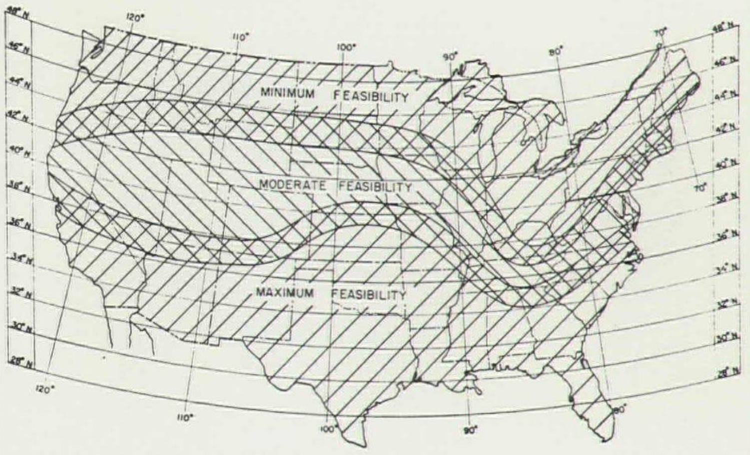
Also, this summer, the heating system is being modified to take into account the water-to-air water-loop heat pumps that were added at the time of the building expansion. An additional storage tank is being provided so that there will be both a "hot" tank and a "cold" tank. The "hot" tank will be used for direct heating, with the water temperature being allowed to rise above 110F, which is too high for the water-to-air heat pumps to reject heat into. The "cold" tank then will serve for heat rejection, and also as an additional heat source for the water-to-air pumps. The over-all system efficiency is expected to improve markedly with the dual-tank system for storage.

The design procedure is tailored for use by typical design firms

The main objective of the design procedure being developed by the Penn State group and by Frank Bridgers is to make it possible for a large number of engineers and architects to design solar-assisted heat pump systems with confidence and with a minimum of research effort. To accomplish this the procedure will: 1) incorporate design procedures familiar to hvac designers such as those in the ASHRAE handbooks; 2) use weather data that is available to all hvac designers; 3) provide a procedure for economic analysis and optimization of solar-collector area and storage that can be run on a small computer.

The critical design elements in the solar-assisted heat-pump system are the size of collector area needed and the capacity of the storage component. Amount of collector area, in turn, will depend upon the solar radiation available and the efficiency of the collector, and the heating load of the building.

The heating load of a building can be determined either manually using ASHRAE procedures or by one of the several computer programs available. The outdoor design temperature for calculating building heat loss will depend upon local experience. The total heating requirements for a given period can then be approximated by using a modified degree-day method that considers internal energy from lights, people, equipment. The ASHRAE Handbook of Fundamentals lists average annual minimums, and temperatures that are not exceeded more than 1 per cent, or more than 2½ per cent, of the hours in December, January and February. But in some cases—and this is true of Albuquerque, for example—use of these values might lead to a considerably under-designed solar heating system. The 1 per cent temperature for Albuquerque is 14F. But the recognized *design temperature* is 0F. There have been periods, such as January 1971, when for a five-day period the minimum temperature was below 0F, reaching a low of —17F. Because a "pick-up" factor or other safety factors generally are not used in solar heating design, a conservative outdoor design temperature should be used.



Relative feasibility of solar-assisted heat pumps is indicated by the cross-hatched zones. Overlap indicates borderline cases.

The collector area depends upon the extent of solar contribution

The procedures listed below are tentative, "simplified" methods of obtaining the data necessary to design collector area and storage capacity of solar systems. The validity of these methods will be tested by the procedure outlined earlier to determine if the proposed design procedure gives acceptable design results. It may be that more vigorous computer techniques will be required.

The type of weather data to be used for sizing collectors depends upon whether the system will consist of only solar energy plus a heat pump (called a "stand-alone" solar system), or whether there will be an auxiliary energy source. In many parts of the West, the days have 70 per cent or more possible sunshine, and a stand-alone system will suffice. But in the Midwest and the East, 25 or even 50 per cent auxiliary heating may be necessary. In any event, the standby system for auxiliary heating will need to be designed for full heating requirements.

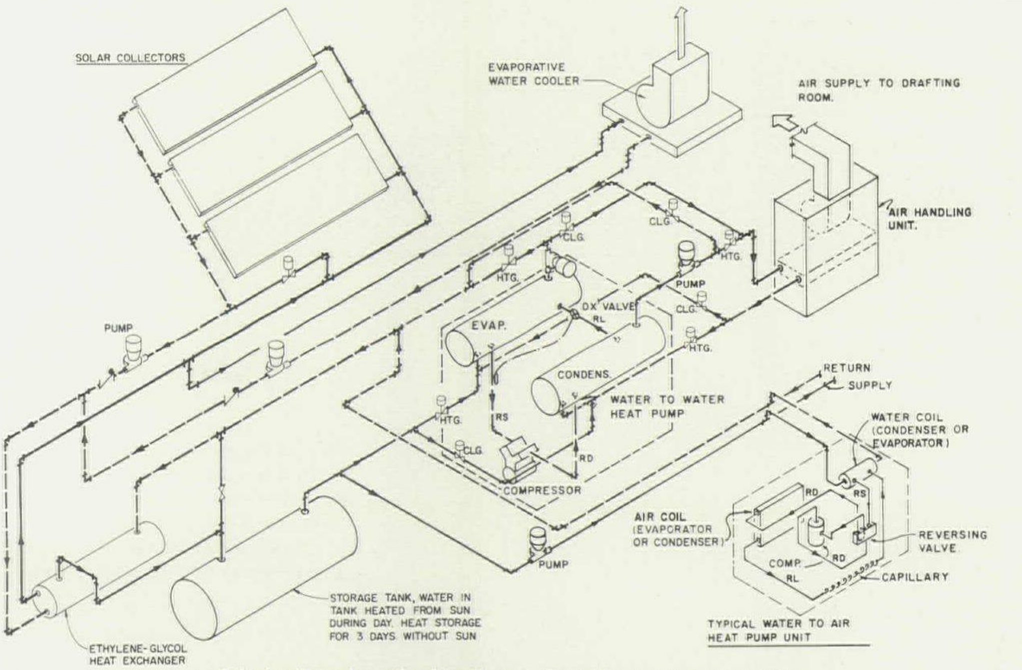
For this type of system, the weather data should be based upon an "average" year. (This data is available from the National Climatic Center in Asheville, North Carolina.) From this data, average daytime and average nighttime temperatures can be determined. Then with these values it is possible to calculate daytime monthly degree days and nighttime monthly degree days; and hence total heating requirements for a monthly period. For most parts of the country, the month of January should be used because it has the coldest average temperatures, and, in many cases, the least possible percentage of sunshine. The total heating load is the transmission load, plus the ventilation load, minus the internal heat.

Solar data for the auxiliary-type system: For determining collector area needed, it suffices to use sunshine data from the Climatic Atlas of the United States inasmuch as the solar contribution is not critical. Mean percentages of possible sunshine and mean daily solar radiation are given. With the charts, it is possible to interpolate values for any location in the 48 contiguous states.

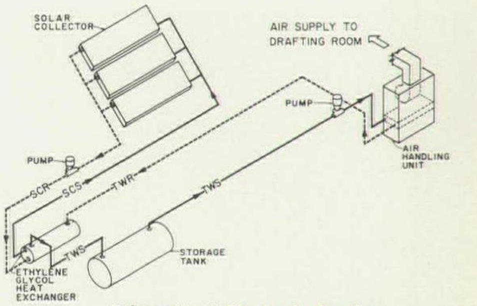
Weather data for the stand-alone system. Because solar contribution is more critical, the weather data used to determine collector area and storage requirements should be that from the cloudiest period in the past 15 years coincidental with the maximum degree days, or the longest extended cold period. For example, for Denver, this period would be the winter of 1972-73. This is the combination of the cloudiest and coldest weather recorded by the Weather Bureau. Such a period can be called the "100-years' darkness" (comparable, in a way to the 100-year winds used for structural and curtain-wall design).

More accurate values for solar radiation than those from the Climatic Atlas can be obtained by using monthly summaries published by the Weather Bureau for 112 locations in the United States. These summaries give average per cent of solar radiation for the month. This percentage multiplied by the average clear-day radiation

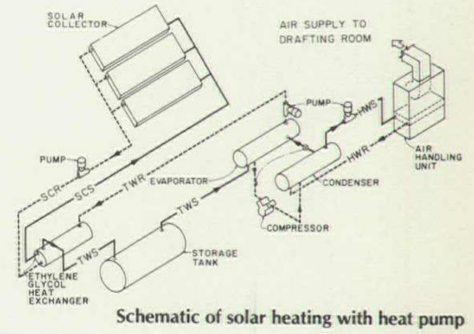
Data from an actual solar-heating system can be used to adjust and "tune" a computer program



Solar heating schematic of total system for Bridgers and Paxton building



Schematic of direct solar heating



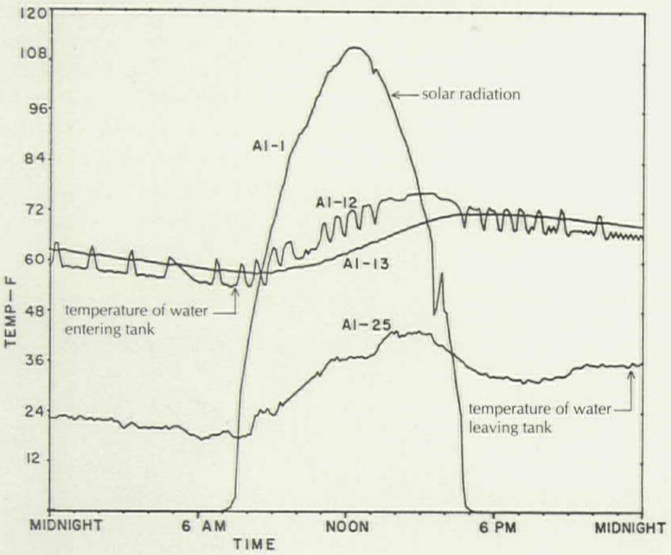
Schematic of solar heating with heat pump

(called insolation) gives the average direct solar radiation per day in Btu/day/sq ft. But, because the total radiation is made up of both direct radiation and diffuse radiation, it is necessary to also determine the diffuse component. Values for the average clear-day radiation and for the ratio of direct to diffuse radiation can be obtained from ASHRAE publications. Average clear-day radiation is given in the ASHRAE Transactions, 1974, in a paper by Morrison and Farber; and ratio of direct to diffuse is given in an ASHRAE bulletin on flat-plate collectors in a paper by Liu and Jordan.

(The mean solar daily radiation values published for U.S. cities may, in some cases, be inaccurate because of inaccuracies present in the solar measuring equipment.)

For the cities having no Weather Bureau, but with airports that record data, such information can be obtained from the National Climatic Center, though this data is not as precise.

Initial sizing of the collector area and storage capacity comes next



Computer-generated data from Bridgers and Paxton building

Collector efficiency is related primarily to the temperature of the fluid from the storage tank and to the outdoor air temperature: the larger the difference, the lower the efficiency. Efficiency also is related to the number of transparent covers over the collector. Up to about a 40F temperature difference, a collector with a single cover (e.g., glass) is efficient enough. With more than that, additional covers give higher efficiencies. Of course, the cost effectiveness of additional covers must be investigated in context with the total design.

The initial size of collector area can be determined by dividing the monthly heating required (January), in Btu's, by the average daily solar radiation multiplied by 30 days (one month) and by the collector efficiency.

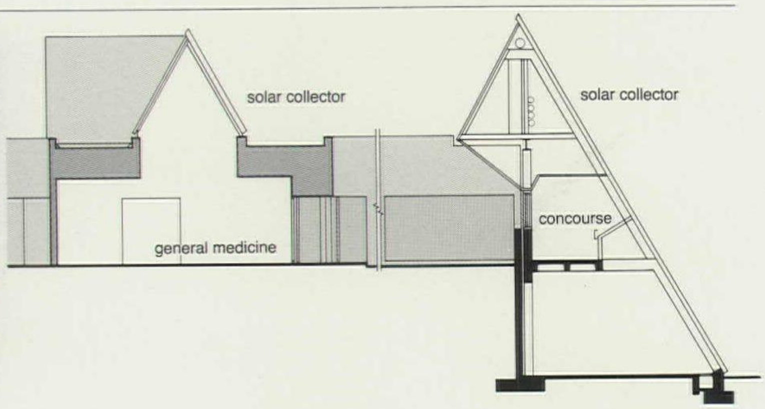
A significant advantage of the solar-assisted heat pump system is that it is possible to use energy collected at very low differential temperatures between the collection fluid and the outdoor temperatures. Furthermore, solar energy can be collected at the highest efficiency when it is most needed, i.e., when the storage tank temperature is at the lowest level. In an area that has zero-degree temperatures, the average temperature of the tank fluid might be as low as 80F. Temperature of the

DAILY SUMMARY SOLAR HEATING STUDY

DAY	AVE. O.A. TEMP	TOTAL CLG.LOAD (TON-HR)	TOTAL HTG.LOAD (MBTU)	AVG.COLL. EFF.	PCT.POSS. SUNSHINE	INSOLATION BTU/SQ.FT.	TOTAL HEAT COLLECTED (MBTU)	HT.PUMP INPUT (KWH)	SUPPLEMENTAL HTG. STANDBY BOILER (MBTU)
1	26.8	27.	23391.	25.	53.	1105.	10639.	724.	0.
2	27.1	17.	23621.	0.	18.	437.	0.	1258.	0.
3	27.6	0.	32925.	0.	0.	94.	0.	1753.	12000.
4	28.3	0.	31657.	27.	32.	704.	7272.	1686.	24000.
5	31.7	341.	24244.	51.	46.	972.	18492.	1291.	12000.
6	32.2	276.	26864.	57.	92.	1849.	39362.	703.	0.
7	16.1	0.	32472.	31.	72.	1468.	17294.	1012.	0.
8	5.0	0.	42421.	45.	89.	1792.	30181.	2053.	0.
9	22.7	92.	28890.	0.	8.	247.	0.	1539.	0.
10	27.8	0.	30919.	54.	100.	2002.	40019.	935.	24000.
11	26.6	0.	32263.	48.	90.	1811.	32774.	686.	0.

Printout of system performance and solar data for modeled system of Denver Community College. (RECORD, mid-August, 1974)

The architect is concerned about how the solar system can be worked into the building fabric



Layout of Shiprock Comprehensive Medical Facility was appropriate for the integration of solar collectors into the design. Drawing shows their location. Architects were Flatow, Moore, Bryan and Fairburn. Consulting engineers were Bridgers and Paxton.

water in the tank, which is "lifted" to utilization temperature by a water-source heat pump, cannot go below 50F if the system is to work properly.

A heat pump system is advantageous when a building needs both cooling and heating because most of the cost of the heat-pump unit can be charged to cooling requirements.

A solar-assisted heat pump system also makes sense from the standpoint of the auxiliary energy—in this case electricity. The utility will need to have the connected load for the heat pump operating as an air conditioner in the summer, so its use in the winter will probably be welcome either as a heat pump or an air conditioner. On the other hand, it is hard to imagine an energy company being happy about providing 100 per cent standby for a fully solar-heated building.

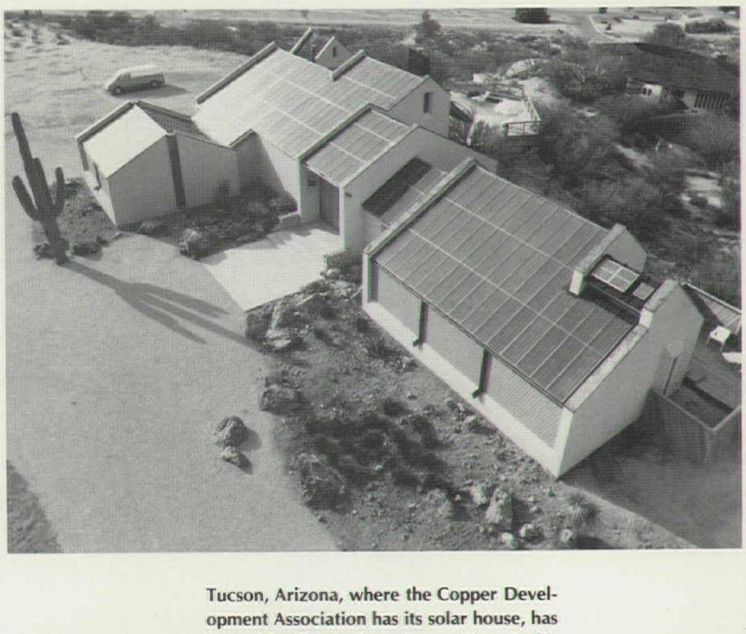
The critical design elements in the solar-assisted heat pump system are the size of collector area needed and the capacity of the storage component. Amount of collector area, in turn, will depend upon the solar radiation available, the efficiency of the collector, and the heating load of the building.

The calculations for amount of collector area required for the Bridgers and Paxton Solar Building indicated 793 sq ft of surface. The area of building heated is 5,000 sq ft. It has a limited number of windows and several skylights.

If the Bridgers and Paxton building were to have been designed for solar energy as the only source for heating, without the heat-pump booster, then the collector area would have had to have been three times larger and the storage tank two times larger than what was installed.

Size of the storage tank depends upon degree of solar contribution

Determination of storage tank size is based primarily on the percentage of the solar-energy contribution to the total. In Albuquerque, a three-day storage capacity based upon maximum heating requirements would be considered reasonable for a heat-pump-assisted solar system. The area of the solar collectors and the capacity of the solar system should be verified by computer. If, however, solar energy is only to supply a fraction of the total requirement, and a full-capacity standby system is provided, much less storage is needed. If the storage system is only to provide 70 per cent of the total, then it would be more economical to provide only a single day's storage capacity.



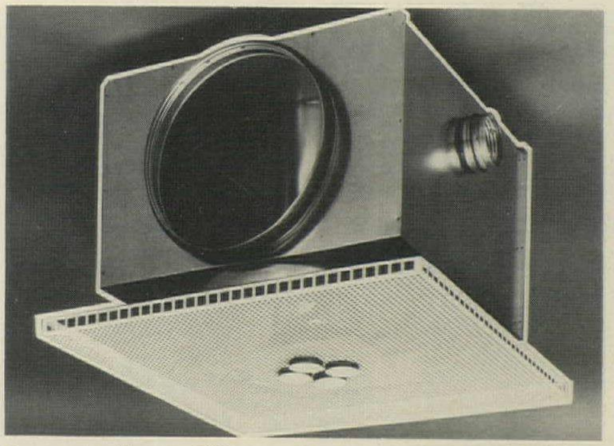
Tucson, Arizona, where the Copper Development Association has its solar house, has favorable climate for solar cooling. Architect: Arthur Kotch, AIA.

Economic optimization calls for computer analysis

Prior to economic optimization, it is possible to verify the preliminary calculation of collector area through computer analysis based upon 12-hour temperature readings for the entire heating season. A heat balance can be made on the storage water to determine when and how much supplementary energy is required. The amount of collector area and of storage can be verified, or an adjustment can be made to meet design objectives. A more accurate method of verifying the preliminary calculations would be to use 3-hour weather observations from the Weather Bureau Stations. And a still more accurate method would use 1-hr observations available from a very limited number of Weather Bureau Stations.

For economic optimization of collector area and storage-tank size, it is desirable to use a computer program that correlates the principal variables.

For more information, circle item numbers on Reader Service Inquiry Card, pages 189-190.



Constant-throw diffuser eliminates air dumping

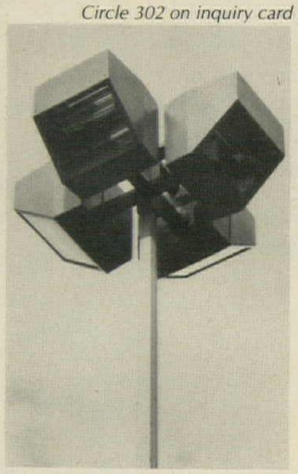
Called the "Paramix" diffuser, the product is fitted with a jet device that uses a small quantity of air at system pressure upstream of the variable-volume box, bypassing the box, to maintain constant throw and diffusion pattern regardless of variations in the main air flow. The system was designed to eliminate air dumping and drafts in occupied zones, and uses no more than 2 per cent of the maximum air quantities at 1 in. wg. pressure to handle up to 800 cfm. The diffuser is furnished with one to four jet nozzles with adjustable orifices for throw direction. ▪ American SF Products, Inc., Fort Lauderdale, Fla.

