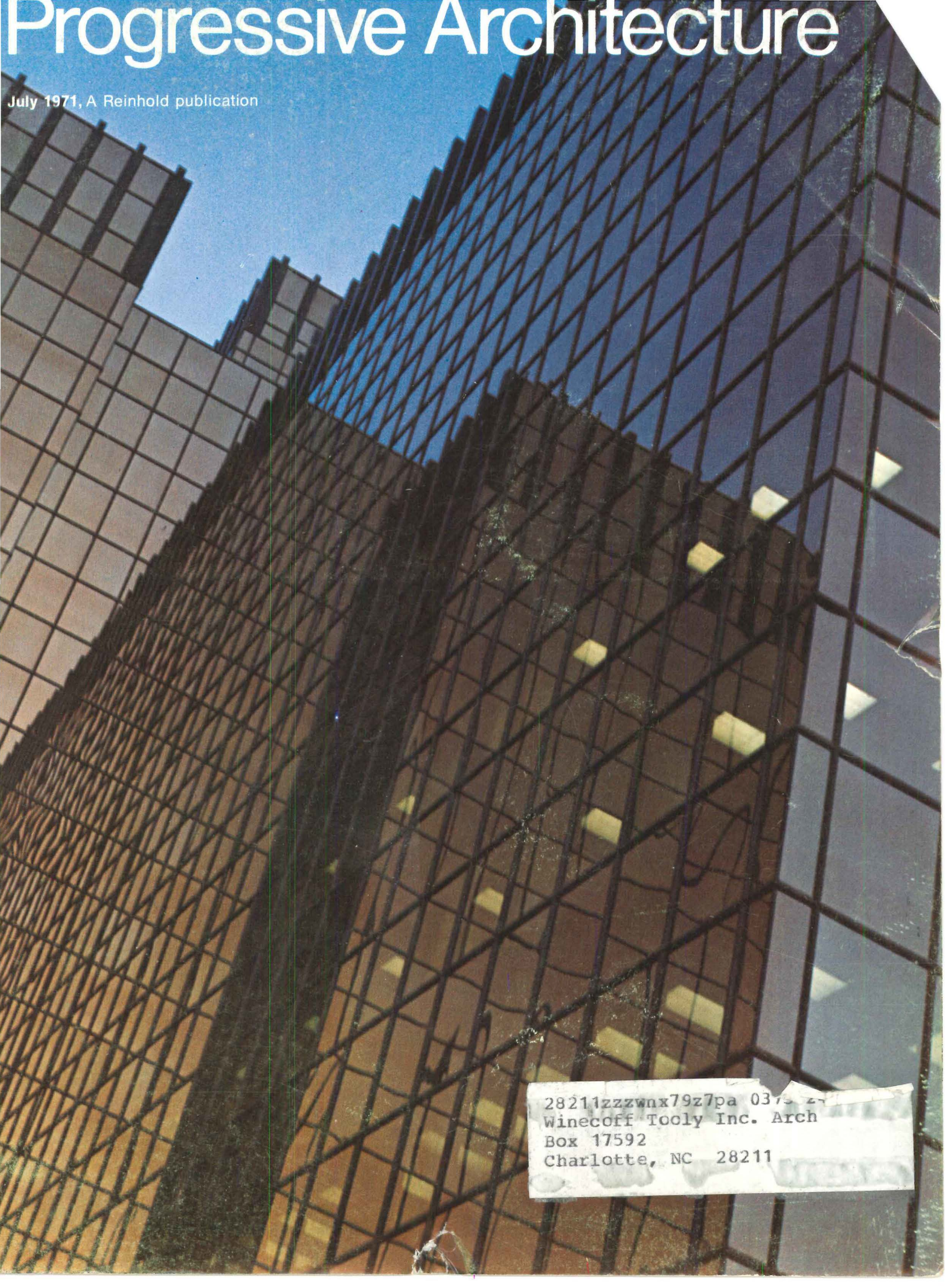
Progressive Architecture

July 1971, A Reinhold publication



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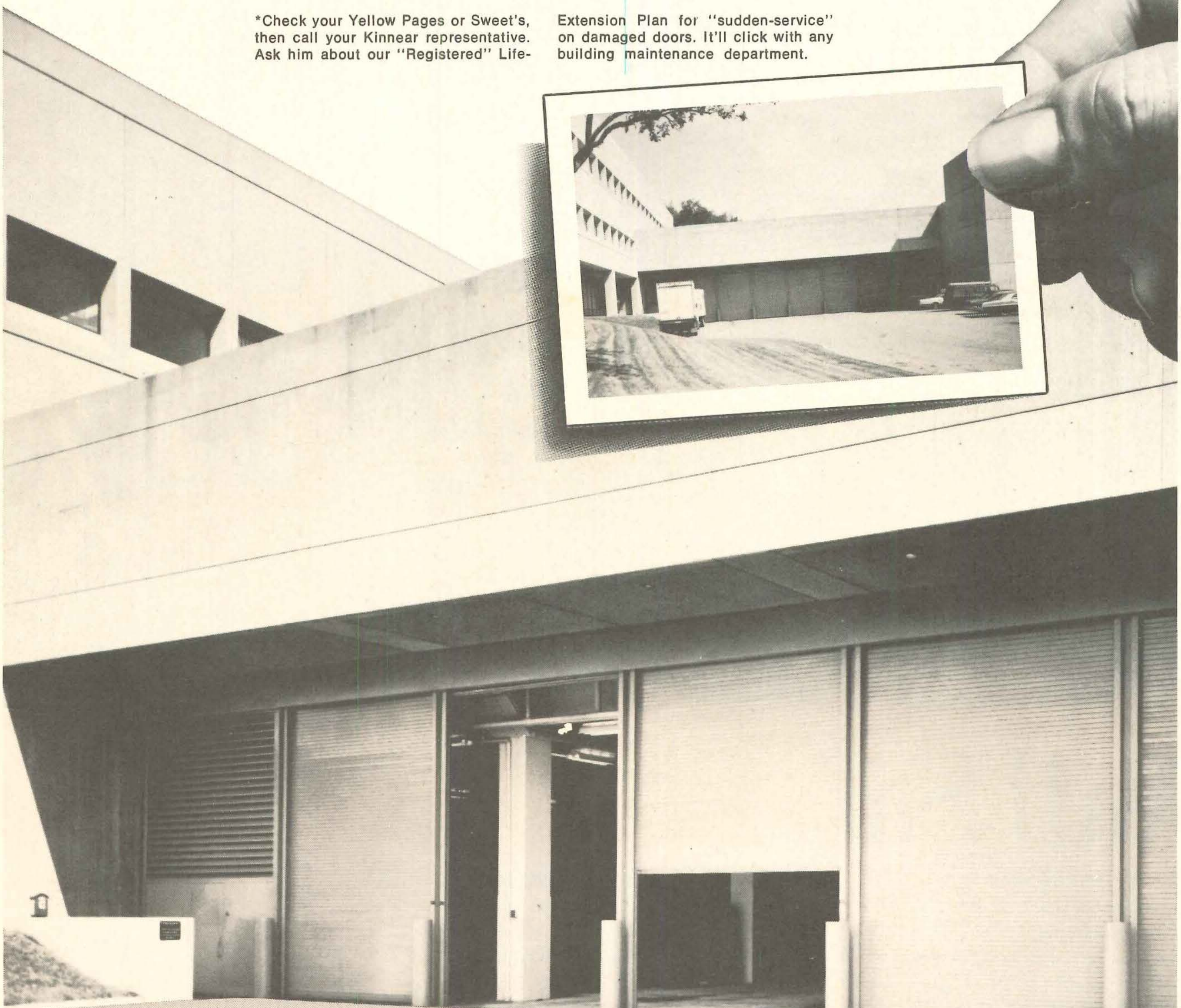

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Progressive Architecture

Computers and the architect

Cover: Control Data Corporation headquarters, Bloomington, Minn. photographed by Hedrich-Blessing.