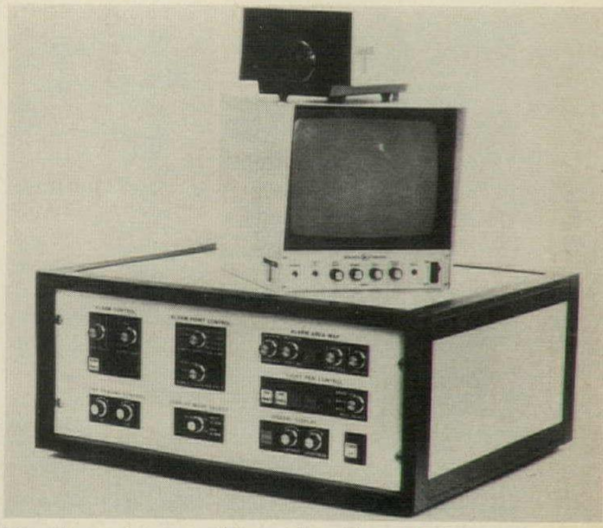
Circle 300 on inquiry card

Precise, low glare sodium lighting

Called the CLX, the new luminaire incorporates a computer-designed aluminum reflector with energy-efficient high pressure sodium lamps to fill an area with the proper amount of low glare light with no spill over. The seamless, two-piece molded housing, finished in bronze coloring, is fiberglass-reinforced polyester. ▪ Crouse-Hinds Co., Syracuse, N.Y.

Circle 302 on inquiry card

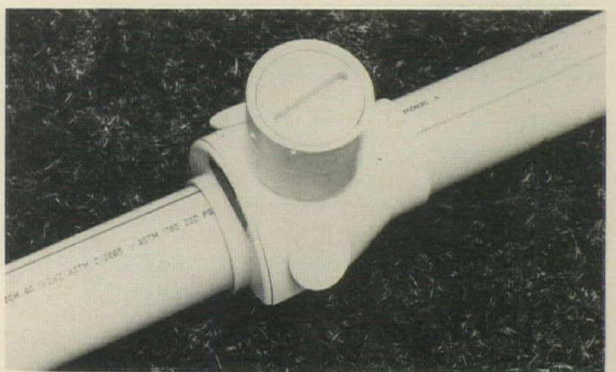




Monitor, alarm and intrusion detection system

A new system to provide complete video monitoring and alarm for intrusions into a selected viewing area can accommodate up to 65,000 plus digital alarm areas within the camera field of view. A remote pan, tilt and zoom control can be operated either manually or automatically by intruder position signals. The unit is recommended for virtually any building security application. ▪ Video Tek, Inc., Mountain Lakes, N.J.

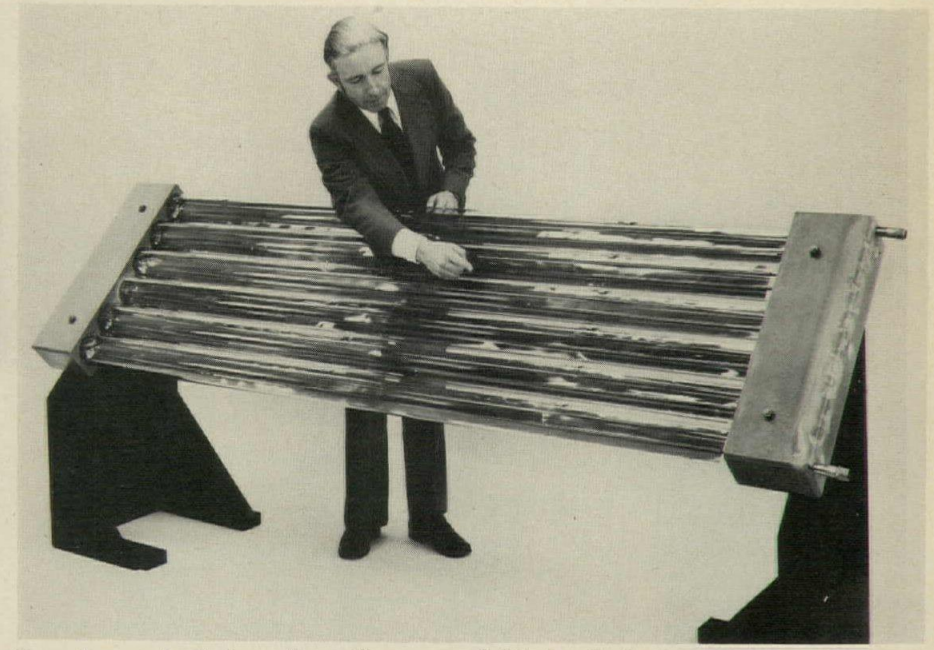
Circle 303 on inquiry card



Vinyl backwater valve prevents sewage backflow

These in-line vinyl backwater valves, said to prevent backflow from the municipal sewer into the house during heavy rain or flood conditions, weld directly into PVC building sewers and drains without requiring adapters. The company claims the valves conform to all provisions set forth in BOAC plumbing codes and offer full-flow and positive mechanical seal. The vinyl backwater valves are corrosion-resistant. ▪ Genova, Inc., Davison, Mich.

Circle 301 on inquiry card



Experimental tubular solar collector available for limited application

The company has announced a high-performance tubular solar collector incorporating a selectively coated flat absorber plate housed within a highly evacuated glass tube. The individual collector tubes are mounted in modules of from six (as shown) to ten tubes. The unit is reported to be two to three times as efficient as conventional two-pane, flat-plate collectors in terms of delivered energy per unit of absorber area. Tracking is not necessary to achieve working temperatures as high as 250 to 300 degrees F with good efficiency. The high vacuum maintained permanently within this collector assures, according to the company, that both convection and conduction losses are significantly suppressed. ▪ Corning Glass Works, Corning, N.Y.

Circle 304 on inquiry card

more products on page 143

LOOK TO GUTH

FOR THE NEWEST IDEAS IN ENERGY-EFFICIENT LIGHTING

Meeting today's needs today, Guth is developing new lighting systems that do a better job of illuminating and use less energy at the same time.

An example is watt-saving high-pressure sodium lighting for indoor applications that reduce own-operate costs by as much as 20% per year compared to fluorescent systems. Another is the Dual Area Light, two lighting systems in one, that illuminates a larger area with less wattage for dual savings in both energy and fixtures.

These systems are typical of Guth's response to the demand for more energy-efficient lighting. So before you specify lighting for any indoor or outdoor applications, look to Guth Lighting first — the source of the newest ideas.

Guth Lighting, P. O. Box 7079, St. Louis, Mo. 63177, (314) 533-3200.

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For more data, circle 40 on inquiry card

For more information, circle numbers on Reader Service Inquiry Card, pages 189-190.

SCRUBBER SYSTEM PROBLEMS / A six-page illustrated bulletin spells out the benefits of engineered treatment programs for a wide variety of scrubber systems for control of fouling and corrosion, and to help furnish clear effluent for re-use. Bulletin 746 explains how the programs can reduce suspended solids, minimize nozzle clogging, improve sludge handling qualities, reduce sludge volume and actually improve scrubber system efficiency to or above its rated design capacity. Case histories are cited. The company specializes in water treatment products and programs, and also offers engineered service programs for water and process systems, professional consulting engineering services, and treatment control equipment. ▪ Betz, Trevose, Pa.

Circle 400 on inquiry card

GLAZING PANEL SYSTEM / An eight-page color brochure describes *Panel Mullion 450*, a prefabricated panel system providing for one construction trade to completely enclose a building. The brochure outlines the direct glazing method for panel and glass installation. Drawings illustrate the structure of the 4½ in. deep units, each consisting of exterior aluminum, a rigid insulating core of polyurethane foam, and an interior surface of gypsum board which may be decorated as desired. Each panel is thermally broken creating a unit with a 'U' factor of .03. ▪ Kawneer Architectural Products, Niles, Mich.

Circle 401 on inquiry card

ICE RINK BUILDINGS / A color brochure outlines the advantages of pre-engineered buildings for ice rinks. Included are pro forma income statement, floor plans, benefits of design/build and how to conduct feasibility studies. ▪ Butler Mfg. Co., Kansas City, Mo.

Circle 402 on inquiry card

HAND WROUGHT IRON / The company is offering its 1975 color catalog of genuine hand forged wrought iron window guards, gates and railings. Included in the 24-page brochure are customarily used dimensions, although the company points out that all wrought iron is custom made to exact requirements. All iron is treated with a special rust-preventative prime coat and finished to specifications before installation. ▪ Pinecrest Inc., Minneapolis, Minn.

Circle 403 on inquiry card

REINFORCED PLASTIC PULTRUSIONS / A "Designer's Guide" providing application and specification information on *Extren* fiberglass reinforced plastic pultrusions contains information on its use for platforms, walkways, ladders, safety railings, exhaust systems, cable trays, fume hoods, towers, bridges, and spanning structures. The bulletin contains a quick specification chart which illustrates the tensile and compressive strengths, modulus of elasticity, density, arc resistance, and fire retardant properties of each FRP pultrusion shape. ▪ Morrison Molded Fiber Glass Co., Bristol, Va.

Circle 404 on inquiry card

LAP AND PANEL SIDING / Lap and panel siding selections in a wide variety of patterns and textures are offered in this catalog. Exterior illustrations of siding on single/multi-family housing are shown to provide design alternatives. Product specifications and installation tips are included, along with data on softwood plywood siding in redwood, cedar or fir; hardboard and overlaid particle-board sidings; medium density overlaid plywood and redwood finished lumber. The catalog also lists applicable standards, and delineates basic use and limitations. ▪ Georgia-Pacific Corp., Portland, Ore.

Circle 405 on inquiry card

RACEWAY DESIGN MANUAL / The 1975 edition of the "Steel Electrical Raceways Design Manual" of the American Iron and Steel Institute is said to provide basic information on electrical distribution system design criteria and the use of steel raceways in these systems. The 69-page publication is based on the application of provisions of the 1975 National Electrical Code of the National Fire Protection Association, and single copies are available without charge. ▪ American Iron and Steel Institute, Washington, D.C.

Circle 406 on inquiry card

METAL WALLS, ROOFS / A 40-page catalog covering the company's complete line of metal wall and roof systems includes cutaway illustrations of exterior profiles, panel systems, dimensions, features, load span tables and complete architectural specifications. It also contains a color chart and architectural specifications on available coatings. A complete list of available literature and of company District Sales Offices is provided. ▪ Elwin G. Smith Div., Cyclops Corp., Pittsburgh, Pa.

Circle 407 on inquiry card

A-E OFFICE EQUIPMENT / A four-page brochure showcases the company's engineering reproduction machines, microfiche systems and drafting room furnishings and supplies. ▪ Bruning Div., Addressograph Multigraph Corp., Schaumburg, Ill.

Circle 408 on inquiry card

LIFTING PRODUCTS / Simple hand hoists to engineering overhead cranes and monorail systems are described in a bulletin entitled "Solutiona for Lifting Problems." ▪ Acco, Bridgeport, Conn.

Circle 409 on inquiry card

GROUTING HEAVY EQUIPMENT / Installation procedures for "HT-648" high tensile grout under engines, compressors, and other heavy equipment are described in a six-page bulletin covering preparation of foundations, forms, and bonding surfaces; selection and preparation of tools; preparation of the grout; and organization of the installation team. Special information is provided on finishing and curing. Typical grout installations are shown in photographs and cross-section drawings. ▪ The Ceilcote Co., Berea, Ohio.

Circle 410 on inquiry card

POSTAL CENTERS / Postal centers for new communities, housing developments and mobile home parks are described in a four-page brochure discussing the U.S. Postal Service's new Centralized Mail Distribution concept which replaces traditional door-to-door delivery. In place of individual home mail boxes, the Postal Service is encouraging central delivery and postal centers. These installations are suited to townhouses, garden apartments, condominiums, etc. ▪ American Device, Steeleville, Ill.

Circle 411 on inquiry card

EXPANDED HALLER PROGRAM / An expanded program of basic structural frameworks and optional interior components features Fritz Haller's desks, pedestals and open transfer units—re-engineered, with new wood finishes and new components—to enable architects and designers to create an unlimited number of arrangements. The units can be either completely open, semi-enclosed or completely enclosed. Panel enclosures in any combination of five colors combine with desks and table tops now available in walnut and oak veneer, as well as two colors of plastic laminates. ▪ Herman Miller, Inc., Zeeland, Mich.

Circle 412 on inquiry card

Now! Lower installed cost even more with an all gasket DWV system.

Introducing Wade's new carrier-fittings for Tyler NO-HUB  and SV TY-SEAL.® 

A Anchor device on all single horizontal units reduces deflection, requires only three bolts instead of four.

B Carriers designed for SV pipe with compression gasket or No-Hub.

C Serrated face plate for monolithic floor construction.

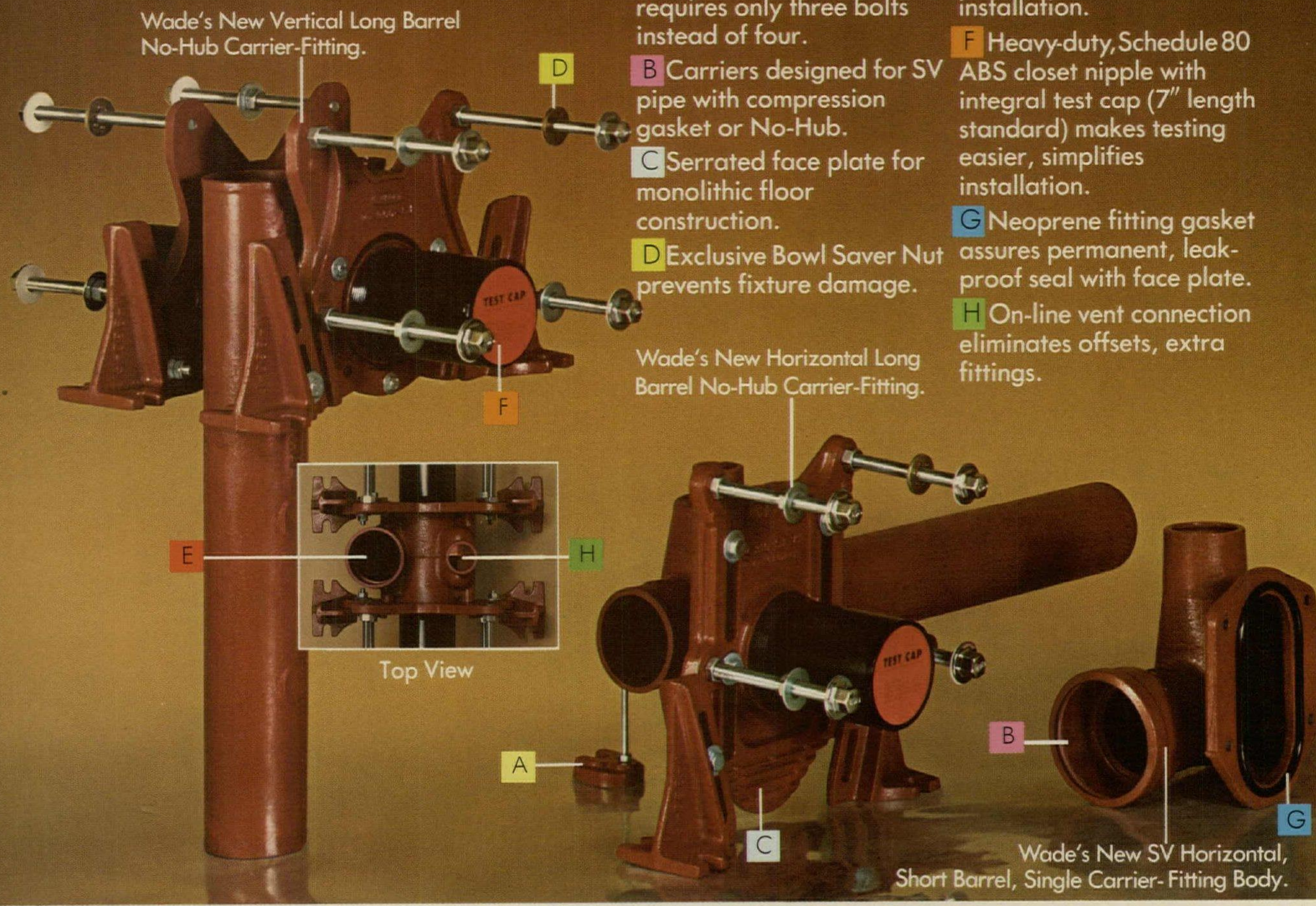
D Exclusive Bowl Saver Nut prevents fixture damage.

E All connections will accept SV TY-SEAL or No-Hub for fast, easy installation.

F Heavy-duty, Schedule 80 ABS closet nipple with integral test cap (7" length standard) makes testing easier, simplifies installation.

G Neoprene fitting gasket assures permanent, leak-proof seal with face plate.

H On-line vent connection eliminates offsets, extra fittings.



This page of information on Wade's new carrier-fittings for SERVICE WEIGHT TY-SEAL® gasket and Tyler NO-HUB systems can help you save in two important ways.

First, you save on material costs. You know that SV and No-Hub piping costs less—significantly less—than XH Class soil pipe. When you specify SV or No-Hub piping to reduce costs, Wade completes the job with SV or No-Hub carriers (compatible with your piping system).

Second, you save installation time. Wade's new carriers can be connected with SV compression gaskets or No-Hub couplings. You choose the way to save.

Specify the new Wade carriers designed for use with SV or No-Hub for your next DWV installation.

Save on lower material costs. Save installation time. Lower your total installed cost.

For information on the new Wade carriers for SV compression gaskets, or No-Hub connections, write Box 2027, Tyler, Texas 75701.

Tyler Pipe
Subsidiary of
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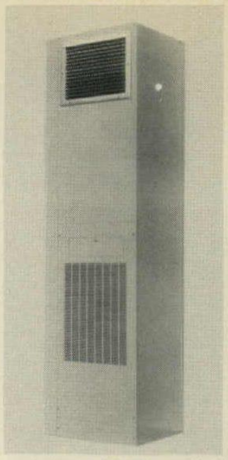
For more data, circle 42 on inquiry card

HEAT RECOVERY UNIT / A new water-to-air heat recovery unit, called the "Hi-Line SEASONAIRE" reduces energy use by recovering heat from areas of a building requiring cooling; the recovered heat is then transferred to areas that require heating. With a heating capacity of 9600 Btuh and a cooling capacity of 9000 Btuh, the Energy Efficiency Ratio (EER) produced is 8.3 for compressor and fan motor. A comparable EER was obtained in testing larger capacity units. The unit is said to be quiet in operation, and is recommended for hospitals, nursing homes, office and apartment buildings and other structures where noise can present a problem. The units are self-contained and modular and can be stacked for multistory building use. A malfunction in one unit will not affect the rest. ▪ McQuay-Perfex Inc., Minneapolis, Minn.



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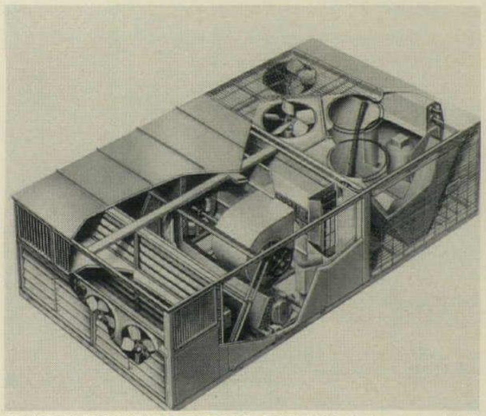
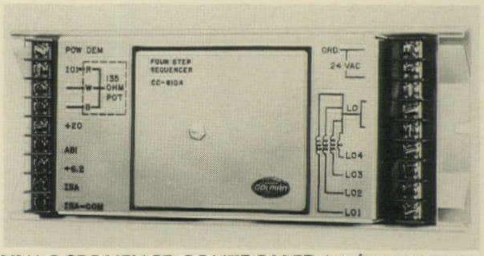


SINGLE ZONE ROOFTOP SYSTEM / A new, high efficiency, low-profile, single zone rooftop system for the industrial and commercial market, called the DSS1, includes units having 26- and 30-ton cooling capacity with heating available in electric and hot water versions only from 114,000 to 950,000 Btu. As a wider range of models comes on line, the DSS1 will feature additional fuel options of natural gas, propane and oil. A solid state electronic control system cycles the mechanical equipment to match the output to the load condition. ▪ Lennox Industries Inc., Marshalltown, Iowa.