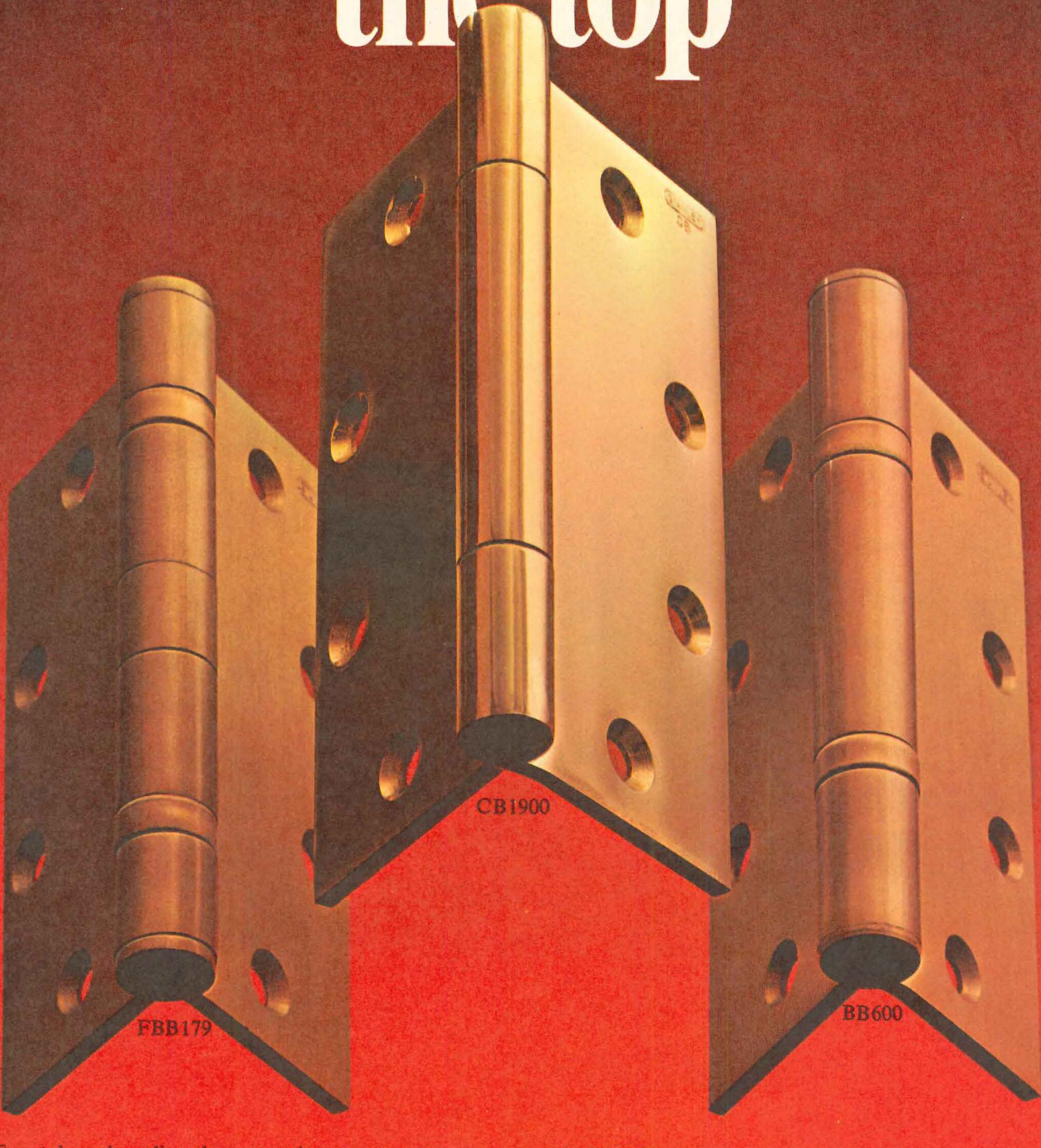
Departments

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

Subscriptions payable in advance. Publisher reserves right to refuse unqualified subscriptions. Subscription prices to those who, by title, are architects, engineers, specifications writers, estimators, designers, or draftsmen, and to government departments, trade associations, above title groups on temporary military service, architectural schools, architectural students, advertisers and their employees: $6 for one year; $9 for two years; $12 for three years. All others, and those professionals outside the U.S., U.S. Possessions and Canada: $12 for one year; $18 for two years; $24 for three years. Foreign nonprofessionals: $24 for one year. Single copy $3, payable in advance. Indexed in Art Index, Architectural Index, Engineering Index. Second-class postage paid at Stamford. Conn. and additional offices. Volume LII. No. 7. Printed in U.S.A. Reinhold Publishing Corporation

What makes this ceiling right for this job?

Let's take it from the top



For style and quality, the one at the top—and it doesn't matter how many hinges you look at—is Stanley's CB1900. We call this one *LifeSpan*. The slimmest, longest life, *concealed* bearing hinge manufactured today. So unusual, we've even had it patented. So fine, it meets every architectural challenge. So great, we guarantee it for the life of the building.

Of course, there's also the BB600 *Slimline*—the *first* three-knuckle ball bearing hinge made.

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ews

uild or not to build?

Editor: I enjoyed reading Margaret ie's good letter in your May issue (p. praise of your January editorial on erving ecological environments.

nen turned to p. 72 and looked with or at the photographs of a vacation se which strikes me as an excellent ex-le of ecological atrocity. What a shame a lovely wild place on the Maine coast grabbed up for a cottage site.

put it mildly, your editorial policy on tions of the natural environment, ns ambivalent, if not downright cynical.

ert Fairfield
nto, Canada

u-like?

Editor: It would be interesting to read tical commentary on the remarkable mblance of many recent houses (such e Owen residence in the May issue, p. o houses being done half-a-century by Le Corbusier. Is it the new eclecti-, or is architecture just now beginning tch up with Corbu?

ie P. Jones
sville, Ala.

Editor: In one of my encounters with ent struggling with the problems of e to spend money and where to save devised a system for evaluating the ive merit of various expenses. It's d on the encounter-minute per dollar, MD.

e system works in the following man-If one wants to rate the 50 or so sq ft a secretary uses, multiply the secre-by the space (the encounter) times the tes of use per year divided by dollar (say, $30 per square foot).

1 sec'y x 480 min/day uses x 200 days/year
÷ 50 sf x $30/sf
$= \frac{96000}{1500} = 64$ (approx.)

Thus, an EMD of about 64—a very good rating.

On a $25,000 ± office building lobby in a building of 10,000 people, assume four one-minute encounters per day per person and 2500 visitors @ 2 1.5 encounters.

10,000 people x 4 min/day x 200 days/yr
+ 2500 x 3 min/day x 200 days/yr
= 8000000 + 1500000
÷ 250000
= 38—not bad, either.

A single piece of artwork (say $25,000), on the other hand, unless really unusual, probably wouldn't draw more than a 2-or 3-second glance from the regular inhabitants of the building and maybe only twice a day. The 2500 visitors might look for 15 seconds or so on the way in and out.

10,000 people x 6 sec/day x 200 days/yr
+ 2500 vstrs x 30 sec/day x 200 days/yr
= 12000000 + 15000000
÷ 25000 x 60 sec/min
$= \frac{270}{15}$
= 1.6—not very high!

The fun of this system is that it may be applied to virtually anything. Try, for instance, an obscure Rembrandt in a museum's study collection. I came out with an EMD of .005 (a rather valueless object, evidently).

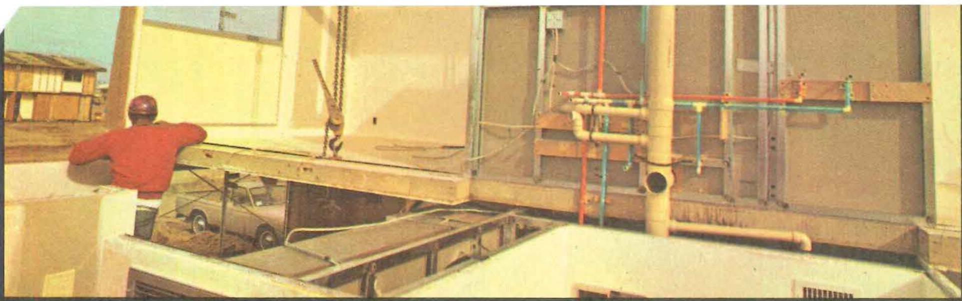
For a long term investor, the amortization period may be used instead of a year for a more realistic picture. I respectfully submit the EMD as a unit for coping with anything from a terrazzo floor to a Jackson Pollock.

Joseph Zelvin
New York, N. Y.

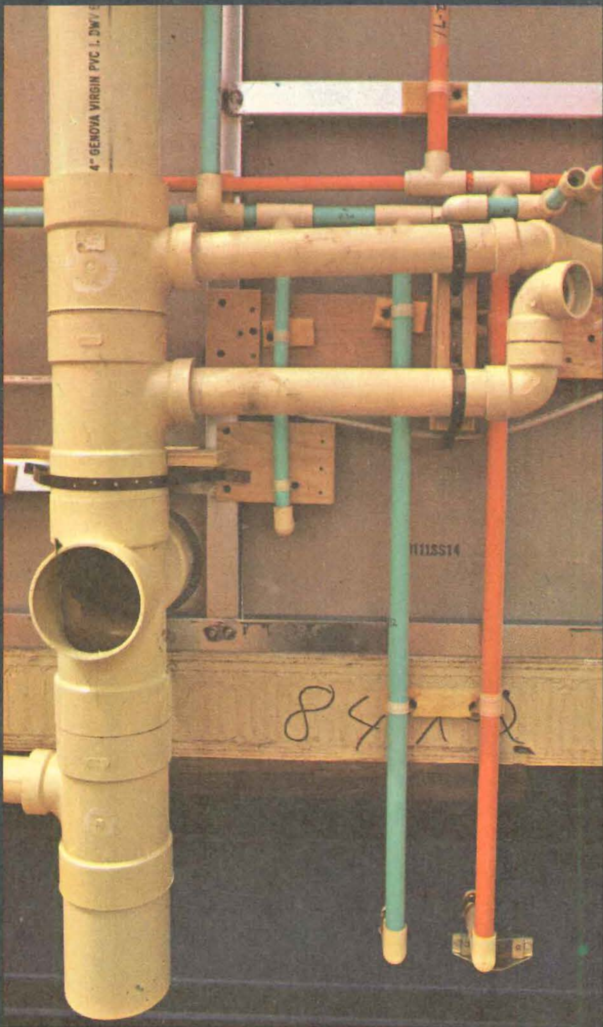
If something doesn't happen soon

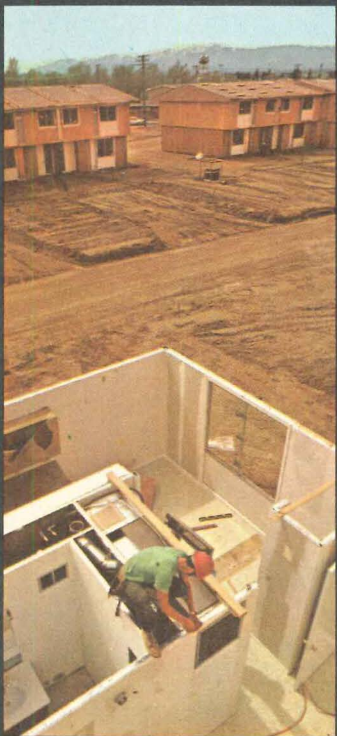
Dear Editor: I have just finished reading the May issue of P/A, and had to tell you that your editorial on housing (p. 71) was exceptionally well written and 100 percent correct. I don't know how long it will take the politicians and the professionals to realize the magnitude of the impact of what could be accomplished if we followed your words, but if something doesn't happen soon, then the rejuvenation of housing within our cities today will become an impossibility.