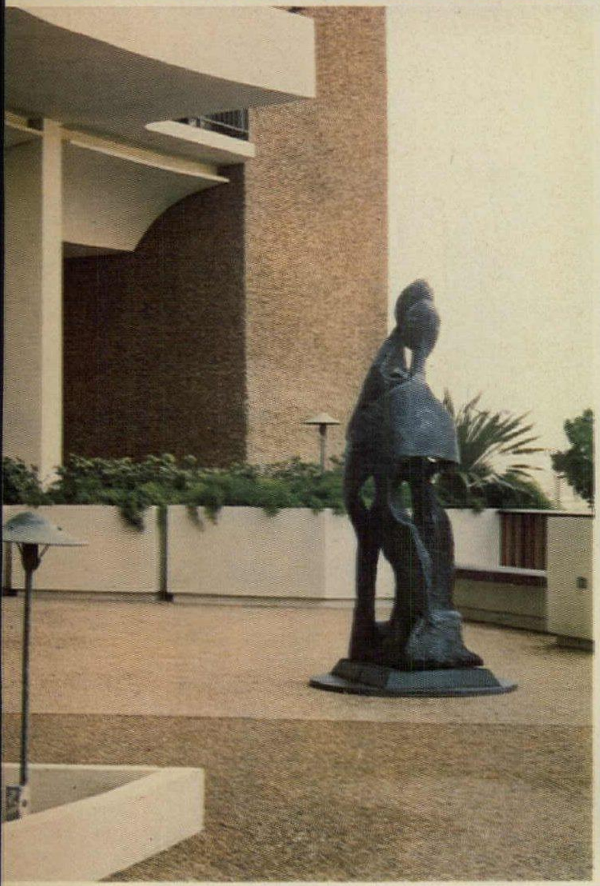
Circle 306 on inquiry card

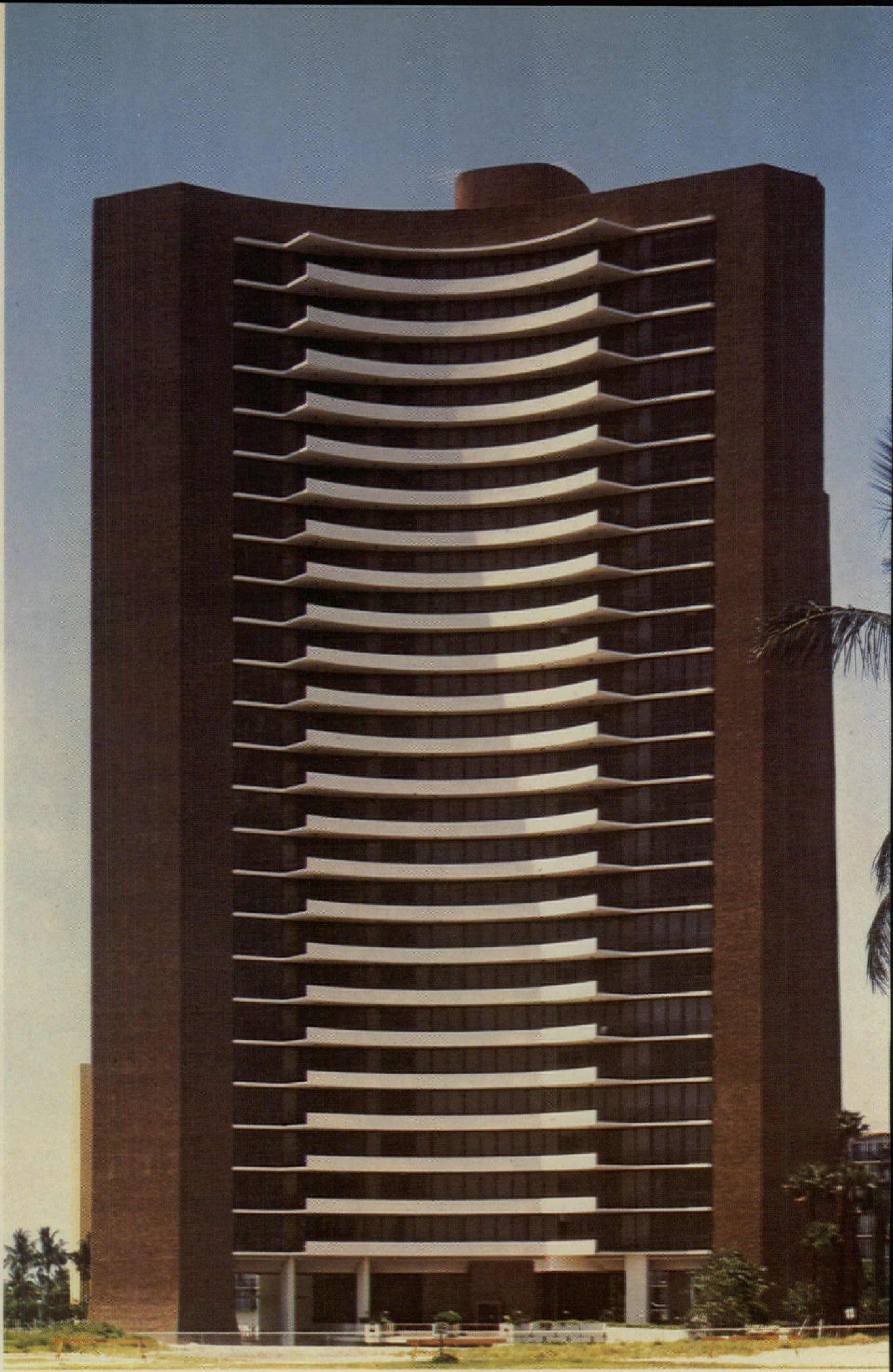


HVAC SEQUENCE CONTROLLER / A four-stage sequencing controller, designed to sequence heating and/or cooling equipment in air conditioning and other similar temperature controlling equipment features outputs that can each handle a minimum steady state current of .1 amps and a maximum of .9 amps at 24 VAC. Throttling ranges are available from 2 to 60 degrees F with 3 degrees F and 6 degrees F selectable by jumper. The new controller will also accept remote temperature set-points, power demand limiting inputs, and can sequence two additional slaved control devices. ▪ Barber-Colman Co., Rockford, Ill.

Circle 307 on inquiry card

more products on page 145





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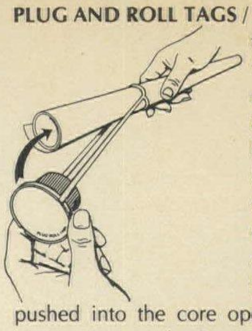
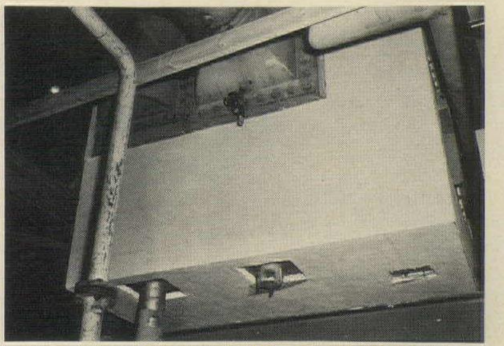
For more data, circle 44 on inquiry card

PLUG AND ROLL TAGS / A device to identify rolled tracings, plans and prints, "Plug'Roll" tags may be used to identify work around the drawing board, or completed work in tube files, bins or on shelves. For delicate drawings, which usually are rolled around a cardboard core, the tag is pushed into the core opening. Plug size is ⅞ in. ▪ Guy Voyce Mfg. Co., New York City.



Circle 308 on inquiry card

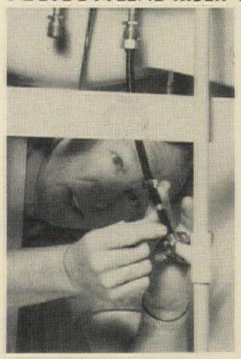


MINERAL WOOL INSULATING CEMENTS / Two mineral wool insulating cements are now being offered for energy conservation purposes. After being mixed with water, both products can be troweled easily onto virtually any surface where they set rapidly. Designed especially to form a rust inhibiting, noncorrosive insulation for heated surfaces, up to 1900° F, "No. 1 Plus" cement can be used as a leveling material over insulating blocks, as a complete insulation on irregular surfaces, as a patching material or for general insulation and maintenance work. "SUPER POWERHOUSE" (shown) for service up to 1200°F—can be used as a surface layer over insulation blocks, blankets, pipe insulation and over other insulating cements. Further, it can be applied over irregular surfaces and provides on-site pipe fittings. ▪ Keene Corp., Insulation Div., Princeton, N.J. *Circle 309 on inquiry card*

MINI WATER COOLER / Available in 4- and 6-gal. capacities (SW-4-A and SW-6-A), this compact unit is suited for low traffic areas where chilled water demand is intermittent. Ease of operation and maintenance are claimed. ▪ Halsey Taylor Div., King-Seeley Thermos Co., Warren, Ohio.

Circle 310 on inquiry card

POLYBUTYLENE RISER TUBES / Riser tubes, ⅜-in. diameter flexible water-supply pipes leading from the wall shutoff valve to plumbing fixtures, now come in polybutylene (PB). PB risers can be cut with a knife and the heat-resistant tubes cost less than chromed brass, according to the company. Only the regular fittings are needed for either new or replacement work. The new risers come in two end styles: bullet-nosed for lavatories and sinks, and flanged for toilets. Lengths of 12-, 20- and 36-in. are available. ▪ Genova, Inc., Davison, Mich. *Circle 311 on inquiry card*



more products on page 147

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Balanced Pressure Valve

...stands guard over safety, comfort and economy

Here's a new concept in design for single-handle controlled shower and shower/bath valves, developed especially for institutional, commercial or residential installations. The benefits will please you and your customers . . . at a price you can both live with!

Speakman's Pressure Compensating Valve* protects against sudden, dangerous changes in water temperature due to pressure variation. As an added safety feature, water flow is automatically reduced to an insignificant trickle when either cold or hot water supplies are cut off completely.

There's even less chance of scalding because the valve must be turned off in the cold position. Selection of desired water temperature must progress from cold . . . through warm . . . to hot . . . and back.

Adjustable Temperature Limit Stop, an added safety feature (standard on all models), can be set to limit the temperature by restricting travel of the control handle. You get not only additional protection, but water and fuel conservation as well. Volume control is available on Sentinel Mark II, conveniently located on the face plate.

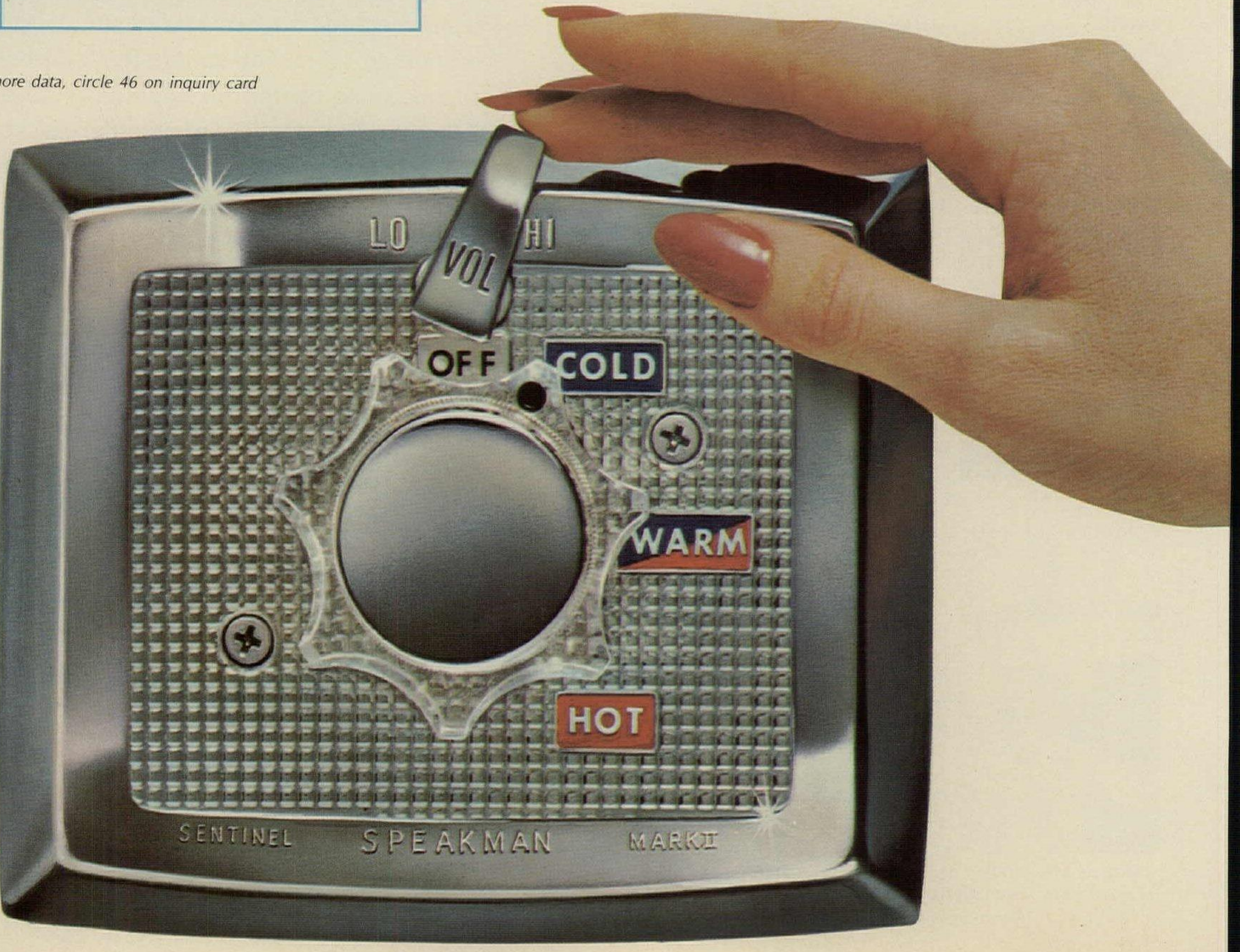
Factory-sealed balancing module is easy to replace as inlet seals are located at the back where they can't bind. Long-lasting ceramic valve module is also easy to remove and concealed stops are available. And for Back-to-Back installations, a reversible supply requires only a simple reversal of the ceramic valve module.

Combine the features of laboratory and field tested Sentinel Mark II with the traditional quality you get from Speakman. Then call your Speakman representative. He'll see you get the full story on all 32 models. Or write Speakman Company, P.O. Box 191, Wilmington, Del. 19899, for free brochure.

*Patent Pending

Speakman Company

For more data, circle 46 on inquiry card

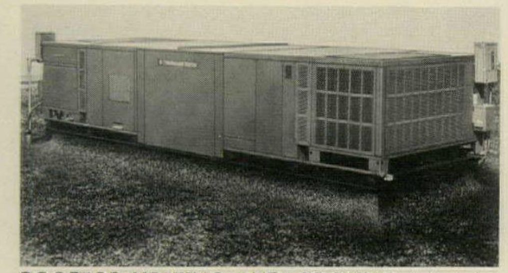


WATER-CONSERVING FIXTURES / The line includes toilets, showerheads and faucets for lavatories and kitchen sinks—all engineered to use less water without loss of efficiency. "Water-Guard" toilets, as an example, will flush efficiently and positively with 30 per cent less water than most conventional toilets. The siphon jet toilet has a redesigned flushing system based on a new trapway design that ensures positive flushing action with less water. Designed for residential, commercial and institutional use, the toilets are available with round front or elongated bowls. ▪ Kohler Co., Kohler, Wis.

Circle 312 on inquiry card

CEILING MOUNT AIR CLEANER / The unit removes up to 92 per cent of smoke and other airborne impurities, mounts on the ceiling, and operates very quietly without strong drafts of air. The "CF Mark III" is engineered around four collecting cells that are easily removed and cleaned. ▪ Metal-Fab, Inc., Wichita, Kan.

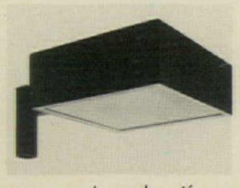
Circle 313 on inquiry card



ROOFTOP HEATING AND COOLING / A twin-package system permitting dual-fuel rooftop heating and cooling for commercial and industrial applications offers heating and/or cooling by combining three distinct types of 7½- and 10-ton units: single-package cooling, heat pump electric heating/cooling, or gas heating/electric cooling. Twin-package units provide 15-, 17½- or 20-ton capacities. Using a common plenum, these units permit multi-compressor operation, variable ratio of heating-to-cooling capacities, and simplification of maintenance procedures due to multiples of small-capacity heating and/or cooling units. ▪ General Electric Co., Louisville, Ky.

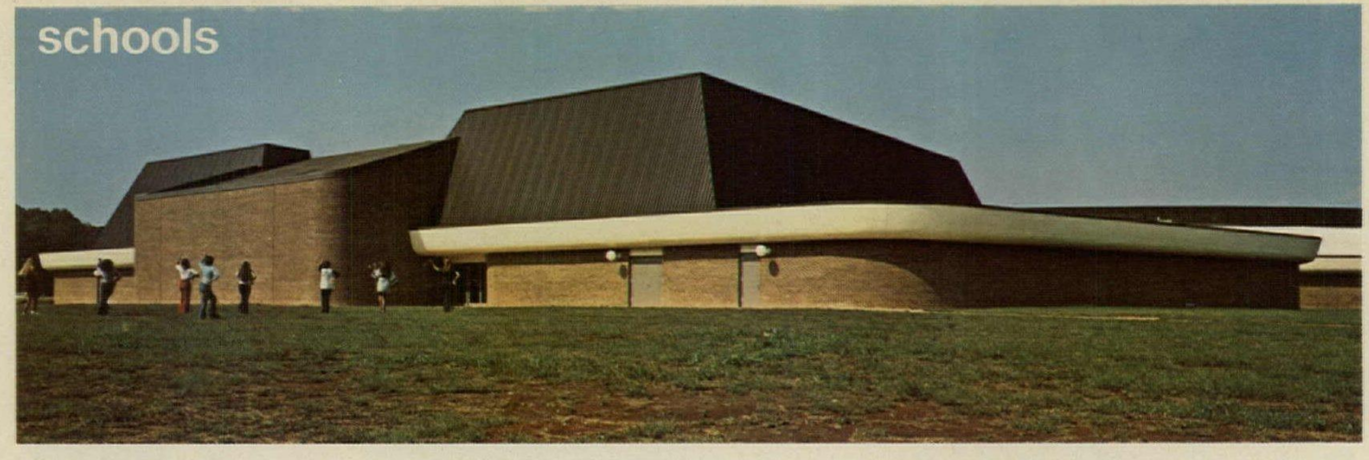
Circle 314 on inquiry card

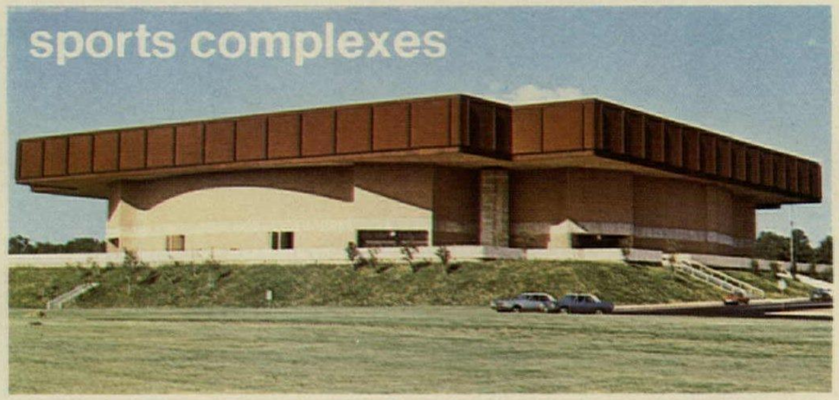
LOW-PROFILE LUMINAIRE / Designed specifically for high-lumen-output, low-energy-usage HID light sources, this square downlight (side-mounted with pole adaptors) is recommended where limited lighting and unobtrusiveness are in order. If more light is needed, two can be mounted on opposite sides of the pole, and a cluster of four gives ample lighting to an expansive area. Lamping specifications are: 400 or 1000-watt mercury vapor, 400 or 1000-watt metal halide, and 250 or 400-watt high-pressure sodium. The "Matador" is constructed of non-corroding, heavy-gauge aluminum. The extruded lens frame of anodized aluminum is mounted with a continuous piano hinge and is fully gasketed. The standard baked-on, matte-black, acrylic enamel finish is guaranteed for five years. ▪ Jet-Phillips, Houston, Tex.



Circle 315 on inquiry card

more products on page 149





BINKLEY

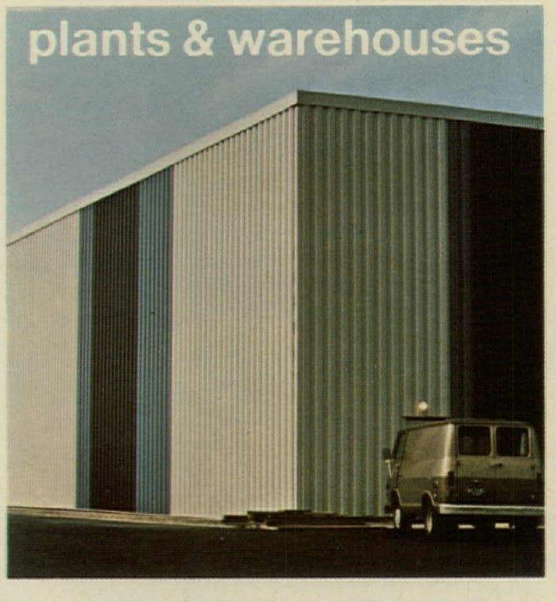
versatile metal wall systems

What types of buildings are built with Binkley Metal Wall Systems? Practically all types. What with 15 different patterns, a host of colorful finishes — and systems such as "No Girt", "Quick Wall", "Explosive" "Fired Rated", "Acoustical" and the various conventional ones — it's no wonder so many people prefer the beauty, functional efficiency and VERSATILITY by BINKLEY.

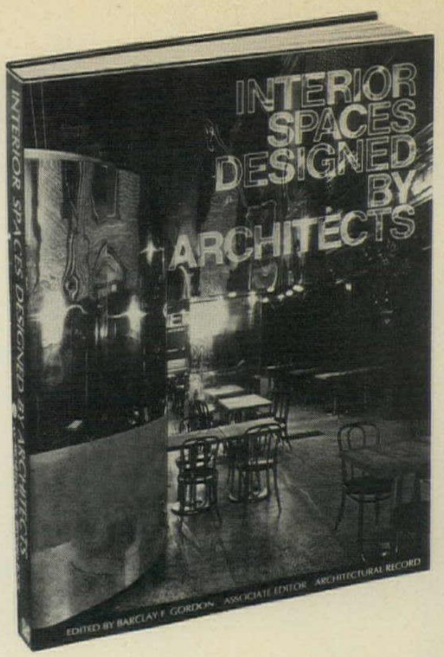
Engineering and Design services available.

Write for new Architectural Design-Detail Book.

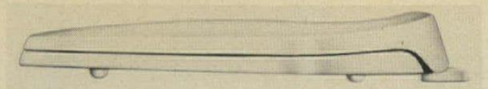
THE BINKLEY COMPANY
331 THORNTON AVE. / ST. LOUIS, MO. 63119 / 314-968-4750



For more data, circle 49 on inquiry card



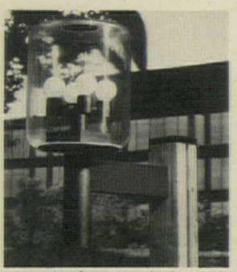
PRODUCT REPORTS *continued from page 147*



SOLID PLASTIC TOILET SEAT / The new seat features larger inside dimensions for comfort and swept-back lid with inlaid bumper for easy cleaning. Scratch-resistant and unbreakable, the seat installs from above the bowl with a "top-tightening" hinge that is bar-less and totally corrosion free. Available in a complete range of bold shades and fixture-matching colors, the seat carries a five-year written guarantee. ■ Bemis Mfg. Co., Sheboygan Falls, Wis.

Circle 316 on inquiry card

ARCHITECTURAL LANTERNS / The line consists of spheres, cubes, cylinders and ellipsoids, in a large selection of diffuser sizes and colors, plus white, clear, smoked or bronze. Cast aluminum luminaires are incandescent or mercury vapor, and include white diffuser units. Lanterns are available mounted on sculptured laminated wood poles, or on round or square metal poles. A choice of various configurations up to five units per pole is offered. ■ mcPhilben Lighting, Melville, N.Y.

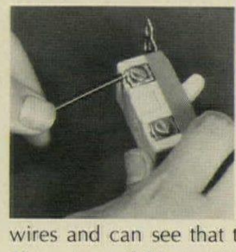


Circle 317 on inquiry card

FLOOR BOX / The box, available in both shallow and deep styles, will accept a wide variety of standard short strap single receptacles, above the floor fittings and carpet flanges. The box which conforms to Federal Specification W-C-583b, type II, Class 2, has a threaded collar that provides a total adjustment ½ in. up. ■ Harvey Hubbell, Inc., Bridgeport, Conn.

Circle 318 on inquiry card

HEAVY DUTY SWITCHES / "Monumental" switches are furnished with a newly designed all bronze backwiring clamp assembly. Because the locking member of the clamp is external rather than internal, the installer can quickly position feed wires and can see that they are properly clamped. They are available toggle or key-operated in 15 or 20 amp, 125/277 volt ratings and single pole through four-way types. ■ Sierra Electric, Gardena, Cal.

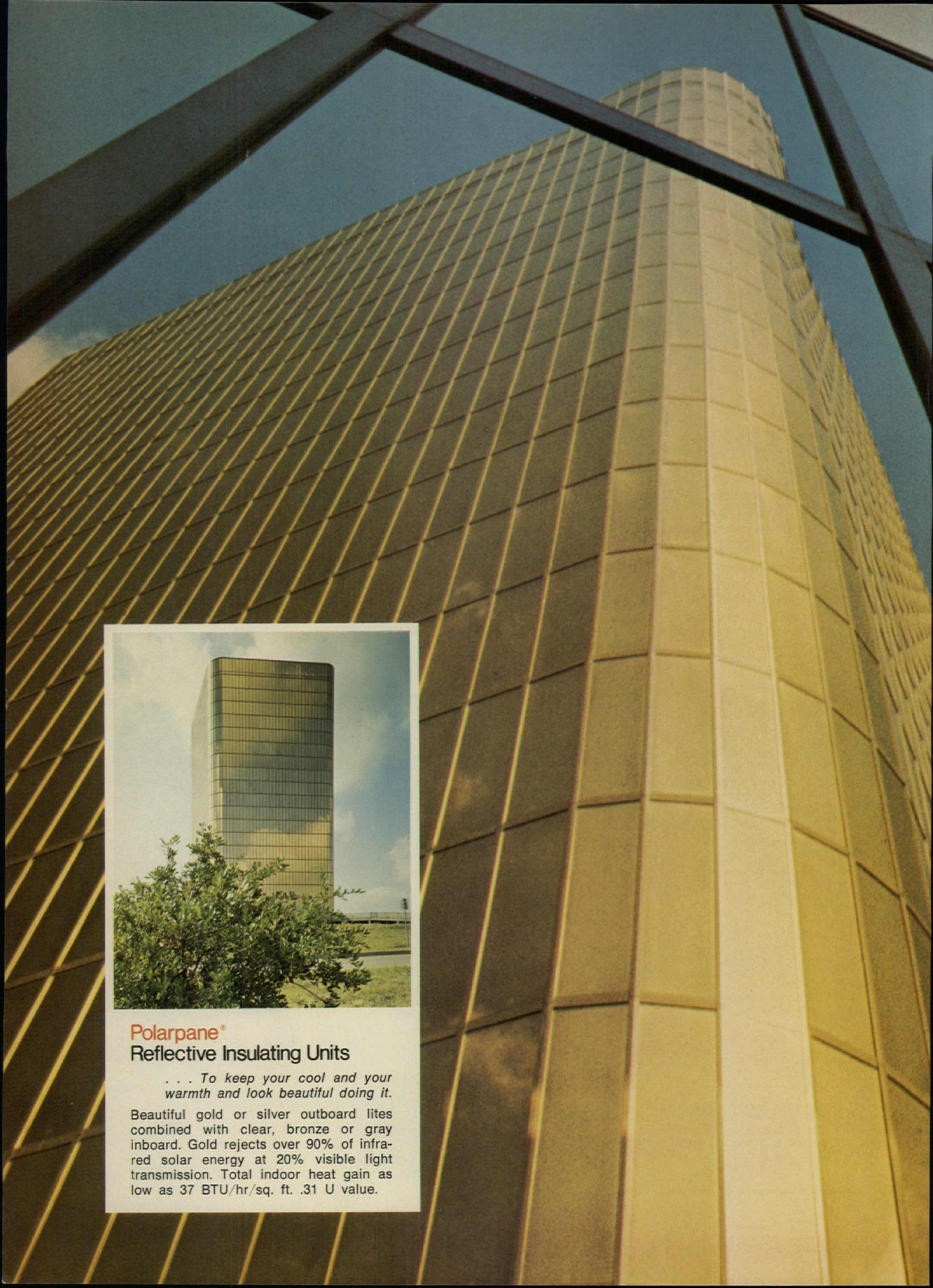


Circle 319 on inquiry card

FIRE SIGNALING SYSTEM / Designed for installation in existing buildings or in new buildings under construction, the system provides for: swift detection of beginning fires; voice and tone signal public address communications; two-way dedicated telephone system to permit fire fighters and other authorized persons to communicate between upper floors and the ground floor command console; automatic interfaces with heating, ventilating and air conditioning equipment for shutdown; automatic interfacing with electrically actuated door locks; control of elevators. The console, which can be designed either as a wall mounted or free-standing unit, is modular to permit expansion of the system. ■ ADT Security Systems, New York City.

Circle 320 on inquiry card

more products on page 185


Polarpane®
Reflective Insulating Units
. . . To keep your cool and your warmth and look beautiful doing it.
Beautiful gold or silver outboard lites combined with clear, bronze or gray inboard. Gold rejects over 90% of infrared solar energy at 20% visible light transmission. Total indoor heat gain as low as 37 BTU/hr/sq. ft. .31 U value.

Power Windows

We make glass with muscle. To put power in your windows. Power to curb the power of the sun. And the cold. And noise. Power to slice a big hunk out of HVAC costs, and energy costs, every day, from now on.

Check to see how well our power windows work. See our catalog in Sweets: 8.26/CE. For further facts, answers and planning assistance, ask your local C-E Glass representative. Or write us: C-E Glass, 825 Hylton Road, Pennsauken, N.J. 08110. (609) 662-0400.

Polarpane® Insulating Glass Units

. . . So you don't have to watch all your heat go out the window.

Available in a wide selection of pattern, clear or tinted glass; annealed and tempered. Hermetically sealed in moisture-free construction. 5 and 20 year warranties.

Polarpane® Sun Control Units

. . . Ideal answer to a glaring problem. Adjustable for privacy.

Rotating venetian blind between sealed lites for full control of sunlight and glare as well as outside view. Blinds stay dust and maintenance-free. Excellent temperature and sound insulating characteristics.

Polarpane® Sound Control Units

. . . So you can hear yourself think without tractor-trailers, jets, assorted motor bikes and missing mufflers.

Basic unit shuts out as much noise as a 6-inch concrete block wall. Higher STC ratings available. .48 U value. Choice of such prestige customers as the Marriott Corporation for their luxurious facilities at Chicago O'Hare, Dulles, Miami, Kansas City and St. Louis International Airports.

C-E GLASS

COMBUSTION ENGINEERING, INC.

For more data, circle 51 on inquiry card

To move kids through a maze, it takes a system.

A total signage system. Like this one at Edgeworth Elementary School in Edgeworth, Pennsylvania: raised metal letters at all building entrances; floor plan maps; stairway and corridor signs; and individual room signs.

Graphically, the system is highly visible and is coordinated as to letter style and colors. Above all, it is extremely functional. And flexible; individual signs may be exchanged on short notice, if room functions are changed.

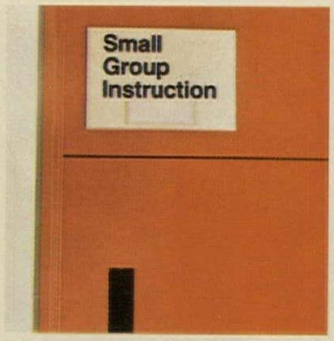
Mischief-resistant signage
Virtually all of the interior signage at Edgeworth School is NOMAR® fiber-reinforced polyester. It is highly resistant to scratches, chemicals and solvents because the graphic image is sandwiched into the fiber and plastic. NOMAR is also ideal for exterior use since it is unaffected by wind, weather and ultra-violet rays. Any image in any color can be reproduced in NOMAR from camera-ready art.

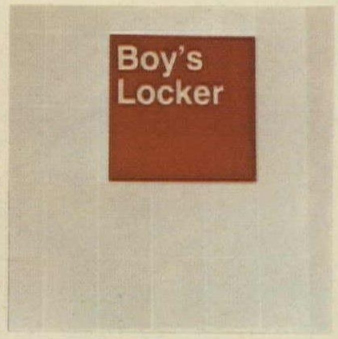
How we work with you
Our staff at Matthews can begin working with you as early as your blueprint stage—or at any building phase thereafter. Based on your requirements, we develop a total signage system for your approval. We then fabricate and install the entire system, interior and exterior. Our design and fabrication facilities encompass every type of architectural signage.

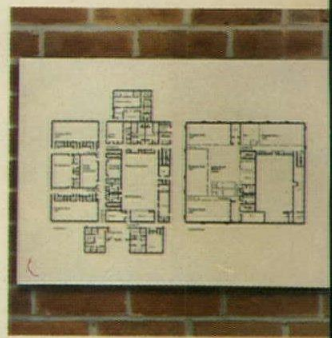
Matthews. For total identification systems that keep people moving. Write for our comprehensive catalog: Jas. H. Matthews & Co., 1315 West Liberty Avenue, Pittsburgh, Pa. 15226.

Edgeworth Elementary School
Quaker Valley School District
Architect:
N. John Cunzolo & Associates, Pittsburgh, Pa.
General Contractor:
Massaro Corporation, Pittsburgh, Pa.

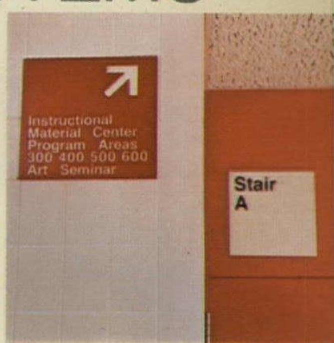
JHM MATTHEWS
Identification Systems

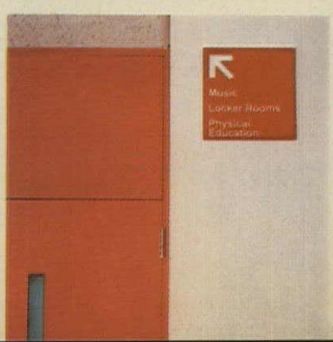
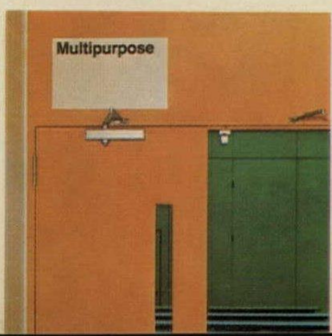


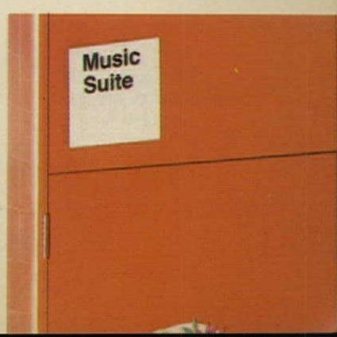





TOTAL SIGNAGE SYSTEMS

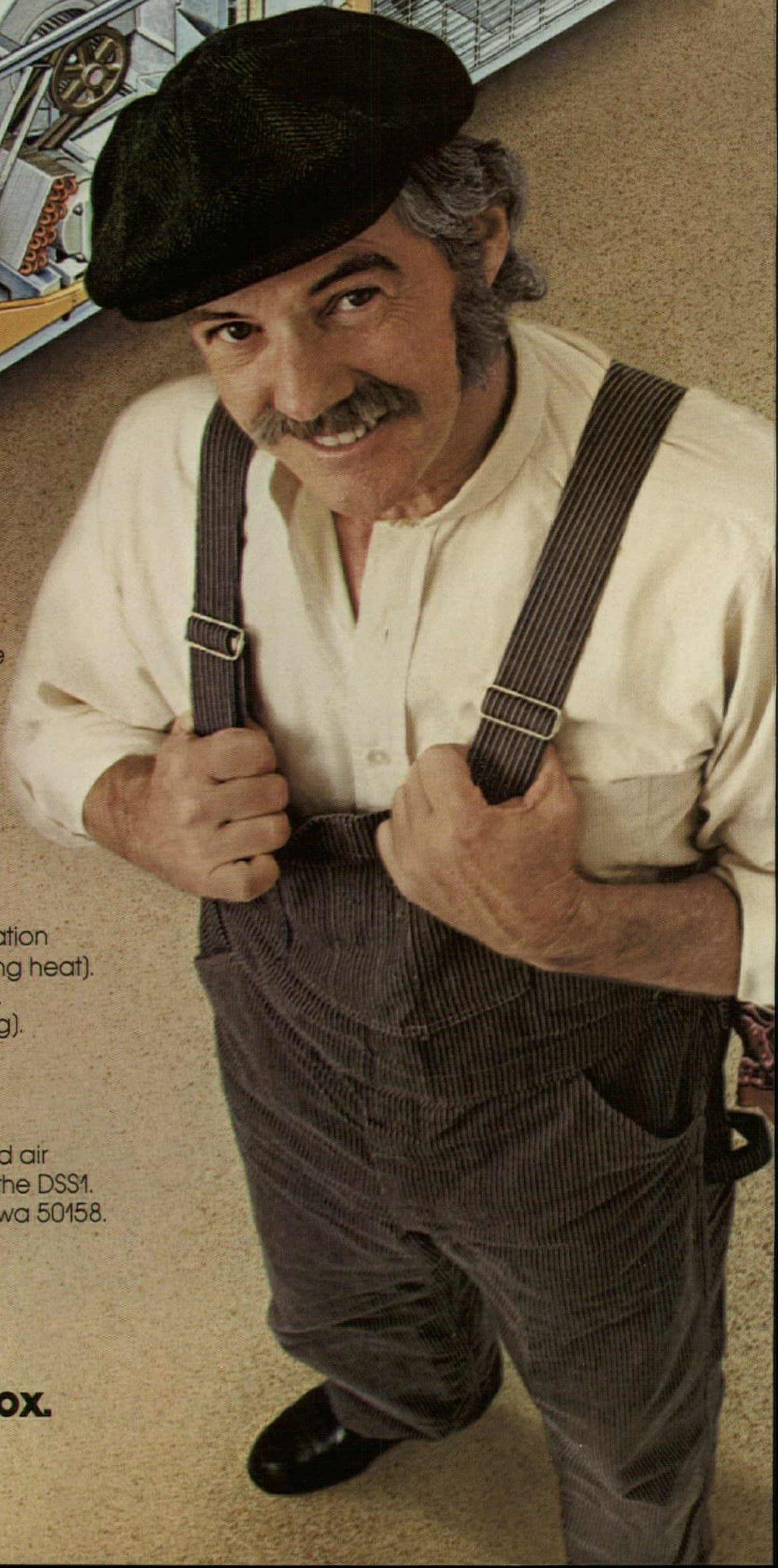


For more data, circle 53 on inquiry card

Take it from Dave Lennox . . .

NOW, YOU CAN DESIGN YOUR OWN

NIFTY WEATHER MACHINE.