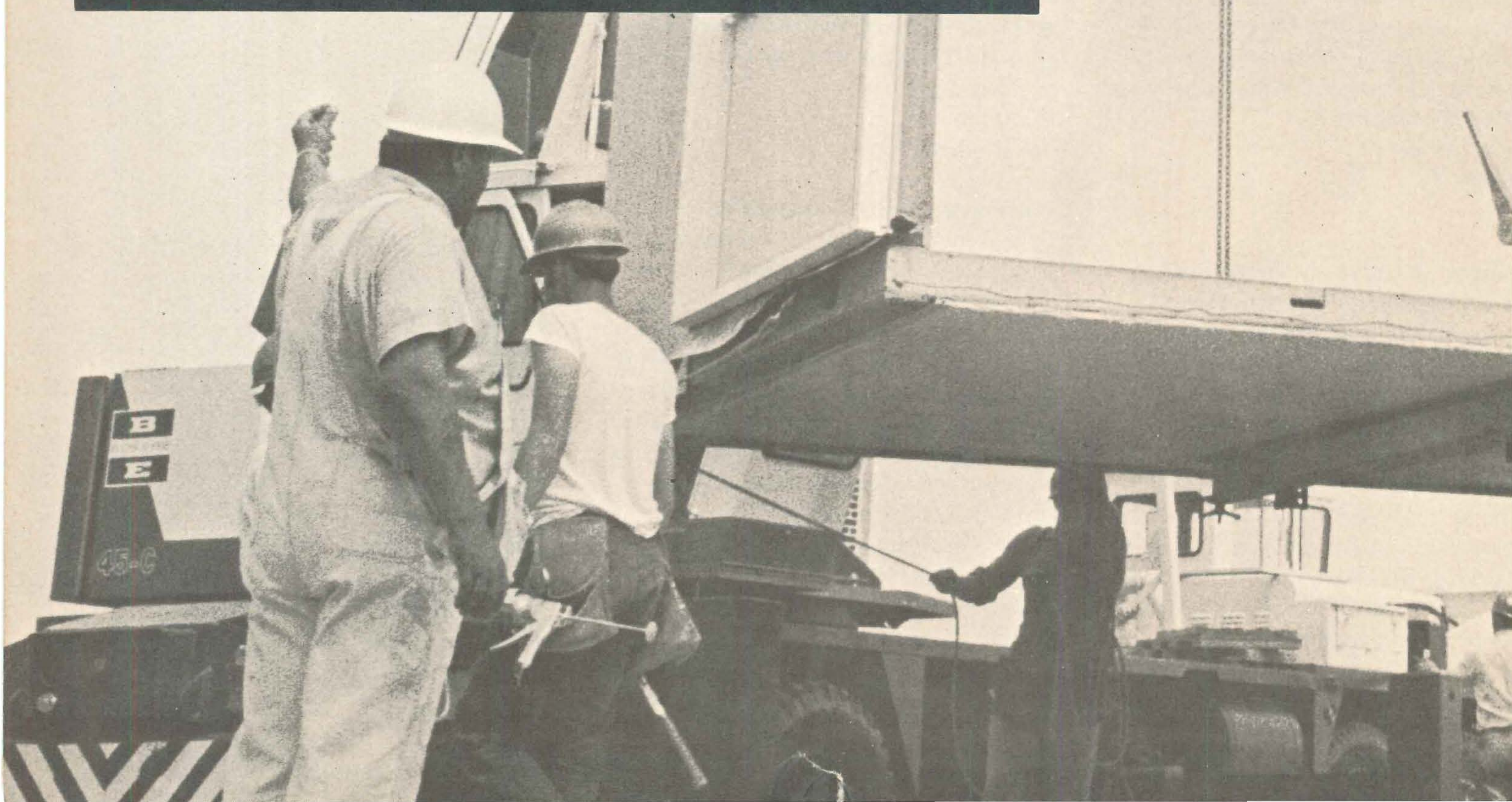
Philip J. Meathe, FAIA
Detroit, Mich.



One important innovation in this particular project is a "utility chase." All plumbing and heating pipes and vents, air conditioning and wiring are centralized into a "plug-in" unit.







For Creative Engineering In Modular Plumbing Systems....

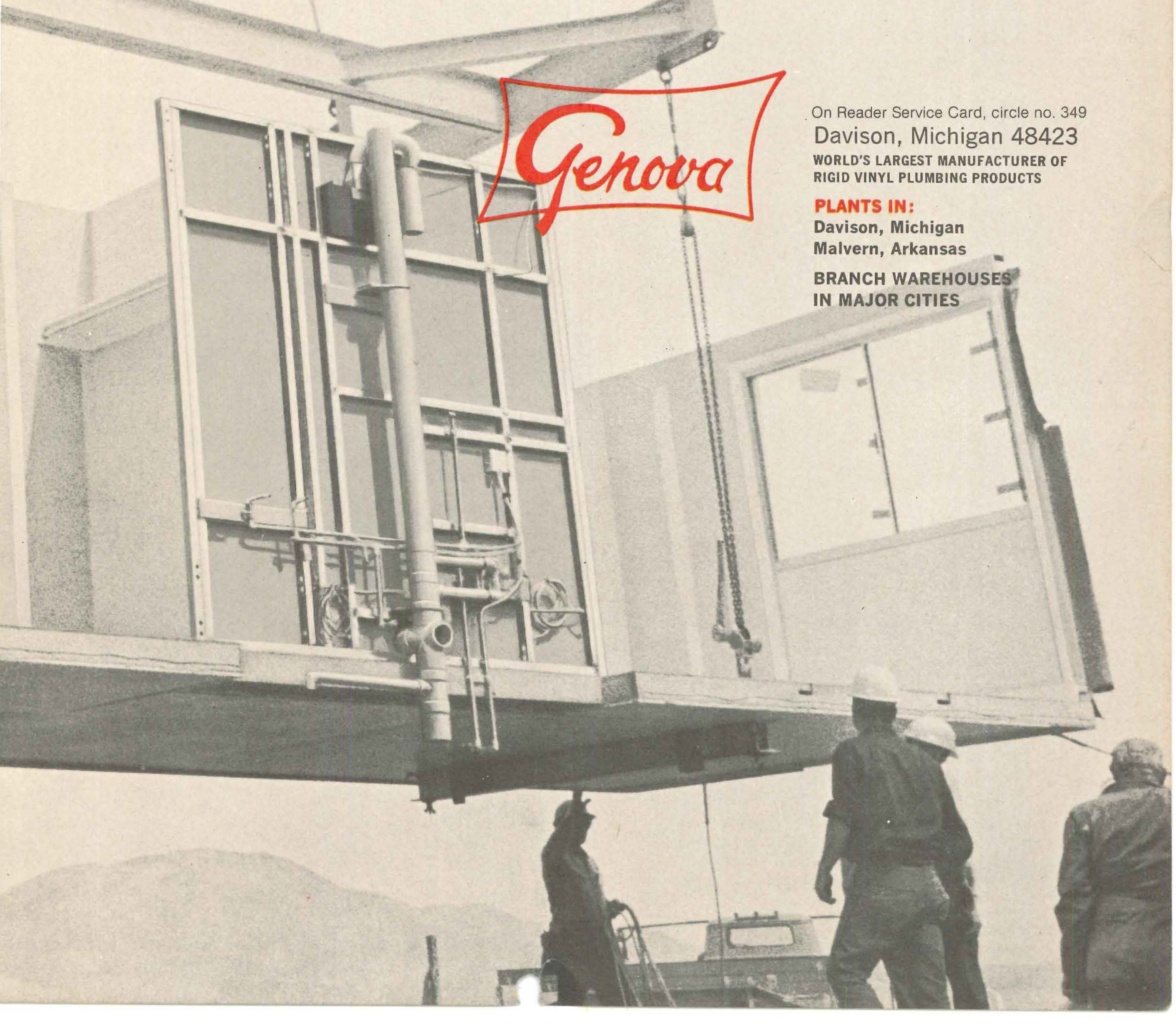
look to Genova

Many new construction innovations are incorporated in the hundreds of units of this mass produced modular housing project now being built at a California Air Force Base. Genova's creative engineering in modular plumbing is playing an important role in this project. Genova doesn't just supply pipe and fittings for the plumbing . . . Genova creates new ideas.

Right from the very start of Operation Breakthrough, Genova has pioneered such new concepts as an "In-Wall" PVC drainage, waste and vent system that fits standard 2" x 4" wall construction, a color coded hot and cold water supply system and the revolutionary single stack drainage system.

Genova not only comes up with the new ideas; they engineer the job, provide the necessary on-site assistance and yes, even serve as plumbing code consultants. This kind of help is backed up by two plants with a capacity to produce the goods and on time, too. Genova calls it . . . . . TOTAL CAPABILITY!

If you're moving into the modular housing industry, you'll move faster with Genova. A quick phone call will get you started. (313-653-4181.)



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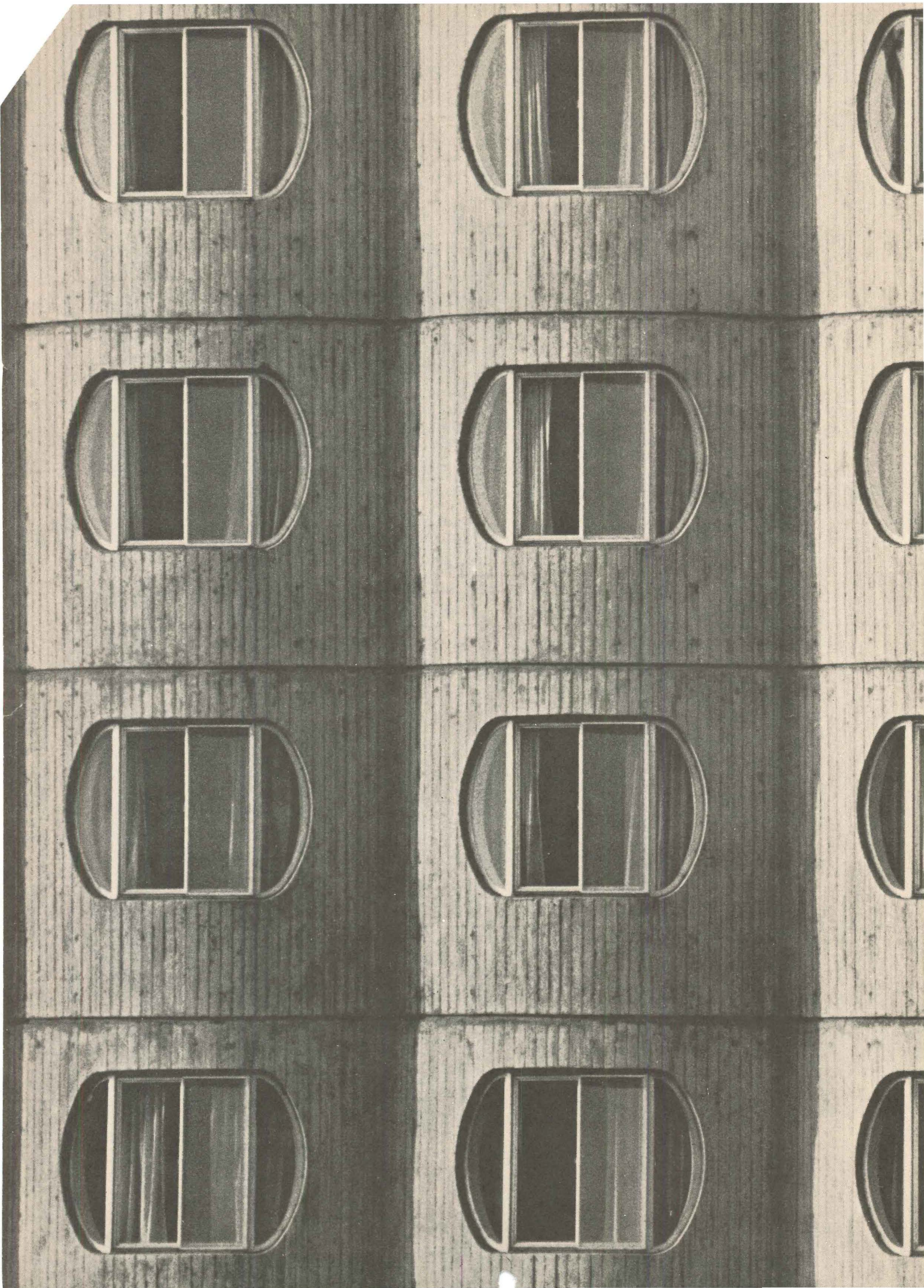

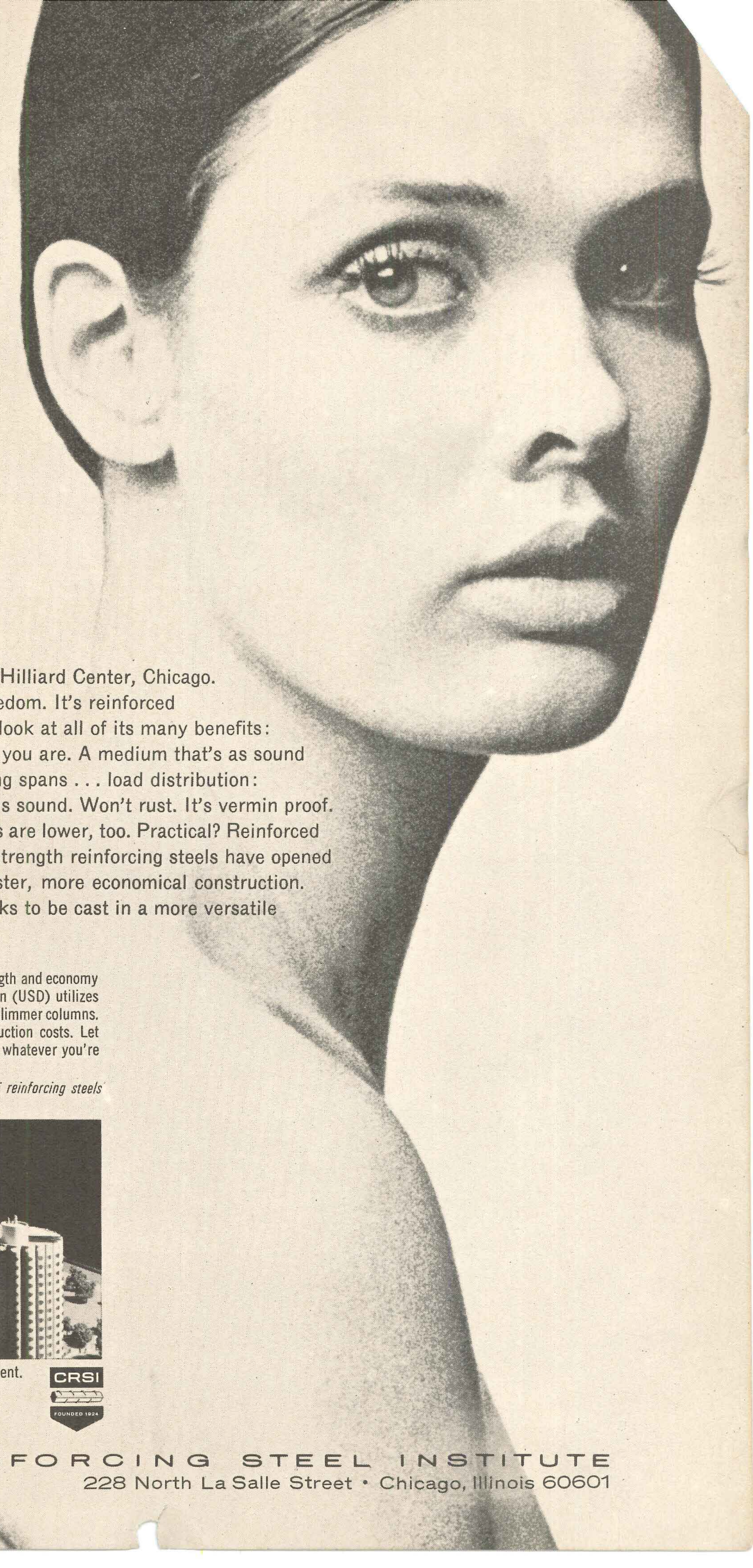

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beautiful
vorld of
einforced
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erfect

. beautiful view in the new Raymond M. Hilliard Center, Chicago. ure. Shape. And incomparable design freedom. It's reinforced rete. No other medium offers more. Just look at all of its many benefits: vailable. Everywhere. Ready to go when you are. A medium that's as sound durable as any you'll ever work with. Long spans . . . load distribution: oblems. And reinforced concrete dampens sound. Won't rust. It's vermin proof. test rating: the best. Your insurance rates are lower, too. Practical? Reinforced rete is practically perfect. And new high strength reinforcing steels have opened loor to unlimited design possibilities. Faster, more economical construction. ur mind is occupied by a building that asks to be cast in a more versatile um, move to reinforced concrete.

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· 60" the new term that describes ASTM specs for 60,000 psi reinforcing steels aded in 1968.

nd M. Hilliard Center, Chicago. A public housing development.
per: The Chicago Housing Authority
ct & Engineer: Bertrand Goldberg Associates
ctor: Paschen Contractors, Inc.

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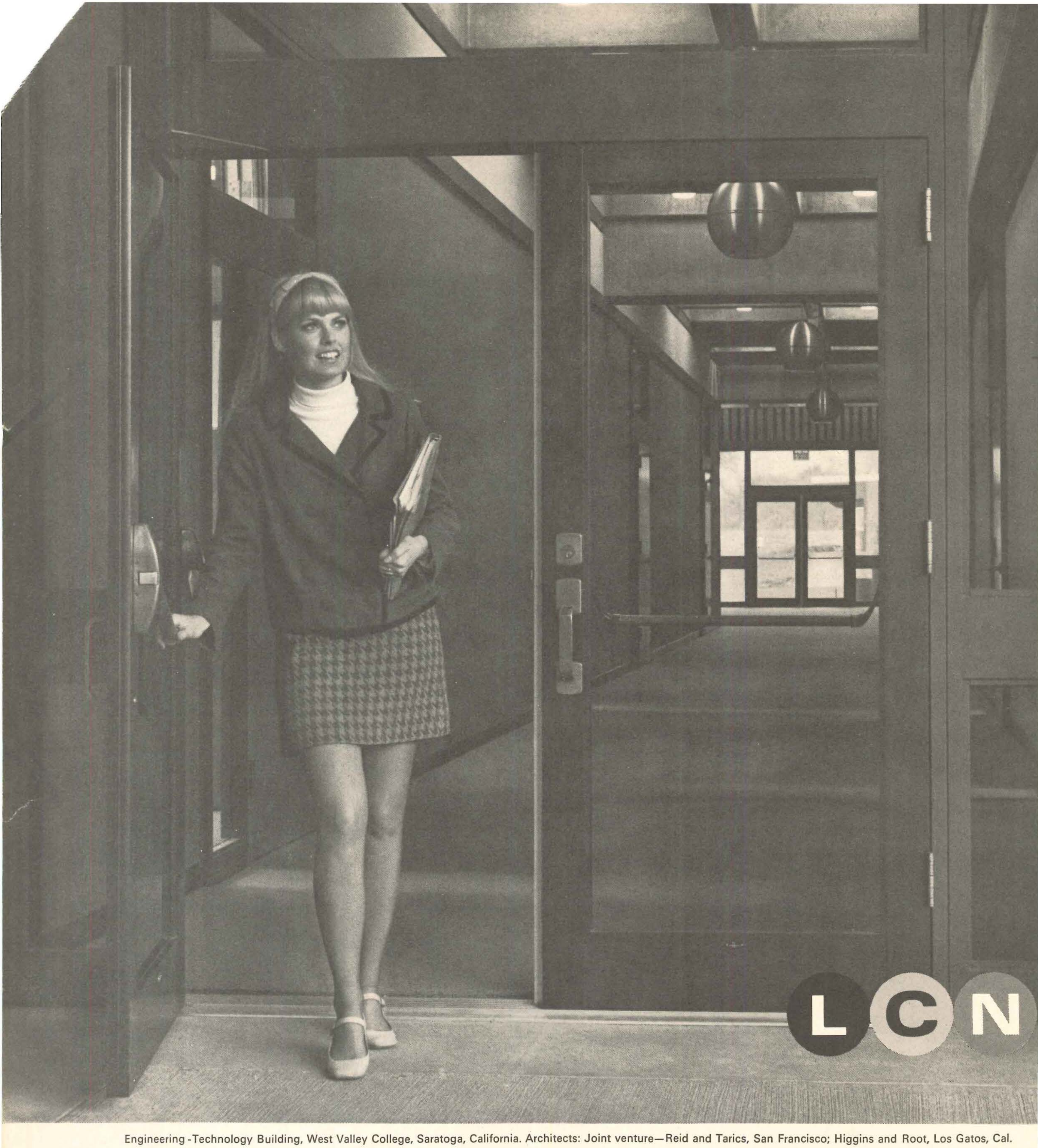
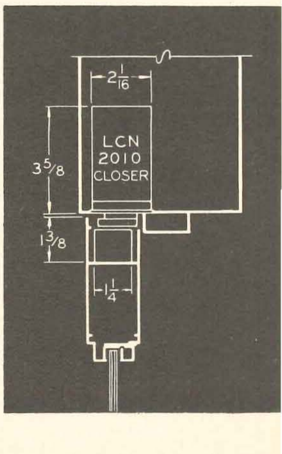


Engineering-Technology Building, West Valley College, Saratoga, California. Architects: Joint venture—Reid and Tarics, San Francisco; Higgins and Root, Los Gatos, Cal.