The new Lennox DSS1 system lets you design your own single zone HVAC package. For commercial rooftop installations, it offers extraordinary flexibility . . . efficient operation and service . . . exceptional energy savings . . . and consequent cost savings.

Here are a few of the many DSS1 options that give you the right size, right energy, right cost for your application.

- Dual range selection (26 & 30 ton cooling; up to 770,000 Btuh heating).
- Two-speed, first stage compressor saves energy.
- Heat recovery package (allows recovery of heat from refrigeration in supermarkets and restaurants; controls humidity without losing heat).
- Power Saver™ package (allows use of outdoor air for cooling).
- Power Saver II™ package (allows recovery of heat from lighting).
- Return air fan and exhaust fan (allows finer air balance).
- Electric heat (oil, gas & hot water systems at your option).
- Solid state, energy-saving control system.

Get the facts. Find out how you can design your own heating and air conditioning package with our new, unique single zone system: the DSS1. Write: Lennox Industries Inc., 574 South 12th Ave., Marshalltown, Iowa 50158.

LENNOX®
AIR CONDITIONING • HEATING

"Attaboy, Dave!"

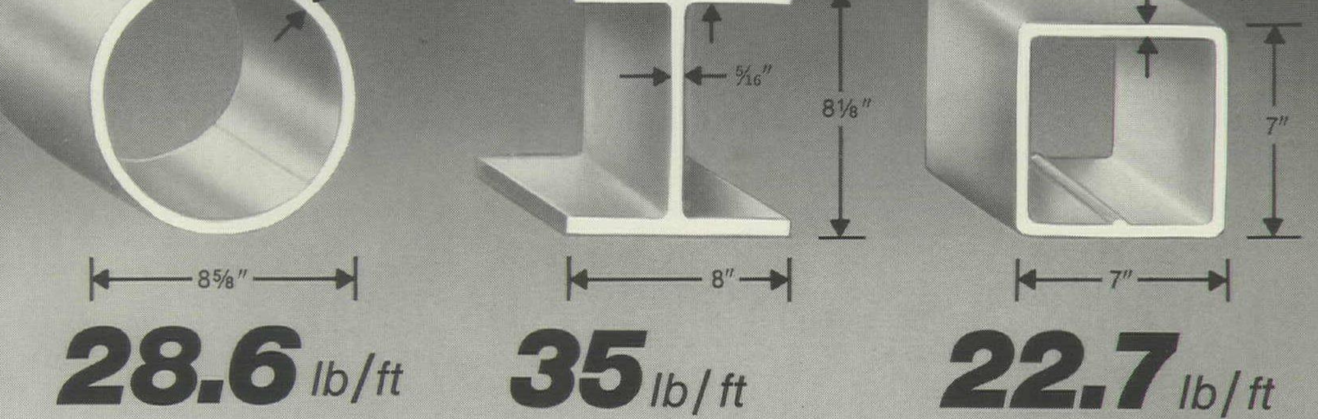
Nifty problem-solving ideas from Lennox.

For more data, circle 54 on inquiry card

46 KSI at no extra cost

why settle for less in a structural column?

PIPE **36** *ksi* — ***W SHAPE*** **36** *ksi* — ***SQUARE TUBING*** **46** *ksi minimum*



28.6 *lb/ft* — **35** *lb/ft* — **22.7** *lb/ft*

Cold formed welded square tubing weighs less than W shape or pipe structural columns. And you get greater yield strength at no extra cost. Shouldn't you be specifying square tubing for your structures?

we produce cold formed welded steel tubing in more sizes and wall thicknesses than anyone in the industry.

RECTANGULAR:
3" x 2" x 3/16" to 20" x 12" x 1/2"

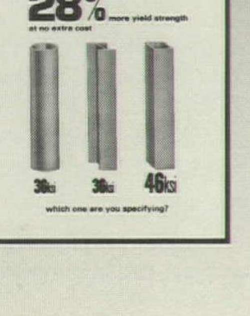
SQUARE:
2" x 2" x 3/16" to 16" x 16" x 1/2"

WELDED TUBE COMPANY OF AMERICA

2400 S. WECCACOE AVE.
PHILADELPHIA, PA 19148 (215) 336-2000

1855 EAST 122ND STREET
CHICAGO, IL 60633 (312) 646-4500

request our new bulletin no. 106 for facts and figures



W-116

For more data, circle 55 on inquiry card

The all new tortoise-and-hare roofing concept.

The concept.
When a tortoise comes from the "factory" its roof is a single weatherproof system. Like the tortoise's shell, Parma Roof is a strong, long-lived single weatherproof system. It's factory constructed, factory quality controlled and it arrives on-site as composite panels. Panels that literally zip together to form a smooth, uninterrupted, tough weather shield.

Because it's a composite dry roof system, it goes together rabbit fast: faster than field-built-up roofs. And it goes up in all types of weather.

The product.
The interior face of Parma is steel. The insulation core is high density isocyanurate foam. The exterior face is a Hypalon® membrane, factory-laminated to steel.

There are no exposed metal surfaces or fasteners. The unique zipper closure provides a positive seal with no mastics or sealants. Panels, joints and flashing are actually heat-welded together and become a single unit. Yet panels "float" independently under expansion and contraction. And a Parma Roof weighs almost 80% less than conventional field-built roofing.

The tests.
Parma Roof has been scrupulously tested for conformance with current roofing product standards. The test results proved that Parma is a match for the toughest building codes. In addition, Parma Roof has a U factor of .09 with .05 U factor obtainable.

All test results were substantiated by an independent laboratory and are available upon request.

The benefits.
Parma simplifies your job. Just specify live load, joist spacing and trim preference. Parma will arrive as you specified it, ready to install. Plus you get the reassurance of single source responsibility for total roof performance.

Parma conserves energy. Very often the size of heating and cooling equipment can be scaled back because of Parma Roof's efficiency. In terms of Life-Cycle Costing, Parma keeps bad weather out, conditioned air in so long-term energy costs go down.

Parma lasts and requires virtually no maintenance. Weather can't hurt it. Foot traffic can't hurt it. The Hypalon® membrane actually gets tougher with age. Costly call-backs are eliminated.

You owe it to yourself and the people you serve to learn more about long-term economies of Parma Roof. Mail the coupon today.

parma™ roof

All things a roof has never been before.

Composite Systems • A Division of Star Manufacturing Co.
Dept. AT–85, Box 94910 • Oklahoma City, Oklahoma 73109
Send me the full Parma Roof story plus Design and Specification Kit.

Name__________ Tel.__________

Title__________

Company__________

Address__________

City__________ State__________ Zip__________

Parma is a Trademark of Star Manufacturing Company — patent applied for.
Hypalon® is a Registered Trademark of I.E. duPont deNemours & Co. (Inc.)

For more data, circle 56 on inquiry card

One of today's smart new creations can save this store $12,000 in lighting.
Automatic Energy Control from Wide-Lite is one beautiful example.
With a typical HID lighting system* AEC can save over 400,000 kilowatt hours and $12,000 for each and every relamp interval. This means savings from 15% to 25% for most commercial installations.
Why? Because AEC maintains constant level illumination — so you won't have to pay for higher initial footcandles to meet the specified minimum as lamps age.
And how does Automatic Energy Control work?
It all starts with a photocell sensor which simply reads illumination levels.
Then the AEC system converts this reading into a signal which alters power input. Thanks to our special dimming ballasts which continuously and automatically adjust lamp lumen output to maintain a predetermined value.
So, as lamp lumen depreciation lowers illumination, AEC automatically compensates by increasing lamp power.
Or if ambient daylight increases total room illumination, AEC automatically compensates by reducing lamp power.
The result is that you get only the amount of light you need. And pay for only the amount of light you need.
Of course, we recommend you use our dustproof luminaires as part of your AEC system to keep maintenance costs at a minimum.
We also recommend you write for our brochure that details how AEC can save on any indoor lighting project you may have.
It shows how fantastic you can look with our smart new creation.
Spectra V Regressed Luminaire
WideLite
POST OFFICE BOX 191, HOUSTON, TEXAS 77001
WIDE-LITE® PRODUCTS ALSO MANUFACTURED IN AUSTRALIA, BELGIUM (FOR EUROPE), CANADA, MEXICO AND GREAT BRITAIN.
A COMPANY OF THE ESQUIRE LIGHTING GROUP
*150 1000-WATT FIXTURES WITH MERCURY VAPOR DX LAMPS, BURNING 12-HOURS PER DAY, FOR A TOTAL OF 16,000 HOURS BEFORE RELAMPING, AT 3¢ PER KWH.
For more data, circle 57 on inquiry card

IF YOU'RE PLANNING A BUILDING, AMERICA'S ENERGY CRISIS JUST HAVE BECOME YOUR BIGGEST

3

Here's an actual case study of a proposed building:

ORIGINAL DESIGN:

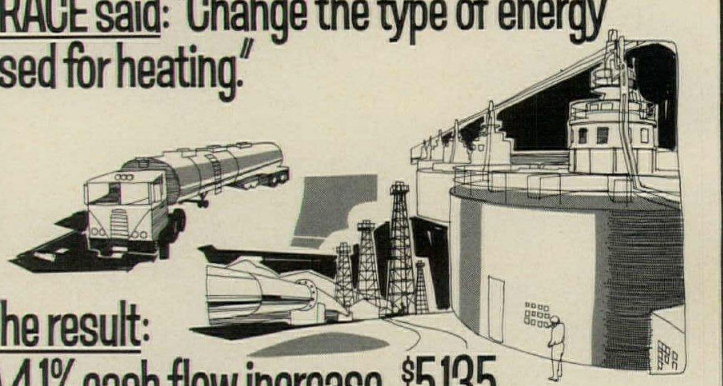
- 20 story building
- 300,000 sq. ft.
- 1st year cash flow - $125,675
- Gas and electric energy
- Absorption water chiller
- Double duct air conditioning system
- 50% Glass
- Insulated clear glass
- 4 watts/sq. ft. lighting intensity
- East/West primary exposures
- 3" Insulation
- 18 CFM/person ventilation

A TRACE analysis showed the effect the following alternatives have on cash flow*

*Cash flow values apply only to this study.

4

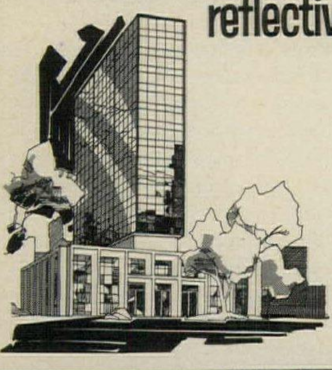
TRACE said: "Change the type of energy used for heating."



The result:
A 4.1% cash flow increase...$5,135

7

TRACE said: "Change from clear glass to reflective glass."



The result:
A 12.1% cash flow increase...$15,221

8

TRACE said: "Change the amount of glass from 50% to 20% and reduce energy cost."

The result:
A 13.5% cash flow increase...$16,932

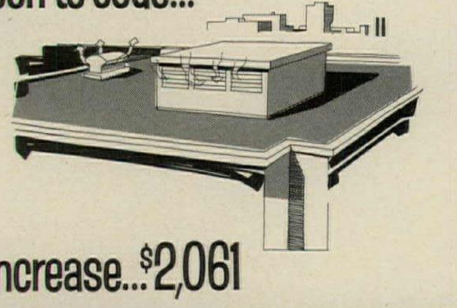
11

TRACE said: "Increase insulation by 3" and reduce energy cost."

The result: A 2.7% cash flow increase...$3,395

12

TRACE said: "Decrease intake of outside air from 18 cfm/person to code... 7.5 cfm/person"

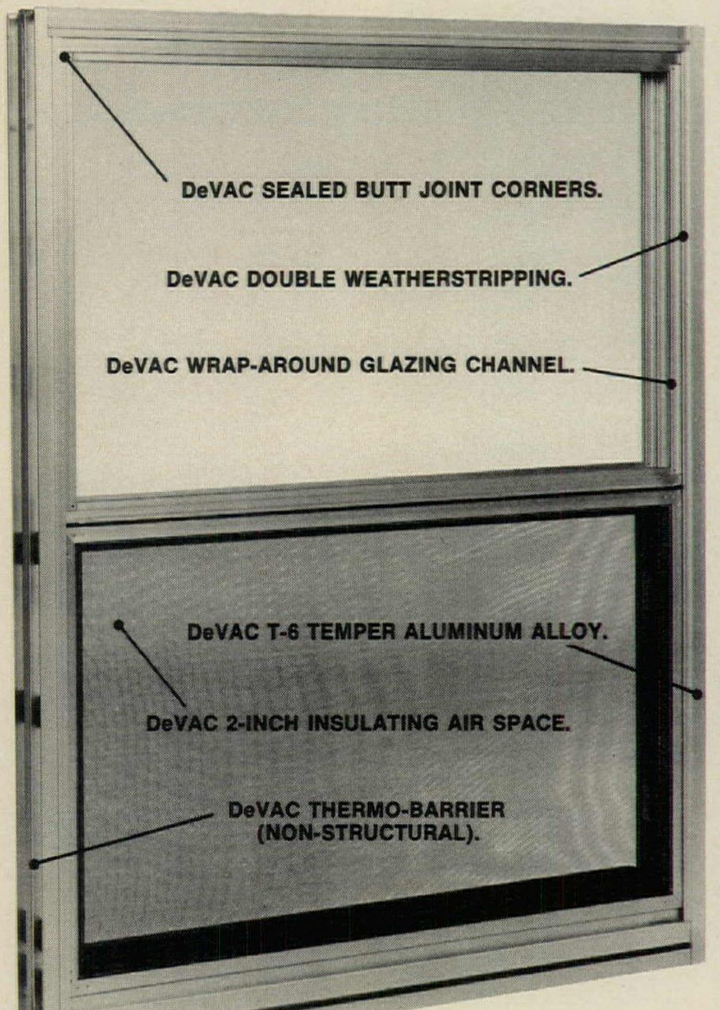


The result:
A 1.6% cash flow increase...$2,061

Window shopping for energy conservation.

A guide to essential features of high-performance environmental windows for new or replacement installations.

Because many aluminum windows look pretty much alike, it's not instantly apparent what standard of performance they are capable of providing. Also, because they ordinarily have no highly visible trademark, it's difficult on installed windows to determine who the manufacturer is.



By all standards of comparison, we know you'll find that DeVAC high-performance aluminum windows more than meet the measure of every benchmark of quality.

How to identify a genuine DeVAC window.

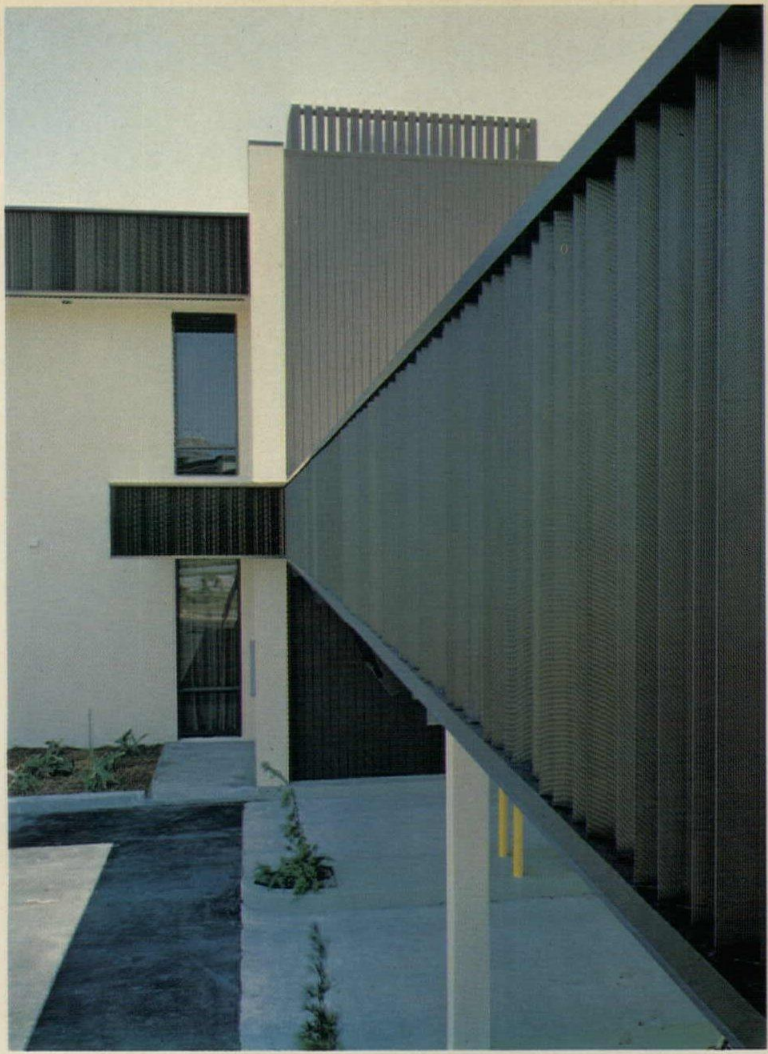
DeVAC windows are constructed of special temper treated prime aluminum alloy. The weatherstripping is dense. DeVAC glazing has a re-usable wrap-around channel with sealed corners, and inspected glass. Air infiltration is less than .15 cubic feet per minute per lineal foot of crack at a wind speed of 25 miles per hour. This is up to 5 times better than industry standards. DeVAC windows resist 8 inches of rainfall per hour with 50 mile per hour wind. This high resistance to water is the result of DeVAC's patented weep flap design. DeVAC windows use a patented non-structural Thermo-Barrier to split the frame, and wide air space dual glazing to cut heat loss/heat gain and conserve energy. DeVAC windows are unconditionally guaranteed in writing for 10 years.

For further information, or a free analysis of your windows—including a scientific measurement of air infiltration—call or write DeVAC, Inc., 10130 Highway 55, Minneapolis, Minnesota 55441. Phone 612/545-0241.

We've made a science of making windows.

DeVAC®

For more data, circle 59 on inquiry card



Project: Guardian Bank, Pinellas Park, Florida Architect: Robert Bernzott
Fabricator: J-C Products Corporation Applicator: Midway Glass Company

Project: Professional Building for Stebbins & Scott, Fort Pierce, Florida
Architect: Stebbins & Scott, A.I.A. Fabricator/Installer: Construction Specialties, Inc.

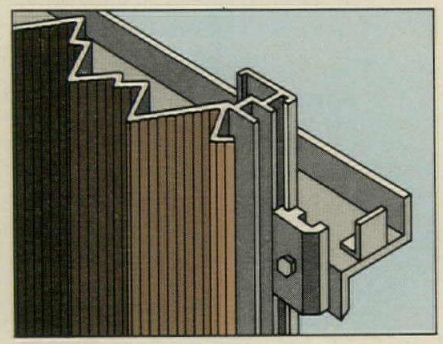
Strength and durability make Alcoa EZ Wall an excellent choice for facing or refacing.

Why settle for less?

You already know how EZ Wall brightens up facades, accent panels and fascia. How compatible it is with other building materials. Now let's concentrate on what EZ Wall can do for your budget.

You can put Alcoa® EZ Wall over an existing wall as easily as any paneling and get an unusual vertical effect that enhances the height of the surface. Because of its configuration and thickness, denting and scratching resulting from vandalism, installation, etc., are minimized. You can even use EZ Wall to create a smashing interior wall in a reception room.

And Alcoa EZ Wall has some additional advantages: 12-inch coverage per panel eliminates extra vertical joints required in metal wall systems with shorter coverage. It can be provided in lengths up to 44 ft, eliminating horizontal joints in many three-story applications. EZ Wall is designed to provide for thermal expansion and field tolerances. It's the only metal wall system of its kind available in acrylic, fluoropolymer enamel, anodic or Duranodic† finishes.



And now it offers a new option: EZ Wall also comes in an insulated version that provides a curtain wall.

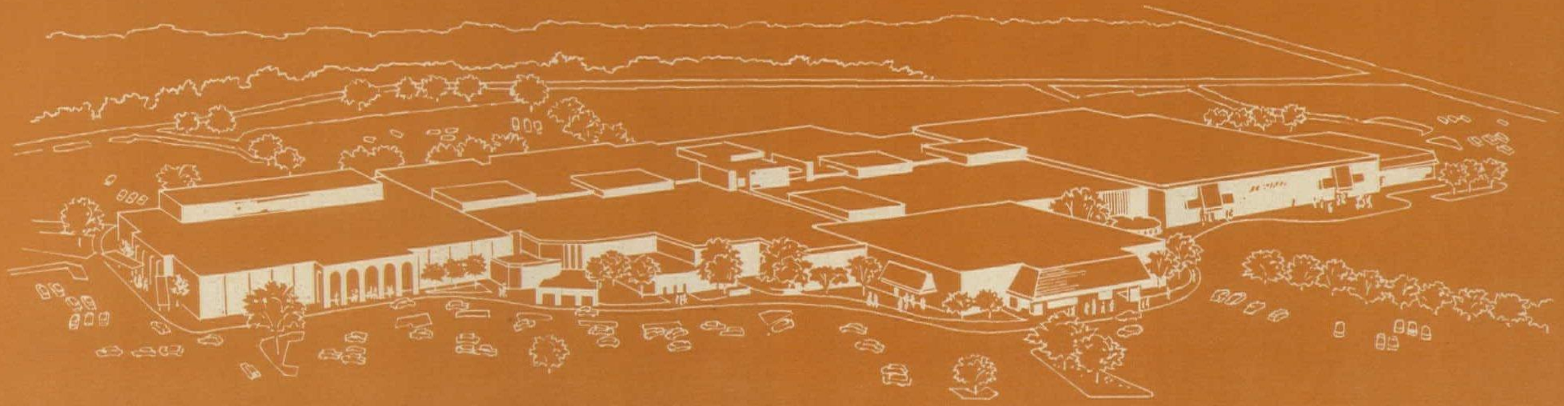
Tell us your needs. At nominal charges, we can custom-design extrusions to accommodate a variety of building panels. And we can give you the benefit of our long experience with wall systems, industrial roofing and siding, finishes and low-, middle- and high-rise building problems. For more information, write Aluminum Company of America, 1230 Alcoa Building, Pittsburgh, PA 15219.

†Trade Name

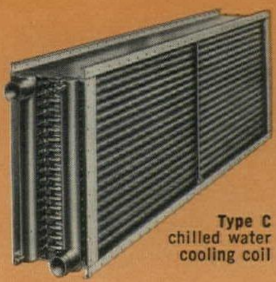
Change for the better with Alcoa Aluminum

ALCOA

For more data, circle 60 on inquiry card



Today's mall developers have one less concern with Aerofin Coil Custom Climate



Type C chilled water cooling coil

Marshall Field & Company/Sears, Roebuck and Co. are two of the major stores in Hawthorn Center. The buying-decision of heat transfer coils may not rate the highest priority. But Aerofin's 50 years of engineering capability gives you a head start on cost-conscious mall heating/cooling. Example: Hawthorn Center, New Century Town, Vernon Hills, Ill. 140 shops radiate from a central court (114,000 sq. ft. of enclosed courts) in a 1,400,000 sq. ft. overall center. Our fan/coil system technology ranges from malls to "mile-high" office buildings —boiler preheat to advanced heat recovery design. For technical help in these trying times, try calling Aerofin offices in Atlanta, Boston, Chicago, Cleveland, Dallas, Los Angeles, New York, Philadelphia, San Francisco, Toronto, Montreal.

AEROFIN CORPORATION
LYNCHBURG, VIRGINIA 24505

Aerofin is sold only by nationally advertised fan manufacturers. Ask for list.

PROFESSIONALS AT WORK

Architect: Loebl, Schlossman, Bennett & Dart, Chicago, Ill.

General Contractor: Inland-Robbins Construction, Inc., Elk Grove Village, Ill.

Consulting Engineers: Herman Blum Consulting Engineers, Inc., Dallas, Tex.

Mechanical Contractor: Advance Heating & Air Conditioning Corporation, Elk Grove Village, Ill.

WHEN PANKOW NEEDED TO SAVE MONTHS, VULCRAFT SAVED THE DAY.

In June 1974, Pankow Construction Company needed to begin erection of the structural steel framing for the Penn-Can Shopping Mall in Cicero, New York.

The plans called for both steel joists and wide flange beams.

Pankow had no problem getting the joists. But then they got some bad news about the beams. Steel mills were back ordered, and could not supply them before the first quarter of 1975.

A costly delay stared Pankow right in the face.

So Pankow and the design team including McLean Steel of Hayward, California, redesigned the structural framing to use Vulcraft open web joist girders, for both floor and roof, to replace wide flange beams.

Vulcraft joist girders were chosen for a number of reasons.

They could be quickly and easily designed to take the place of beams.

Vulcraft could deliver them fast.

And Vulcraft joist girders were competitively priced.

The change to Vulcraft joist girders enabled Pankow to finish the structural framing right on schedule.

Vulcraft joists and joist girders had saved the day.

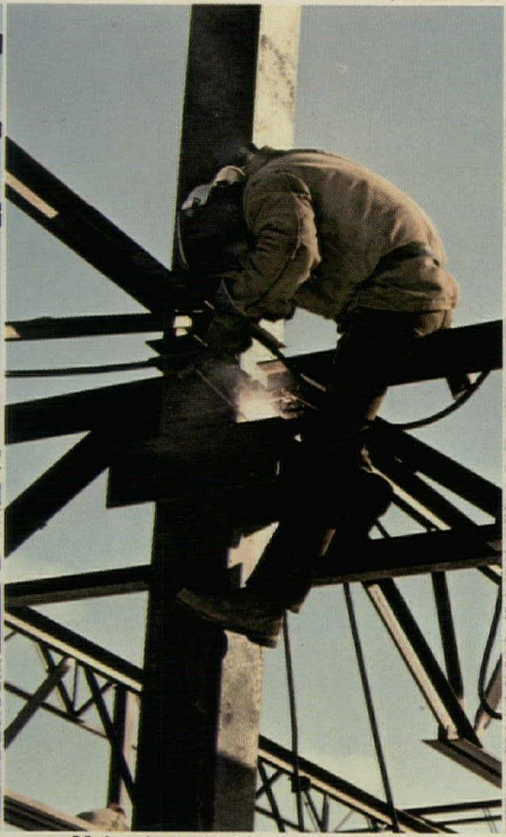
And they can do the same for you.

For more information, just contact your local Vulcraft representative. Or write Vulcraft, P.O. Box 17656, Charlotte, North Carolina 28211 for your Joist & Joist Girder Guide. Or call (704) 366-7000.

It could make your day.

Use of 100' long span joists and 30' joist girders created a large clear span area in the center section of this enclosed shopping mall.

Wide spacing of deep steel joists (6'8" in floors and 7'6" in roofs) resulted in stiffer floor system and saving in the cost of joists.



Vulcraft steel joists and joist girders allowed for simple and fast column connections.

Joist girder design flexability provided for a wide range of load support, from normal roof loads to heavy mechanical equipment loads.

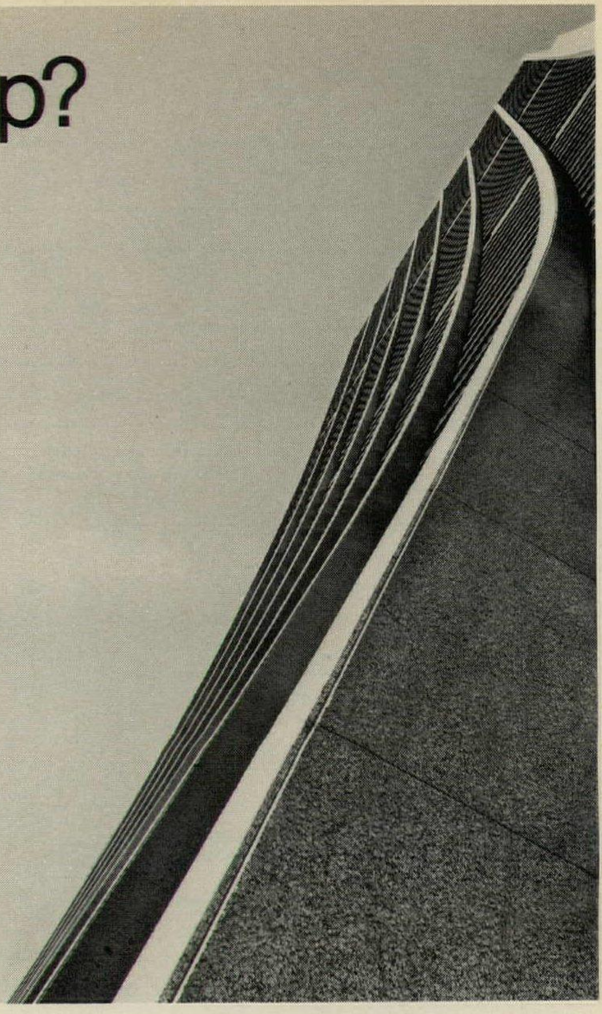
VULCRAFT

A Division of Nucor Corporation

Owner: Penn-Can Shopping Mall *General Contractor:* Pankow Construction Company, Altadena and San Francisco, California, Seattle and Honolulu *Architect:* Welton Becket & Assoc., Los Angeles *Structural Engineer:* Johnson & Neilsen, Los Angeles *Steel Framing System:* McLean Steel, Hayward, California *Steel Fabricator and Erector:* Rebco Steel Corp., Niagara Falls, New York

For more data, circle 62 on inquiry card

Insurance: How high is up?



As your insurance costs soar, Shand, Morahan invites you to look beyond the major insurer.

Since the announcement of triple-digit premium increases for Professional Liability coverage, many architects and engineers are discovering the advantage of Classic Coverage offered through Shand, Morahan & Company, the nation's second largest underwriter for this type of insurance.

Rather than dictating blanket increases for blanket coverage, we have the time and flexibility to tailor your coverage and premium to your exact exposure.

Classic Coverage is tuned to today's court costs, court decisions and escalating claims and settlements, with limits to $10 million. You can even cover *prior acts with new, higher limits*. It's a plan in which you can have total confidence.

When do you renew this year? Ask your broker or agent now for the Shand, Morahan & Company bid.

It may bring your costs a little closer to earth.

The Classic Coverage.

SM

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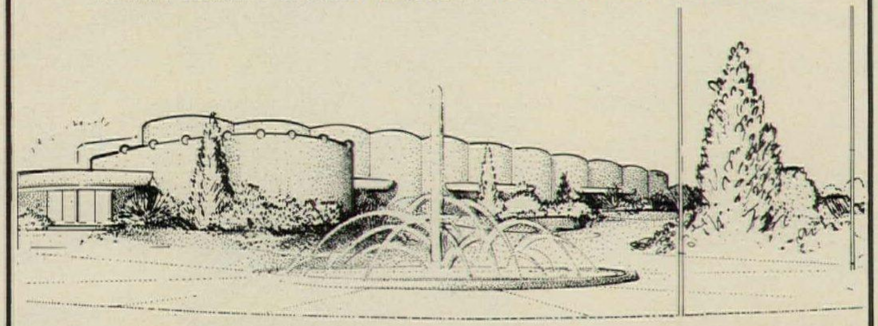
MARIN COUNTY EXHIBIT CENTER . . . SAN RAFAEL, CALIFORNIA



The designers . . . Taliesin Associated Architects of the Frank Lloyd Wright Foundation

The foundation . . . INTERPILE*

The Exhibit Center, when completed, will reflect the style and influence of the famous architect. Consulting Foundation Engineers Lee and Praszker, San Francisco, California specified a boldly imaginative foundation system for the Center. It is the INTERPILE cast-in-place concrete pile. Economical, easy to install, the INTERPILE system can lower your foundation cost, too. Let us tell you how in our new illustrated brochure. Write today.

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THE SCREWED DOWN DECK

a change to the better—Teks® self-drilling fasteners

greater reliability

When you specify that metal deck will be fastened with Teks self-drilling fasteners you're dealing with a known quantity. You *know* the shear strength, the pull-out strength and the tensile strength of every fastener.

more consistent performance

Every Teks fastener that's driven into the deck generates the same high degree of holding power. You are not relying on the "touch" or skill of an operator to determine the strength of the fastening. There's just one consistently strong fastening after another. There are no burn-throughs or weak spots. With Teks fasteners, not only do you get quality performance, you get quality appearance.

economy

Deck fastening is fast and easy with Teks self-drilling fasteners and clean up time is cut way down. Because Teks fasteners never burn through or mar the deck, there's never any need to erect scaffolding and repaint the undersurface. No expensive equipment is needed to drive Teks fasteners, either. All that's required is a conventional power screwgun and an electrical power source. And, because no special skills are needed, you have much greater crew flexibility.

strength

Under severe loading conditions, a Teks fastener allows the distribution or averaging of shear loads throughout the entire deck, providing an effective diaphragm. The brittleness and rigidity of a weld does not permit shear movement. As a result, sequential popping or "domino" type failures can occur.

a simplified fastening operation

Drilling through steel up to one-half inch thick, Teks decking fasteners handle almost any bar joist and structural application. A Stitch Teks has been developed specifically for the quick, secure fastening of hard-to-weld sidelaps. And, when the job is completed, inspection is a simple matter of looking to see that the fasteners are there. This can be done as easily from below the deck as from above.

Change to the better way—specify Teks self-drilling fasteners for your next deck. Send for diaphragm charts and our new catalog.

BUILDEX

A DIVISION OF ILLINOIS TOOL WORKS INC.
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In Canada: Buildex Division, Canada ITW Limited
67 Scarsdale Rd. • Don Mills, Ontario M3B2R2

"New concepts in construction fastening."®

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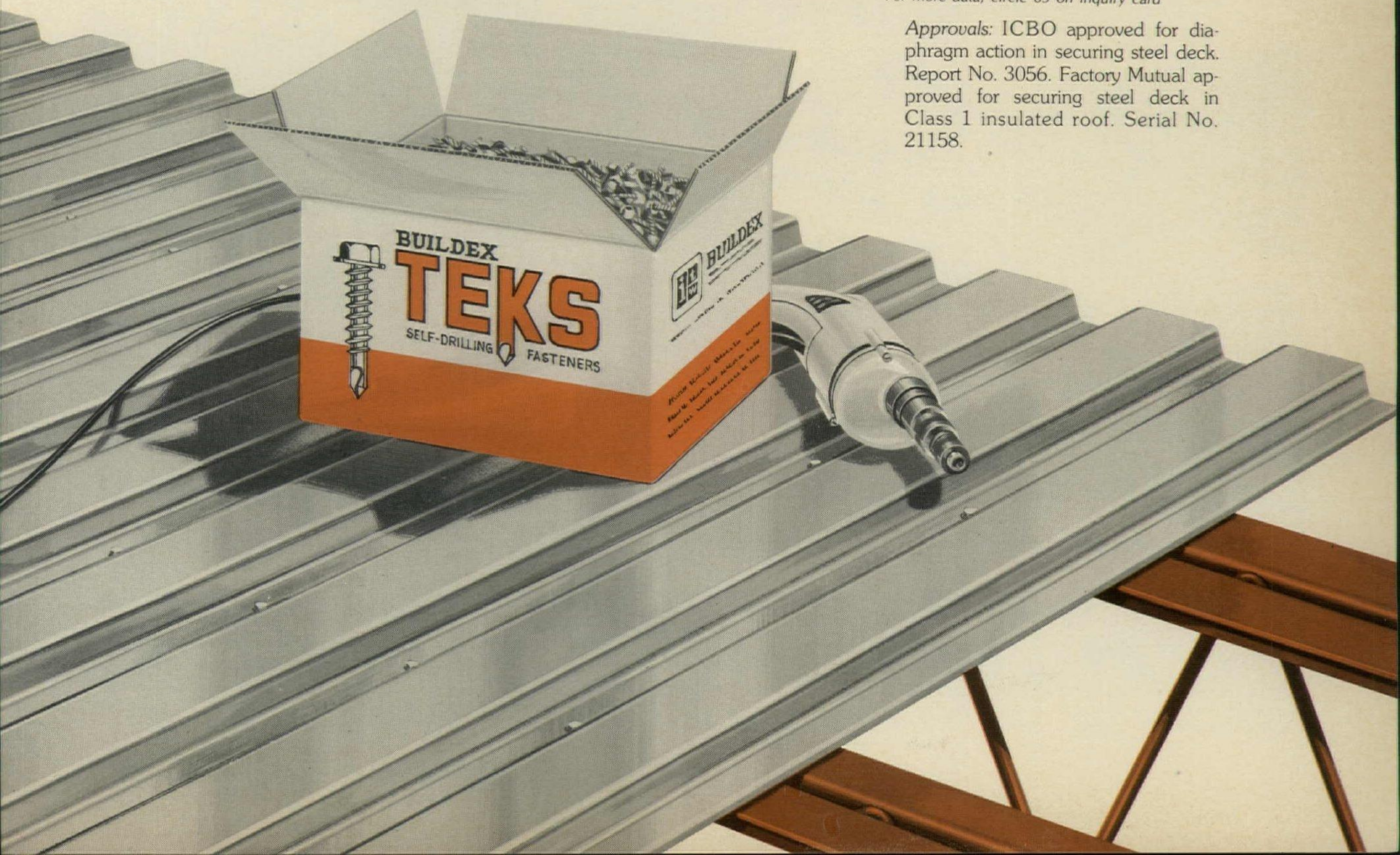
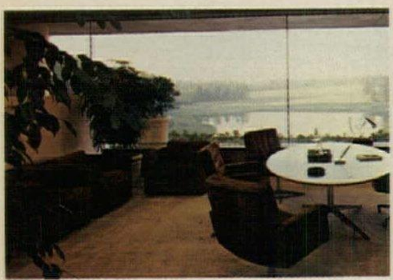
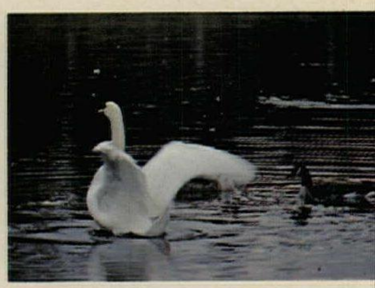
Approvals: ICBO approved for diaphragm action in securing steel deck. Report No. 3056. Factory Mutual approved for securing steel deck in Class 1 insulated roof. Serial No. 21158.



THE PROBLEM: SAVE ENERGY AND KEEP THE VIEW.

THE SOLUTION




Owner: Weyerhaeuser Company, Tacoma, Washington. Architects: Skidmore, Owings & Merrill, San Francisco, California.
Building Contractor: Swinerton & Walberg, San Francisco, California. Glazing Contractor: Cobbledick-Kibbe Glass Co., Oakland, California.

WAS CLEAR.

WEYERHAEUSER ENJOYS WINTER HEAT, SUMMER SHADE.

When the Weyerhaeuser Company decided to build their worldwide headquarters in Tacoma, Washington, they wanted their new building to be a model of energy conservation. At the same time, they wanted to open the interior to the natural beauty of the site.

These somewhat contradictory objectives were solved by designing a low-profile structure with extensive overhangs. And by specifying LOF's heavy-duty clear glass. Together, they minimized solar heat gain in the summer and maximized the entry of solar heat during the winter.

This solution was not only beautiful but so energy-efficient that the Weyerhaeuser Building won a 1973 Energy Conservation Award in the commercial category.

But heavy-duty clear is just one of many glasses from LOF. Depending upon your specific problem, LOF Thermopane® units, Vari-Tran® reflective glass or tinted heavy-duty glass may be the answer.