LCN Overhead Concealed Door Closers

are built to provide the finest possible door control—without intruding in the slightest on the doorway architecture. With the door open you see a slender arm. When the door is closed . . . nothing. Write for catalog—or see it in Sweet's. LCN Closers, Princeton, Ill. 61356



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4545 Tacony St., Phila., Pa. 19124

Another top achievement for AllianceWall®

porcelain-on-steel panels

PROBLEM: How to attract maximum attention for the new Apex Department Store against the relatively low skyline of Pawtucket, R.I. with an economical roof that requires no maintenance and never appears to age?

SOLUTION: Designers at Raymond Loewy & William Snaith Inc., of New York, decided upon a spectacular Pagoda-style supplementary roof constructed with AllianceWall porcelain-on-steel, self-cleaning panels. Using a #118 Matte White the roof was designed so it could be illuminated both from the interior and exterior to achieve dramatic effects and visibility. Also, to the surprise of management the price of AllianceWall panels was in line with competitive products considered for the project.

The self-cleaning AllianceWall porcelain-on-steel panels never require painting or other maintenance. Their smooth, non-porous surface will not retain dirt, grease or stains and will not be affected by the heavy smog of this industrial area. Panels are available in 107 colors.

Planners and Designers: Raymond Loewy/William Snaith, Inc. New York, N.Y.
Engineers: Strobel & Rongved, New York, N.Y.

For complete information including specifications check Sweet's File or write to:

AllianceWall Corporation
P.O. Box 247
Alliance, Ohio 44601

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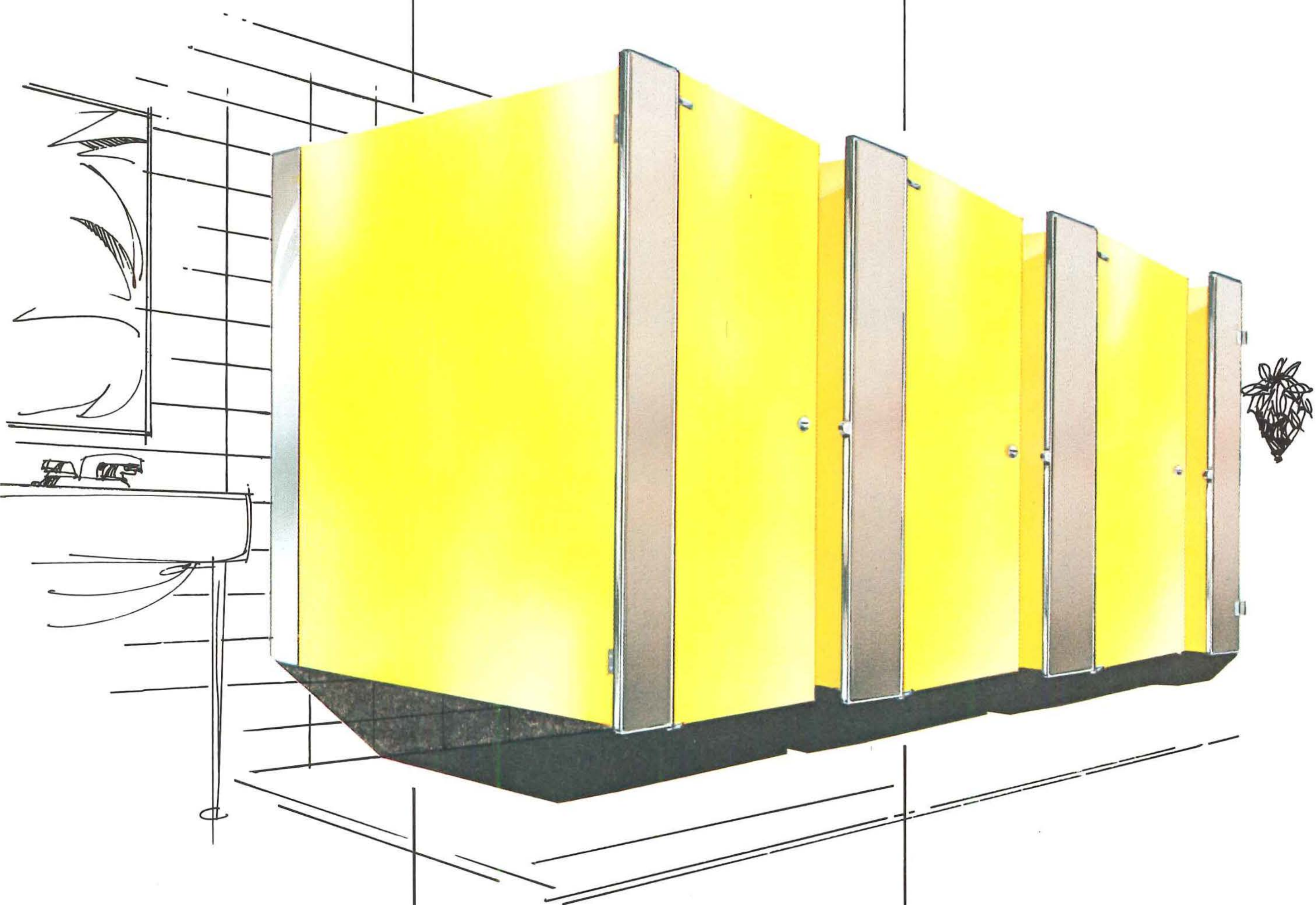
ARCHITECTS
SPECIFY PORCENA,
WALL-HUNG
SANYMETALS
BECAUSE....

Porcena partitions (Porcena is fusion of glass to steel) are cigarette-proof, rust-proof, odor proof and virtually impervious to scratches, corrosion, acids and caustics. They require only a damp cloth to maintain their jewel-bright finish indefinitely. Porcena, the super surface, continues to prove its everlasting wearability far beyond any other surface.

Wall Hung partitions are mounted with a vice grip and tension pad mounting assembly that assures rigid installations for the life of the building. They eliminate the need for ceiling soffits or special floor considerations. Most recessed accessories including paper holders, receptacles and flush buttons are easily accommodated.



Sanymetal recesses all door hardware . . . hinge brackets do not overlap pilaster . . . hinge castings nest in precise, performed recesses providing a smooth, flush, safe and sanitary surface. Latches are internal and quiet doors ride level on concealed thrust bearings.

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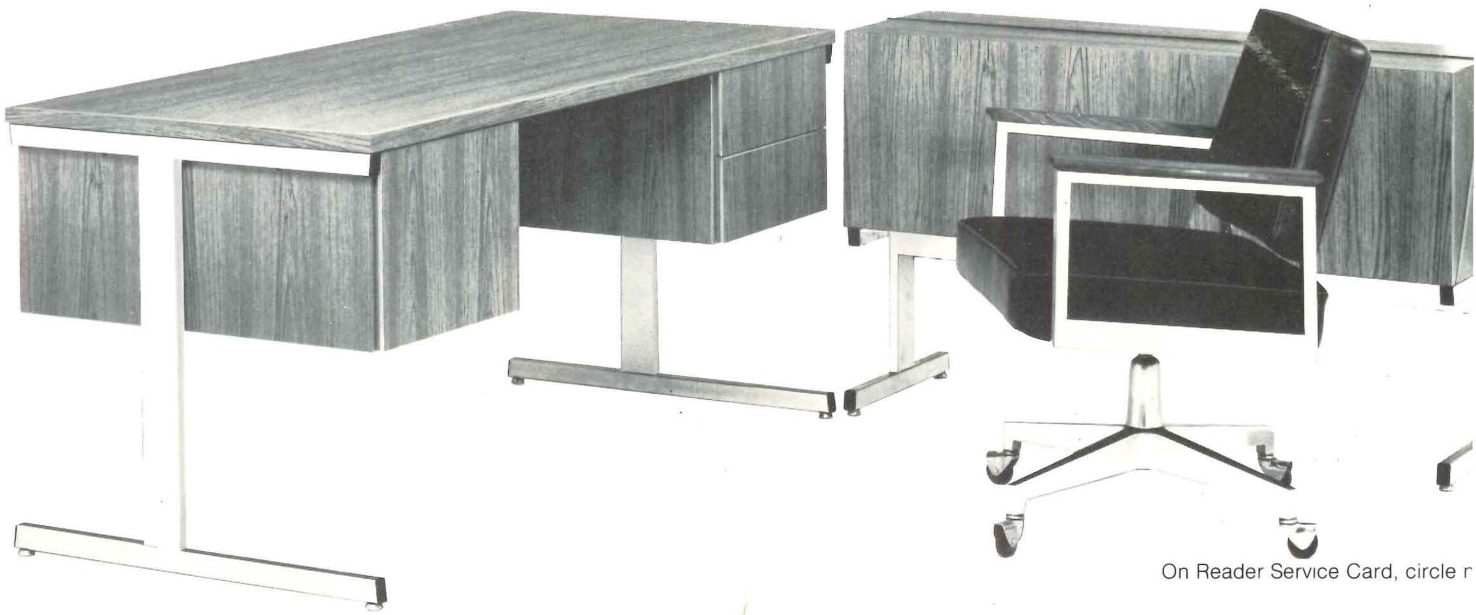

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Executive Plaza, Houston, Texas
Architect: Robert Husmann, Houston, Texas
Engineer: Karl A. Krause, Houston, Texas
Contractor: O'Meara Chandler / Benson Corporation, Houston Texas
Post-tensioning: The Prescon Corporation, Corpus Christi, Texas

Prestressed concrete speaks with style

Executive Plaza, in suburban Houston, is an office complex consisting of a ground-level building connecting two 10-story office towers. Joists and beams within the towers are post-tensioned with Armco ½" TUFWIRE® Strand. The office complex is faced with buff-colored brick and bronze glass. An adjoining three-level parking garage also uses post-tensioned joists and beams for a better strength/weight/cost ratio. Armco's TUFWIRE Strand provides the uniform physical properties that give these structural members their strength.