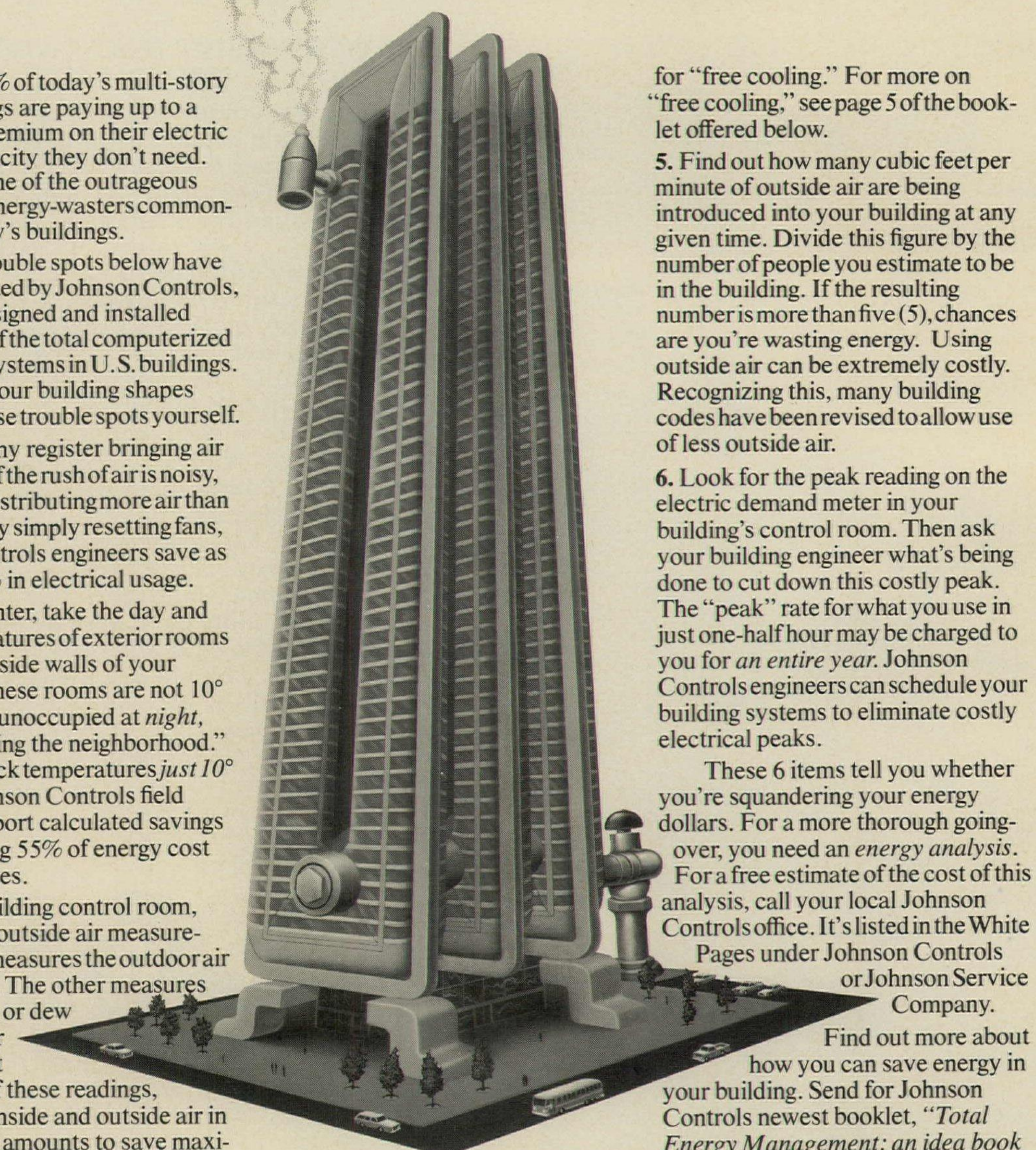
If you want to save energy dollars with the right glass, one of our highly qualified architectural representatives will be glad to help you. Or you can write Libbey-Owens-Ford Company, 811 Madison Avenue, Toledo, Ohio 43695. We'll have a solution for you.

LOF

For more data, circle 66 on inquiry card

6 Ways to Tell If Your Modern Building Is Squandering Costly Energy.

A report to executives from Johnson Controls.



Fully 90% of today's multi-story buildings are paying up to a 15% premium on their electric bill for electricity they don't need. This is just one of the outrageous money- and energy-wasters commonplace in today's buildings.

The 6 trouble spots below have been pinpointed by Johnson Controls, who have designed and installed more than half the total computerized automation systems in U.S. buildings. To see how your building shapes up, check these trouble spots yourself.

1. Listen at any register bringing air into a room. If the rush of air is noisy, you may be distributing more air than is required. By simply resetting fans, Johnson Controls engineers save as much as 15% in electrical usage.

2. During winter, take the day and night temperatures of exterior rooms along the outside walls of your building. If these rooms are not 10° cooler when unoccupied at *night,* you're "heating the neighborhood." By setting back temperatures *just 10°* at night, Johnson Controls field engineers report calculated savings of a whopping 55% of energy cost in Los Angeles.

3. In your building control room, look for *two* outside air measurements. One measures the outdoor air temperature. The other measures the humidity or dew point. If your building can't make both of these readings, it can't mix inside and outside air in just the right amounts to save maximum energy. Using only dampers and controls, Johnson Controls can save you up to 10% in cooling expenditures.

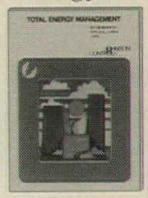
4. Does your air conditioning equipment run when outdoor temperatures dip below 53°? If so, you're probably wasting energy. The average commercial building needs cooling instead of heating even when outside temperatures dip to 30° or even 20°. Your building should use outside air for "free cooling." For more on "free cooling," see page 5 of the booklet offered below.

5. Find out how many cubic feet per minute of outside air are being introduced into your building at any given time. Divide this figure by the number of people you estimate to be in the building. If the resulting number is more than five (5), chances are you're wasting energy. Using outside air can be extremely costly. Recognizing this, many building codes have been revised to allow use of less outside air.

6. Look for the peak reading on the electric demand meter in your building's control room. Then ask your building engineer what's being done to cut down this costly peak. The "peak" rate for what you use in just one-half hour may be charged to you for *an entire year.* Johnson Controls engineers can schedule your building systems to eliminate costly electrical peaks.

These 6 items tell you whether you're squandering your energy dollars. For a more thorough going-over, you need an *energy analysis.* For a free estimate of the cost of this analysis, call your local Johnson Controls office. It's listed in the White Pages under Johnson Controls or Johnson Service Company.

Find out more about how you can save energy in your building. Send for Johnson Controls newest booklet, *"Total Energy Management: an idea book to help you control costs."*



Write Fred L. Brengel, President, Johnson Controls, Inc., Reference G-4, Box 423, Milwaukee, Wis. 53201.

JOHNSON CONTROLS Prime source of problem-solving systems.

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For more data, circle 68 on inquiry card ▶

TALKING COMPUTER TELLS HOW YOU COULD GET UP TO TRIPLE YOUR MONEY BACK ON THE ADDED COST OF 2¼" ROOF INSULATION.

NEW OWENS-CORNING COMPUTER TELLS YOU ALL THIS IN 30 SECONDS		
1. ANNUAL HEATING SAVINGS	$2,217	
2. ANNUAL COOLING SAVINGS	+361	
3. TOTAL ANNUAL FUEL SAVINGS		$2,578
4. INITIAL EQUIPMENT SAVING	$41,640	
5. LESS: COST OF ADDITIONAL INSULATION	−19,500	
6. NET EQUIPMENT SAVING		$22,140

To compute savings for the average life cycle of a building (20 years), multiply annual fuel savings ($2,578) by 20 and add new equipment saving ($22,140). Total, $73,700, is more than *triple* the cost of additional insulation. (That's not counting increases in fuel costs or the effect of continuing inflation.)

There's never been anything like it!

- Simply feed a few facts to our computer via touch-tone telephone.
- Wait 30 seconds.
- Then listen! The computer's voice will give you the approximate savings in a 6-point answer (see table). If you want a print-out in the mail, just say so.

This valuable service (called "The Energy Management System Line to Savings") doesn't cost you a cent, no matter how often you use it.

Saves time and money

We developed it to help architects, engineers, and owners solve a problem. The energy crisis has forced fuel prices up and made 2¼" roof insulation more desirable than ever before.

But the savings on any particular building depend on many variables—and doing the calculations can be tedious and costly.

No longer! Our new system does the job in seconds, makes it easier for you to be a hero to your clients or management.

Note: The savings shown above are approximate and are based on the following: Average 1975 fuel and equipment costs. Upgrading roof insulation from 15/16" to 2¼" on a 60,000-sq.-ft. metal deck. Suburban office building. Northern climate. Gas heating and electric cooling.

Your estimated savings on a particular building depend on size, type, location, method of heating and cooling, and other variables. (The figures you'll get from our computer are approximate savings, of course, and can't replace a full analysis.)

For more information

Call your Owens-Corning representative. Or write to Y. Y. Meeks, Owens-Corning Fiberglas Corporation, Fiberglas Tower, Toledo, Ohio 43659.

Owens-Corning is Fiberglas OWENS/CORNING FIBERGLAS TRADEMARK ®

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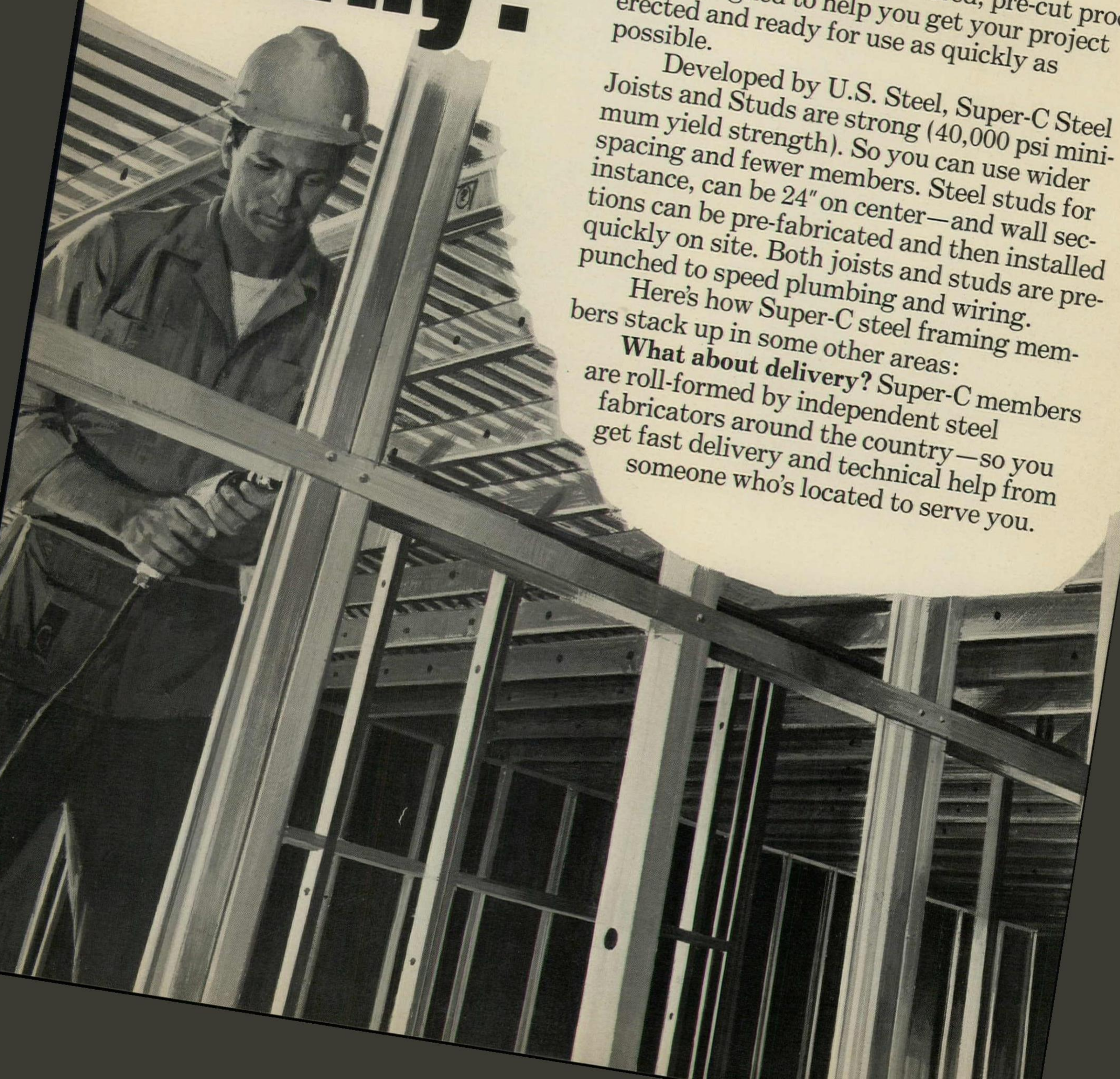
Super-C ste
install faster an
Why?

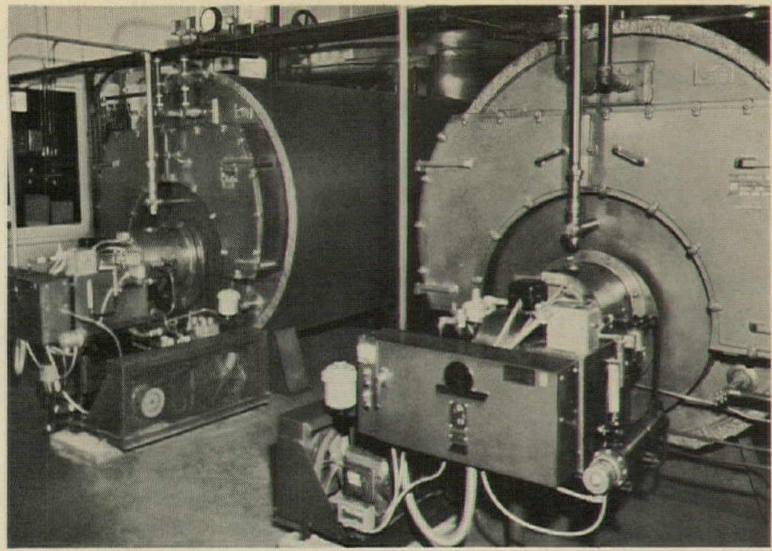
Because they're pre-engineered, pre-cut proc
ucts, designed to help you get your project
erected and ready for use as quickly as
possible.

Developed by U.S. Steel, Super-C Steel Joists and Studs are strong (40,000 psi minimum yield strength). So you can use wider spacing and fewer members. Steel studs for instance, can be 24" on center—and wall sections can be pre-fabricated and then installed quickly on site. Both joists and studs are prepunched to speed plumbing and wiring.

Here's how Super-C steel framing members stack up in some other areas:

What about delivery? Super-C members are roll-formed by independent steel fabricators around the country—so you get fast delivery and technical help from someone who's located to serve you.



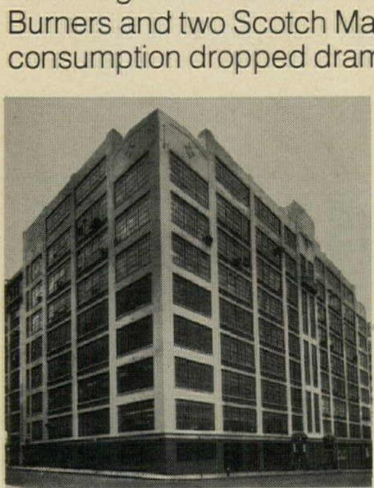


Two Iron Fireman Burners in Scotch Marine Type Boilers replaced two old H.R.T. oil-fired boilers.

Iron Fireman Burners save 41,739 gals. of fuel oil per year in commercial building

(A Case History: from 80,000 to 38,261 gals. fuel oil per year – a 52% saving)

Prior to September, 1973, yearly fuel oil consumption at 160 Jay Street in Brooklyn was averaging around 80,000 gallons #6 fuel oil. Following the installation of two IRON FIREMAN Burners and two Scotch Marine Boilers, fuel consumption dropped dramatically to 38,261 gallons in a 1-year period. Dollar savings at today's oil prices: 41,739 gals. #6 oil saved at approximately $.35 per gallon plus sales tax= $15,777.34.



Nine-story, 180,000 sq. ft. building, 160 Jay Street, Brooklyn, N.Y.
Building Owner: Cama Company, Brooklyn, N.Y.
IRON FIREMAN Dealer: Oil Burner Utility Company, Inc., Long Island City, N.Y.

These IRON FIREMAN Burners are complete fuel burning systems, factory assembled, wired, tested and ready for installation. Installation is through the fire door on old boilers, high or low pressure, depending on boiler design and local codes. A unique stainless steel combustion head assures tight, super-active flame patterns for positive, clean operation. Precisely directed air from the blower whirls the accurately metered oil droplet-fog, mixing it so thoroughly that a refractory chamber is not generally required for efficient combustion.

Benefits: Complete combustion, fuel efficiency, more usable heat. Now, more than ever, it pays to upgrade your heating plant with an IRON FIREMAN Burner System. Find out how you can realize significant fuel savings. Contact your nearest IRON FIREMAN Dealer listed in the Yellow Pages.

DUNHAM-BUSH, INC.
175 South Street, West Hartford, Conn. 06110
One of The Signal Companies

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We're giving pre-fab structures a good name: Winnebago.

Winnebago Living Components bring you all the well-known benefits of factory-built modular units: controlled costs, reduced job delays, shorter construction time. And a great deal more.

DESIGN FLEXIBILITY. We've applied our expertise in lamination to create versatile plywood-and-foam core structural box-beam units that let you avoid stereotype prefab designs. Load-bearing walls let you locate windows and doorways anywhere. Interior wall placement is completely flexible. More than two dozen sizes of modules are available. They'll accept virtually any roof and exterior covering.

RUGGED CONSTRUCTION. Winnebago Living Components are designed to withstand the stresses of rail shipment, to arrive undamaged and ready for prompt placement on the job site.

TURNKEY CAPABILITY. Extensive production facilities let us provide complete units in any standard interior wall finish with full interior appointments: kitchen, bath, custom furnishings through carpeting, draperies, even bedspreads.

We've spent many years building a reputation for sound engineering and construction that's made us number one in motor homes. Let us show you the difference Winnebago quality can make in your motel, apartment complex, or nursing home plans.

Write D. F. Bowers, Gen. Mgr., Living Components Division, Winnebago Industries, Inc., 1110 West I Street, Forest City, Iowa 50436. Or call (515) 582-3535, Ext. 526.

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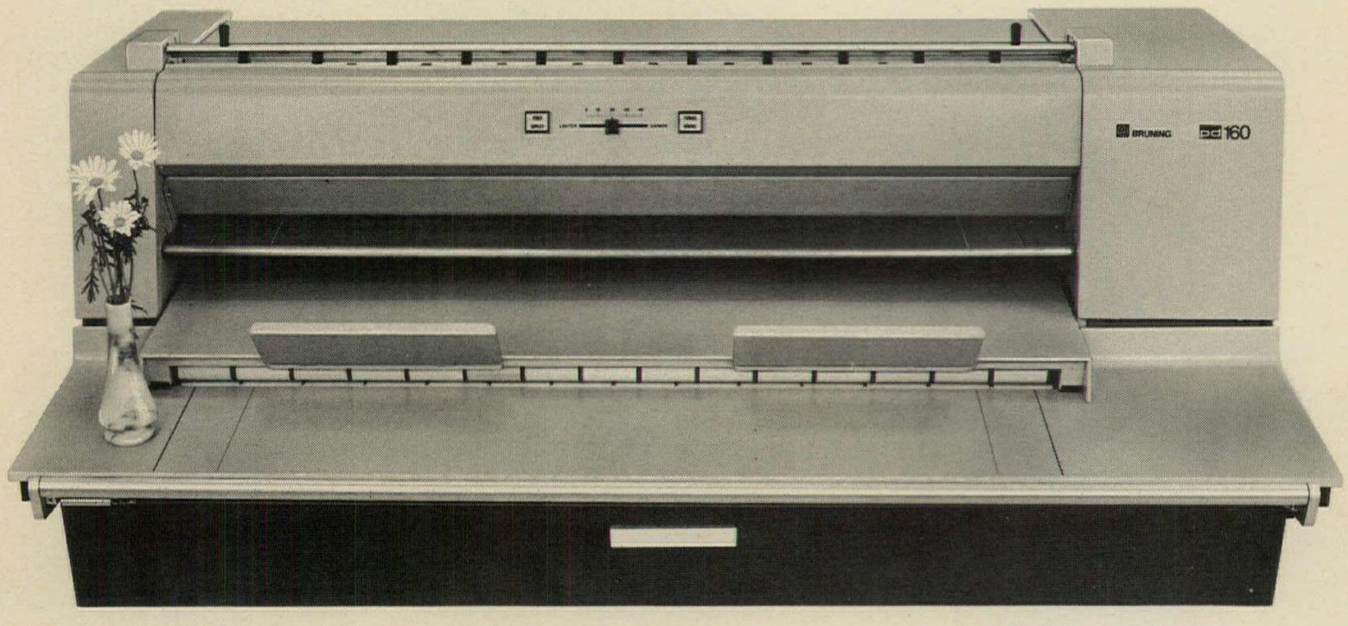
Living Components from WINNEBAGO®

Bruning's odorless energy-saving instant-on/off 110-volt 40 fpm engineering copier.