A unique office complex? Yes, and it demonstrates the freedom, beauty, and strength that prestressed concrete offers today's designers. May we show you more ideas that other designers have created? Ask for a copy of our booklet, *Prestressed Concrete: a Growing Concept in Construction.* Armco Steel Corporation, Department K-431, 7000 Roberts Street, Kansas City, Missouri 64125.

ARMCO STEEL ARMCO

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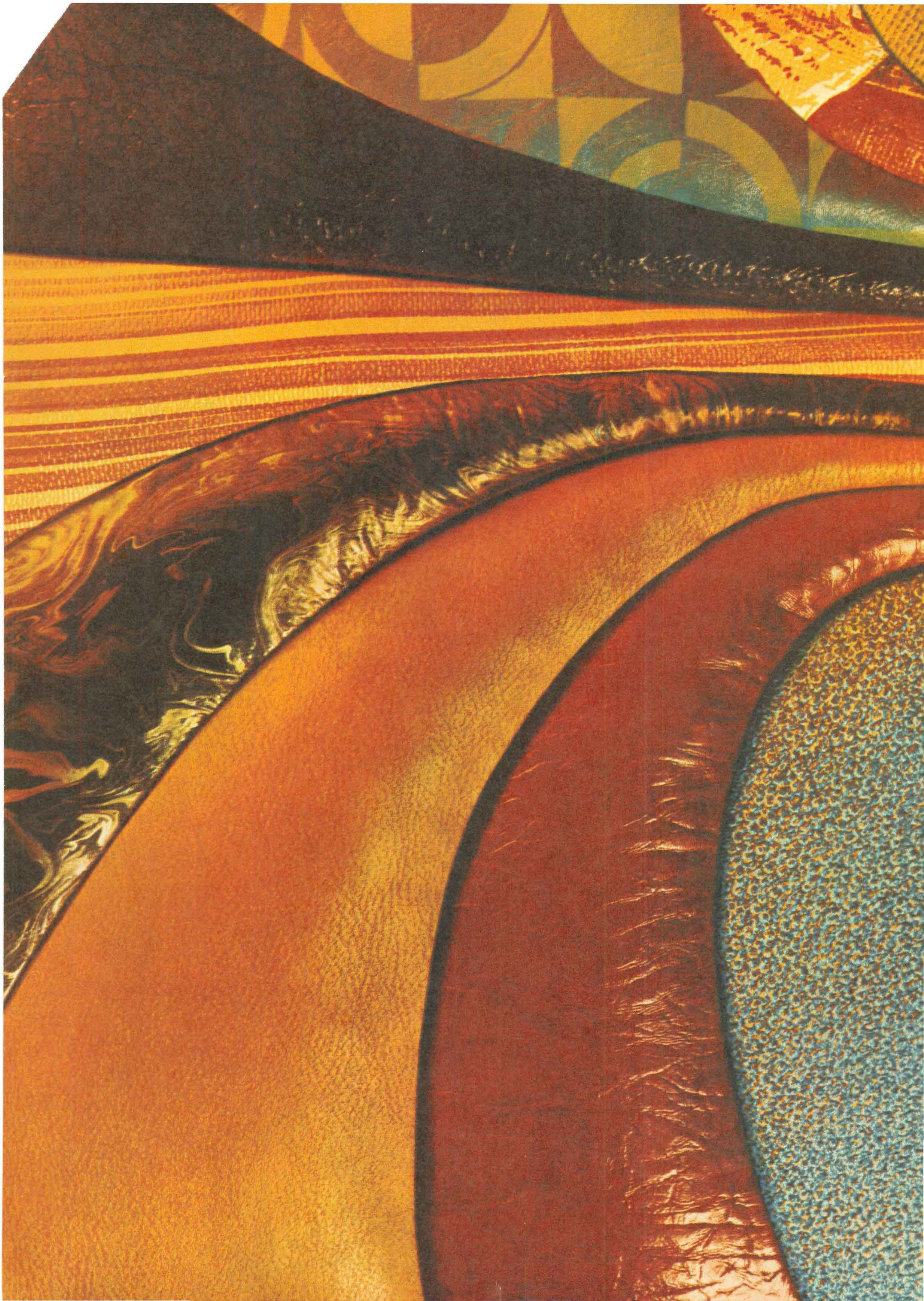

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It's one more way the Uniroyal styling service helps you put together what you need. This time with a design that belongs to you. One that complements the look of your furniture. And gives you something more to sell.

This exclusive service may cost you no more than regular Naugahyde vinyl fabric in the weight and grade you need. On the other hand, it might cost a bit more. It all depends on the total yardage you order in your special design.

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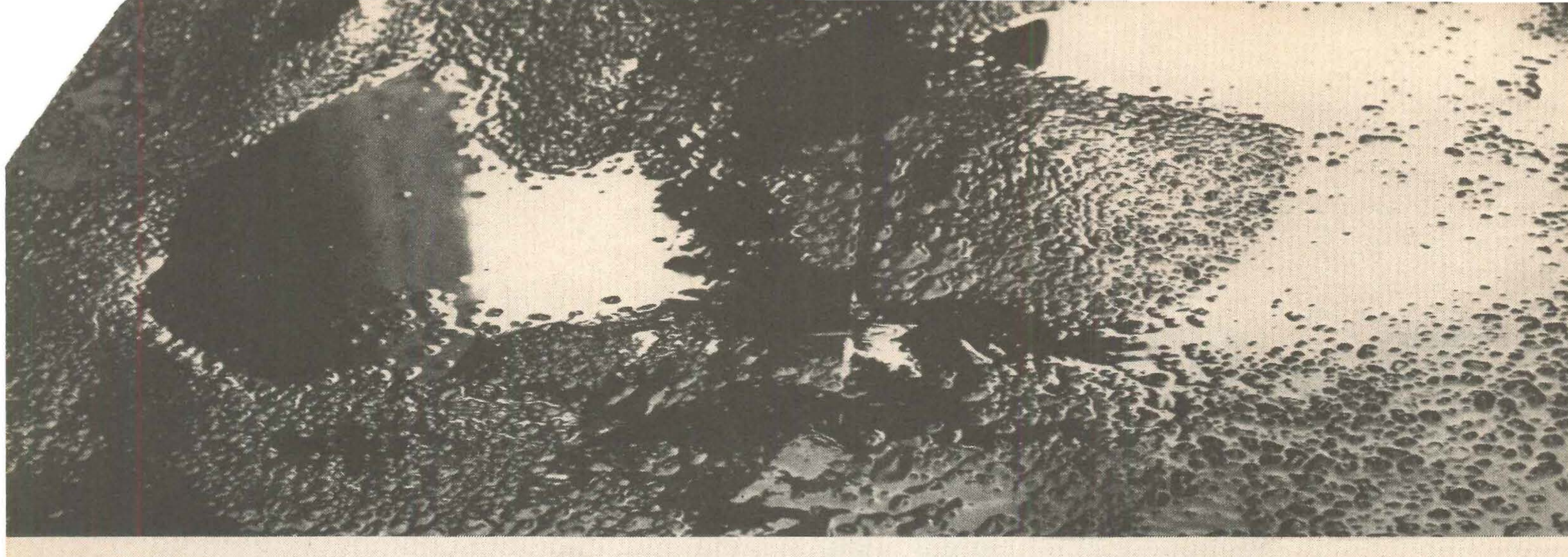


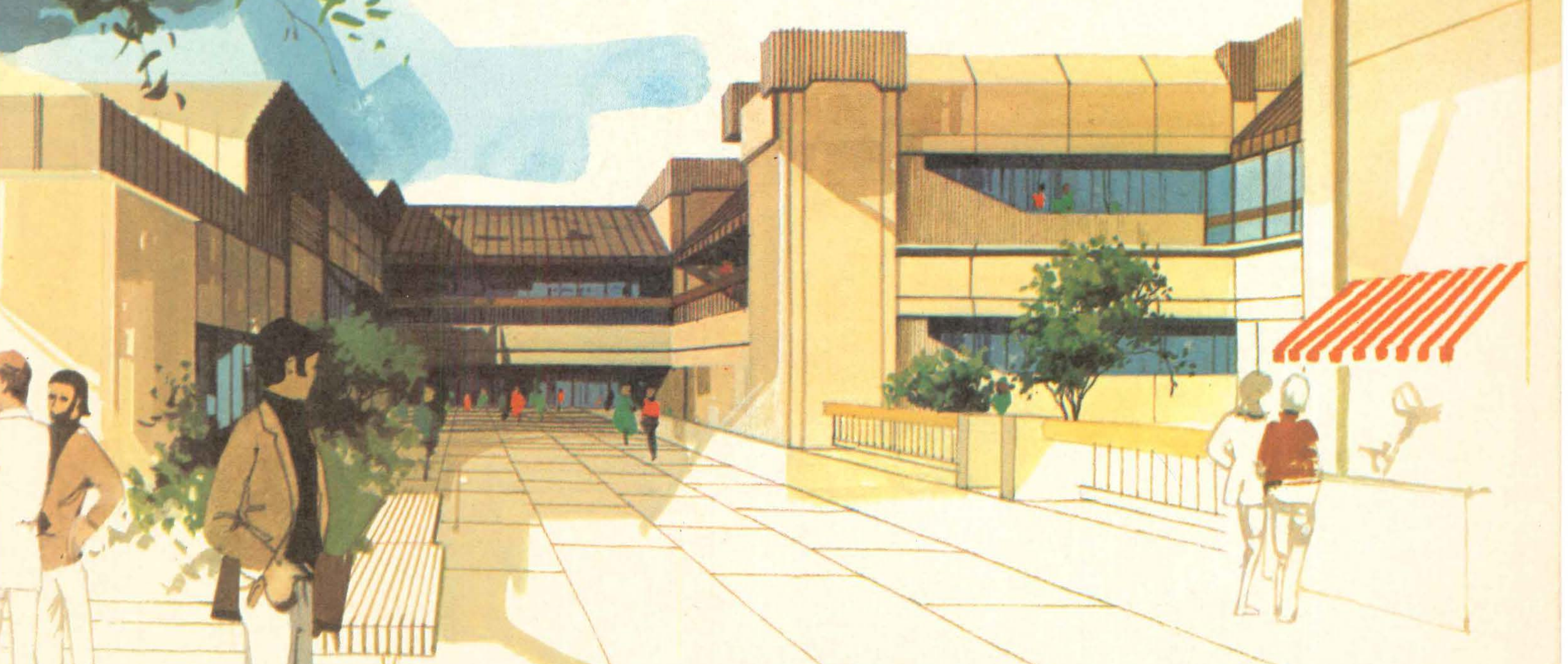
Modular vs. Central Station:

Campus designers opt for Lennox Modular HVAC System

The central station has been specified, traditionally, for heating and cooling a campus. But costs suggested a different choice for the designers of Mount Royal College, Calgary, Alberta. The college will be built in two stages, over a period of time. A modular system poses no diseconomies under such a plan. A central system does. The initial central station installation would have to provide capacity, on standby, to handle all future growth plans.