There's little left to say. You know what all those features, together in one machine, will do for you.

It's perfect as an instant on/off check-printer for your draftsmen. And productive enough to be a valuable addition to your print room. Wherever you use it, the remarkable PD-160 will put out more work more economically than any other medium-volume engineering copier. And it doesn't have to run all day to do it.

See the PD-160 in action. Learn about Bruning's breakthrough with the exclusive PD® development process. Call your Bruning man for a demonstration. Or write Bruning, 1834 Walden Office Square, Schaumburg, Illinois 60172.

We help architects communicate.

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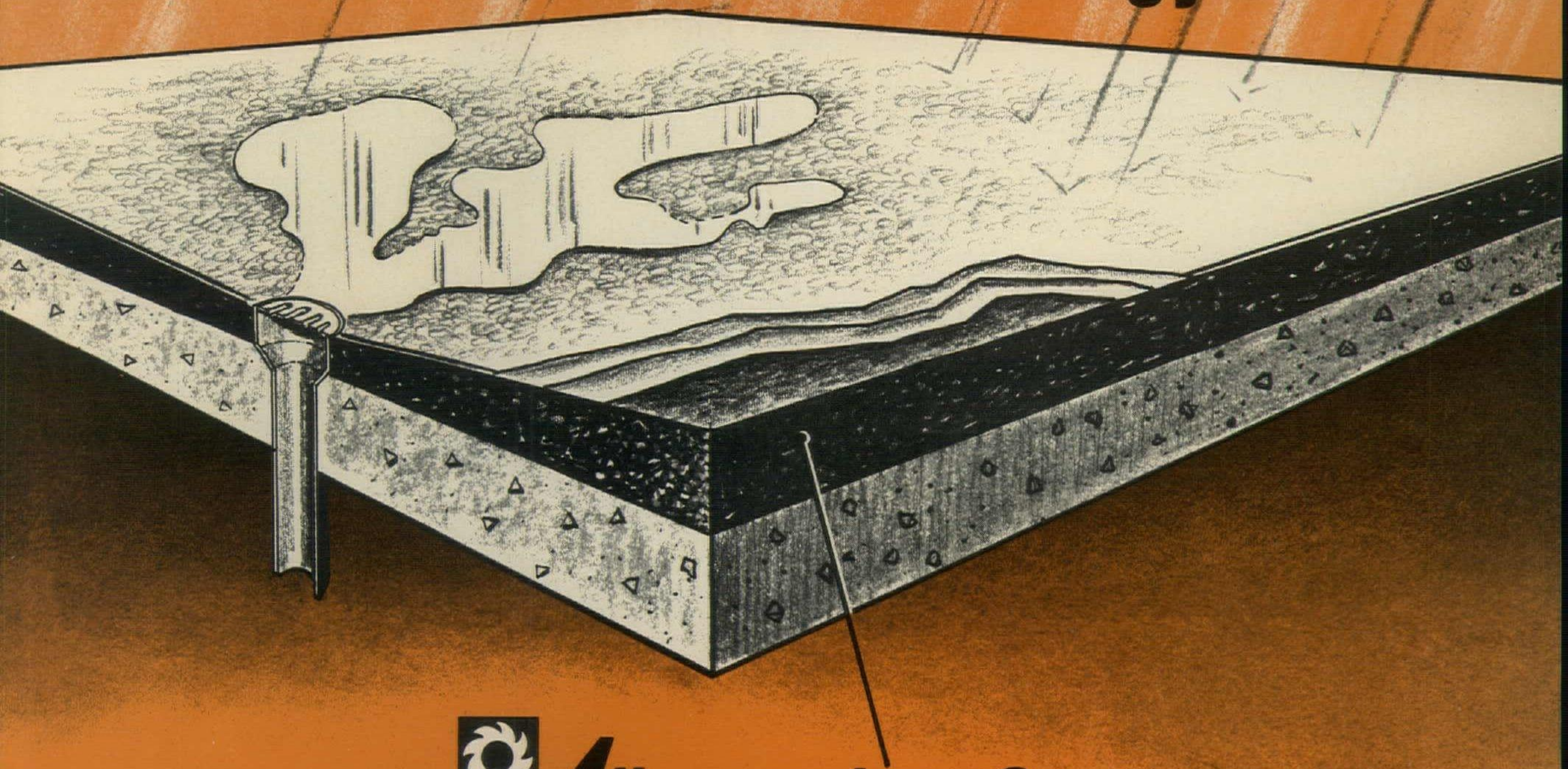
the roof deck that conserves energy!



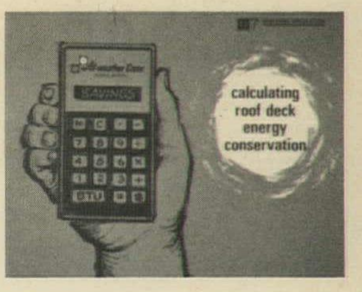
All-weather Crete®
INSULATION

Up to $134,340* savings in 20 years!

Even though the dollar and thermal savings for every building are different, similar dramatic savings are achieved on every All-weather Crete insulated building. It's important! Many owners are now requesting architects to figure costs for the construction process and also costs on yearly operation. All-weather Crete not only provides exceptional fuel/energy savings, but the added thickness provides positive slope to drains. It is also completely seamless — it is applied dry and it transmits vapors. These are all aids to longer roof life.

*This represents the total 20 year savings when using 4" of All-weather Crete in lieu of 1" of rigid or 2" of wet-poured insulation on a 50,000 sq. ft. deck. Therms saved - 288,400; KW/Hrs. saved - 890,000. These figures were taken from an engineering study developed by a professional engineer at a prominent university. Source available upon request.

Figure the thermal and cost savings on your next job. Compare insulations. Do this with the technical workbook, "Calculating Roof Deck Energy Conservation". It's free to architects and engineers. Contact Silbrico Corporation.



SILBRICO CORPORATION
6300 River Road, Hodgkins, Illinois 60525, (312) 735-3322

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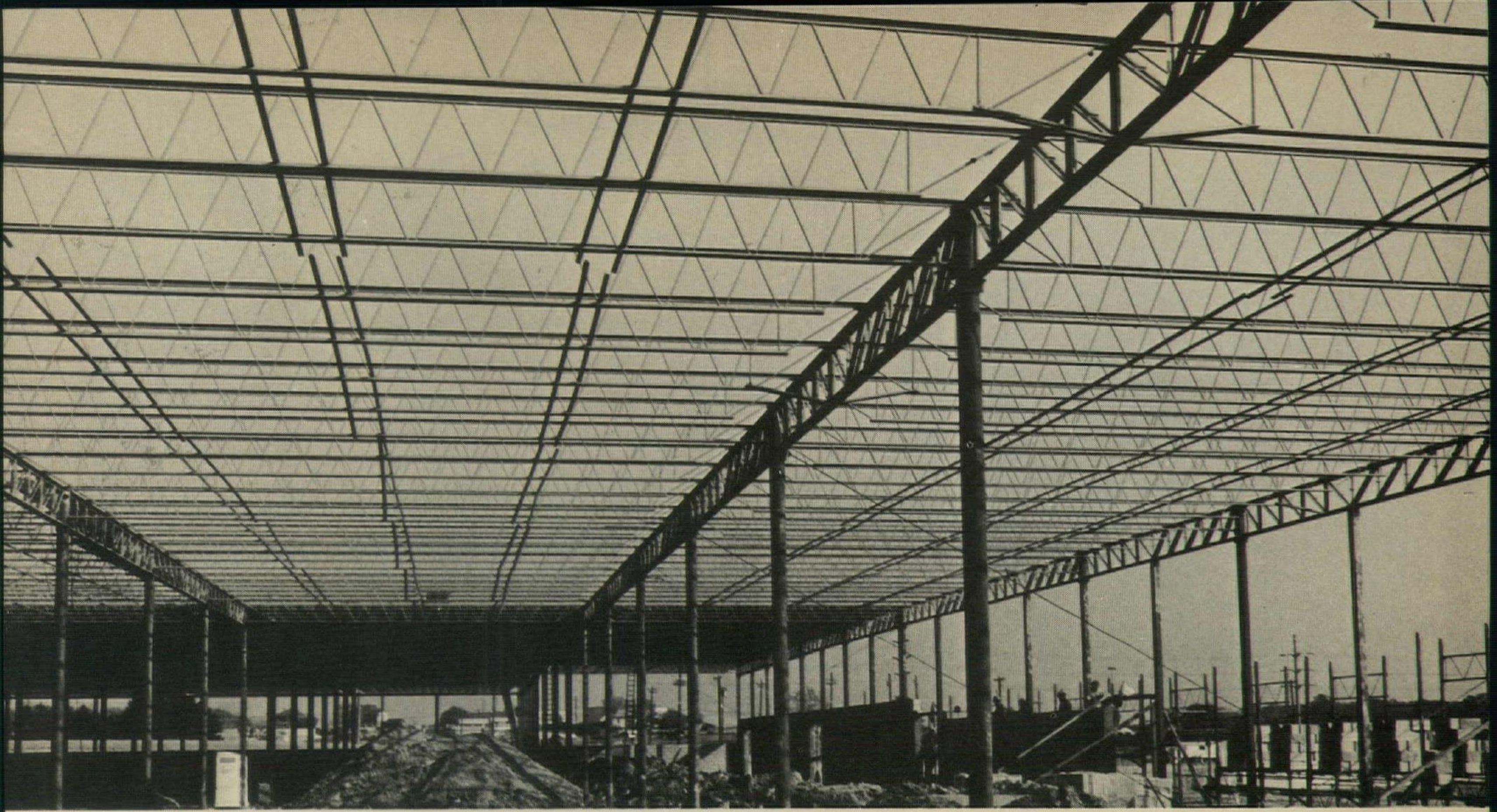

Contractor: Walker & Eby Construction, Inc., Allentown, Pa.
Architect: Spillman Farmer Architects, Bethlehem, Pa.

WITH STEEL JOISTS THIS 150,000 SQUARE FOOT BUILDING TOOK ONLY 120 DAYS TO BUILD.

Careful planning, and the use of open-web steel joists made completion of McGraw-Edison Company's new 150,000 square foot warehouse possible in 120 working days — an amazingly short period of time for a building of this size.

"When we undertook this job," stated Mr. Eby, President of Walker & Eby Construction Company, "we did so with the understanding that we could make the owner's building dollars go farther. That's one of the main reasons we selected steel joists. We estimated that by using steel joists the McGraw-Edison Company Distribution Center was completed months earlier than would have been possible with other framing materials."

Speed, economy and availability are only some of the many benefits offered by strong, lightweight, versatile open-web steel joist construction. So whether it's a warehouse, hospital, motel, shopping center or any other type of building, you'll be time and dollars ahead when you specify and use open-web steel joists.

We've put together a lot of facts about Open-Web Steel Joists, Longspan Joists and Deep Longspan Joists to help you save time and construction costs. All of this is in our latest edition of Specifications and Load Tables. It's FREE. Mail the coupon today.

STEEL JOIST INSTITUTE

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Arlington, Va. 22202

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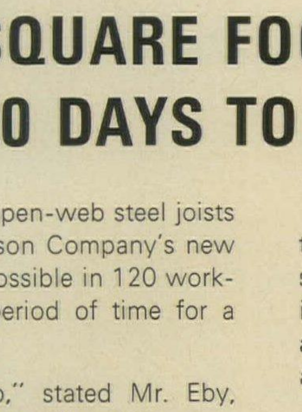
75002



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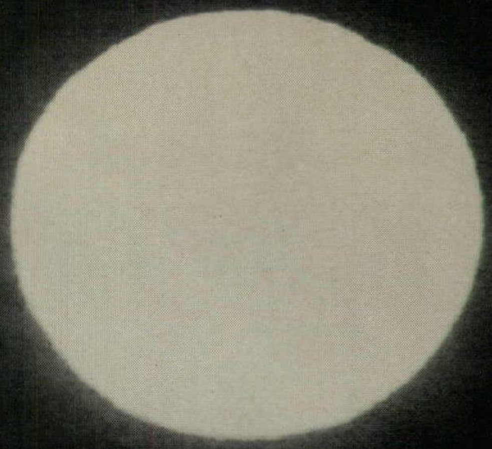

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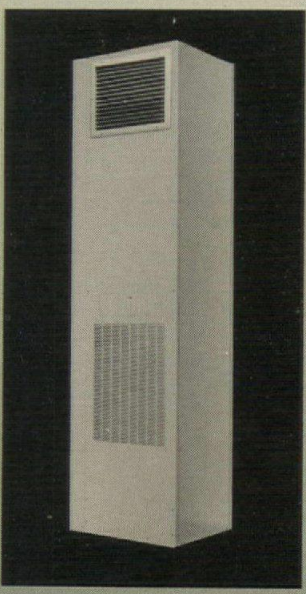
Performance? Well, for openers, the Energy Efficiency Ratios (EER) look like this:

Heating BTUH	C.O.P.*	Cooling BTUH	EER**
9,600	2.7	9,000	8.3
17,600	2.7	18,000	8.7
26,600	3.1	24,000	9.2

*Coefficient of performance **Compressor and fan motor

These new units are very quiet, too. So they're ideal for places like hospitals, nursing homes, office and apartment buildings. They also save on both field-supplied labor



and materials because we ship them with all risers for condenser water and drains, and with all internal control systems. The units are self-contained, too, and they can be stacked one above the other in multistory buildings, each independent of the others. So if a malfunction should occur, only one unit is affected: the rest keep on operating.

And here's another plus: there's plenty of design freedom for the architect because units with finished cabinets are well-suited for use either in new buildings or in remodeling jobs. (Unfinished units can be specified for built-in applications.)

And you can choose ¾, 1, 1½ and 2-ton models, for heat-recovery and/or cooling-only applications.

For full details, contact your McQuay representative, or write: McQuay Group, McQuay-Perfex Inc., Box 1551, Minneapolis, Minnesota 55440.

McQUAY T.M.

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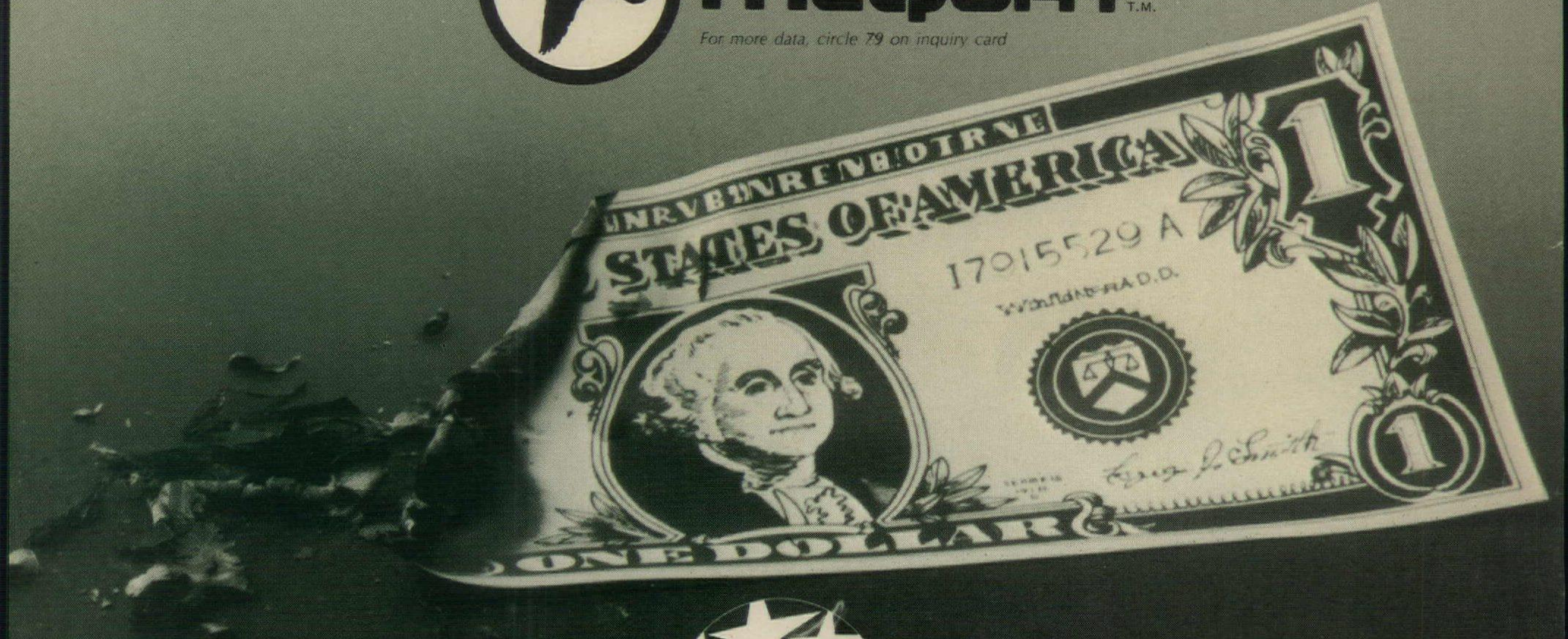

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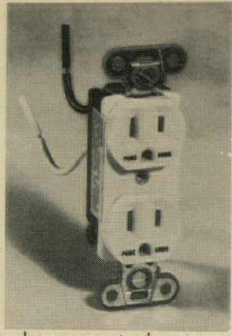
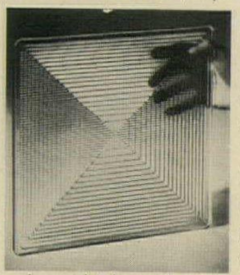


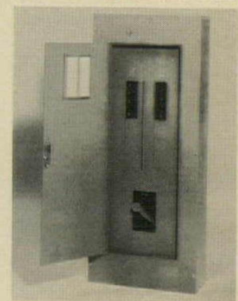
Circle 321 on inquiry card

PRISMATIC LENS / Specially designed to provide low-brightness illumination from indoor high-intensity discharge lamp sources, the 10⅞-in. square *Pyrex* tempered "Lenslite" refractor can be used with HID sources up to 250 watts. The company says the low-brightness design significantly reduces high-angle glare. ▪ Corning Glass Works, Corning, N.Y.

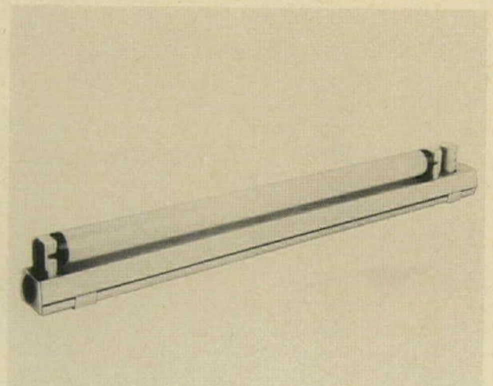


Circle 322 on inquiry card

CUSTOM CIRCUIT BREAKER BOXES / Available up to 600 amps, these load-centers are available off-the-shelf from the company's electrical equipment distributors. Intended for industrial and commercial applications, the breaker boxes can be flush or surface mounted and used as main service or branch circuit panels. Main breakers of 400 and 600 amps can be field-installed in the same box, and boxes are available for indoor or outdoor use. ▪ GTE Sylvania, Waltham, Mass.



Circle 323 on inquiry card



FLUORESCENT FIXTURES / With what company officials describe as the smallest cross-section available, the unit is made of extruded anodized aluminum, in both standard and reflective models, with the non-reflective models being 2¼ in. high and 1⁷⁄₁₆ in. wide. The bantam-sized fixtures are designed especially for installation in such restrictive areas as valances. All models use standard T8 15-watt fluorescent lamps. Both standard and reflective models come in 20⅝ in. and 40½ in. lengths and in standard as well as portable units. ▪ Sentinel Lighting, Div. of Airey-Thompson Co., Los Angeles, Cal.

Circle 324 on inquiry card

ADVERTISING INDEX

Prefiled catalogs of the manufacturers listed below are available in the 1975 Sweet's Catalog File as follows.

A Architectural File (green)
I Industrial Construction File (blue)
L Light Construction File (yellow)
D Interior Design File (black)

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