There were other important economic considerations. Cost predictability is almost 100% with a Lennox modular system. The rooftop units are factory assembled and wired, including controls, and provided with flashed-in-place mounting frames that still further

(Continued overleaf . . .)



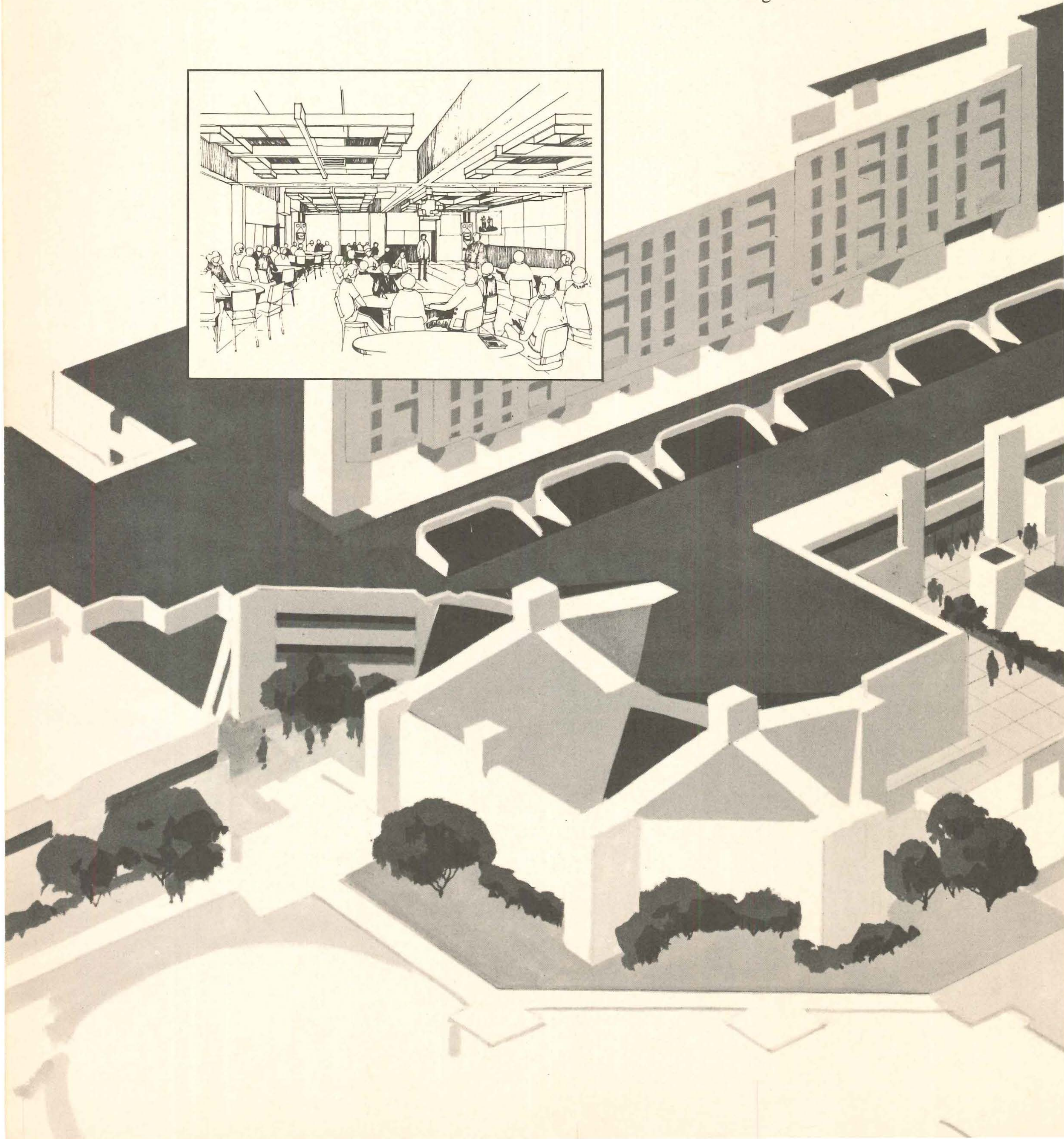
Mount Royal College, Calgary, Alberta, Canada is a post-secondary educational system. The 756,000 square foot community college will be built in two stages —as enrollment demands—to provide academic, residential and recreational facilities for 5,000 students. Basic concept of the $18,000,000 facility is to provide adults with programs of individual learning at individual growth rates.

continued . . .

modular vs. central station

reduce on-site labor. Mo
Royal budgeted $2.30
square foot for HVAC. The Lennox bid was
under $2.00 installed.

The cost of owning the Lennox system is
predictable. Service contracts are available. Th
total cost comparisons can be made between
modular and the central station systems. A
Lennox, in addition to the service contracts, of
designers and owners final, single source respo
bility. Other cost considerations:
free cooling starts whenever



ıde temperatures fall below 70°F. And the ı to reduce fuel and energy consumption in ıupied areas. Since this is a community college, ıg many uses, occupancy will be uneven. A ıl system does not offer this flexibility.

ınal important consideration, of course, is the y of comfort provided to individual spaces. l levels are lower. More sophisticated cleaning ıumidification systems are available than are commonly incorporated in a central station design.

And because ducts and outlets can be moved, the system permits spaces within the college to be changed without faulting the system's performance.

Write Lennox Industries Inc., 600 South 12th Avenue, Marshalltown, Iowa 50158.

LENNOX

AIR CONDITIONING • HEATING

For details, see Sweet's 29A/Le—or write Lennox Industries Inc., 985 S. 12th Avenue, Marshalltown, Iowa 50158.

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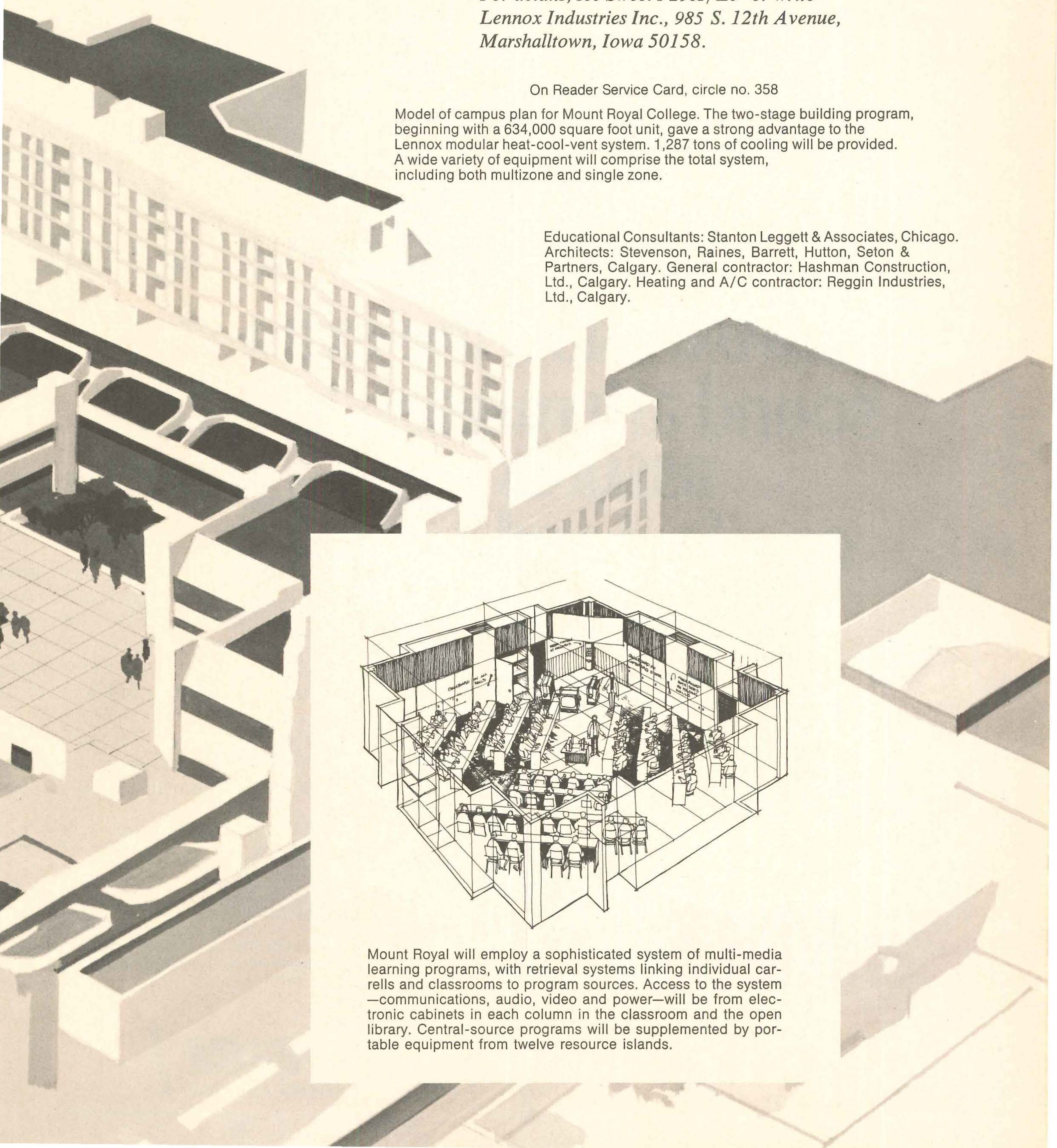
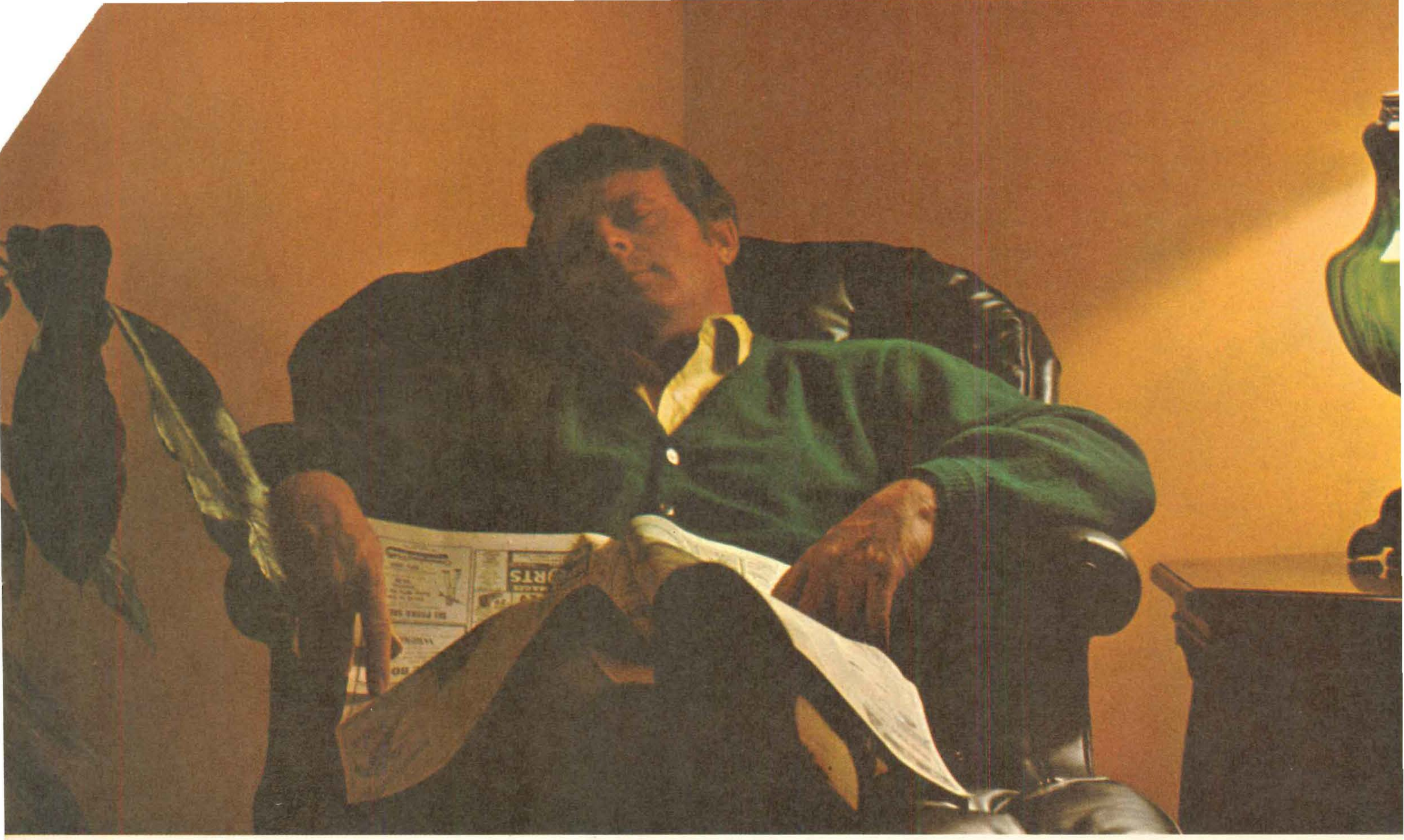


Model of campus plan for Mount Royal College. The two-stage building program, beginning with a 634,000 square foot unit, gave a strong advantage to the Lennox modular heat-cool-vent system. 1,287 tons of cooling will be provided. A wide variety of equipment will comprise the total system, including both multizone and single zone.

Educational Consultants: Stanton Leggett & Associates, Chicago. Architects: Stevenson, Raines, Barrett, Hutton, Seton & Partners, Calgary. General contractor: Hashman Construction, Ltd., Calgary. Heating and A/C contractor: Reggin Industries, Ltd., Calgary.

Mount Royal will employ a sophisticated system of multi-media learning programs, with retrieval systems linking individual carrells and classrooms to program sources. Access to the system —communications, audio, video and power—will be from electronic cabinets in each column in the classroom and the open library. Central-source programs will be supplemented by portable equipment from twelve resource islands.



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The most effective sound-control partitions rel on sound attenuation blankets for efficiency Performance of the partitions is based on th blanket's *acoustical impedance.*†

Extra-dense THERMAFIBER is the only blanke labeled with tested acoustical impedance rating (see table). Since all blankets are not the same substitution of a less dense blanket or one with out a comparable acoustical impedance ratin will impair the acoustical performance of th partition system.

For sound control efficiency comparable t laboratory-tested-and-rated systems, the sam materials must be used in partitions on the job

THERMAFIBER SOUND ATTENUATION BLANKETS		
Blanket Thickness Inches	Density pcf	Acoustical Impedance (Frequency, 1000 Hz) Rayls
No insulation	0	0
1	4	725
1½	3	450
2	2.5	360

Partition system left, 2-in. USG® Metal studs with 2 layers ½-in SHEETROCK* FIRECODE* "C" Gypsum Panel faces and 1½ in THERMAFIBER Sound Attenuation Blankets, achieves STC of 52 without THERMAFIBER, STC is 45.

To protect your specifications, specify THERMAFIBER Soun Attenuation Blankets with U.S.G. partition systems. See our Archite Service man, or write 101 S. Wacker Dr., Chicago, Ill. 60606, Dept. PA-71

†Measurement (in terms of rayls) of a blanket's resistance to flow o acoustical energy, determined by combined performance of th blanket's thickness and density.

*Reg. U.S. Pat. Of

UNITED STATES GYPSUM

BUILDING AMERICA

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Contents

News report

National Gallery of Art starts work on new building

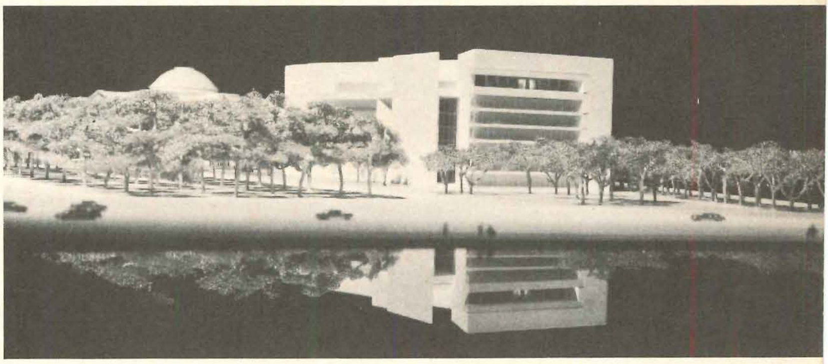
Thirty years after it opened to the public, the capital's National Gallery of Art is expanding. The new building, designed by I.M. Pei & Partners, will be east of the original one; the street that currently separates the old building from the site of the new one will become a landscaped plaza.

The East Building, as it is known, will be roughly a trapezoid divided into two triangles. The larger triangle faces the existing museum and provides the main entrance to the new building. At the heart of the building is a glass enclosed skylit sculpture court; around the court are three separate "house museums," each with about 12,000 sq ft of exhibit space on four levels. They are connected by exhibition bridges and a concourse.

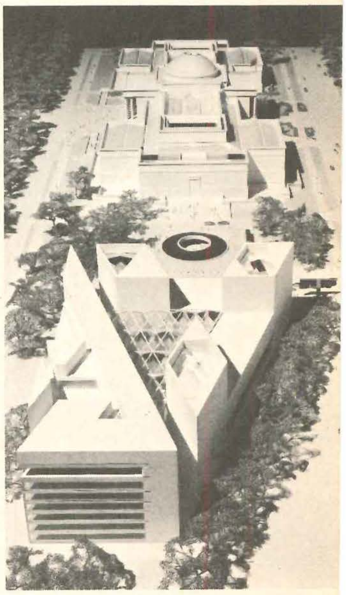
The other triangular part of the East Building will house the Center for Advanced Study in the Visual Arts. The Center consists of offices around a six-story library and a small gallery for special exhibits. A cafe is also provided near the top.

Tennessee marble, the same material as on the exterior of the existing building, will be used to sheathe the new building. The entrance façade of the East Building and its eastern apex are lined up with the long axis of the existing museum. To keep the new structure in harmony with the surrounding area, Pei has aligned three sides with the rectangular street grid; the fourth side follows Pennsylvania Ave. The towers containing the "house museums" maintain the cornice line along Pennsylvania Ave., while the lower elements are at the height of buildings along Constitution Ave.

Linking the two buildings will be a below-ground concourse containing a cafeteria, print and book salesroom and a shipping and receiving area. A large circular glass-sided fountain will bring light from the plaza above. The plaza will be paved with granite cobblestones and surrounded by trees.



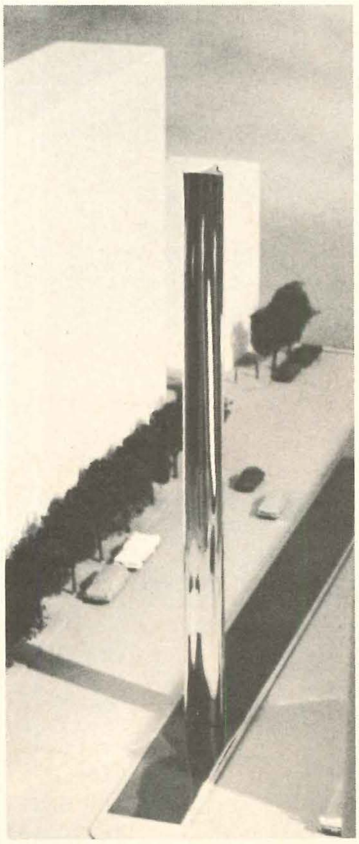
National Gallery's East Building



New York City turns down free obelisk

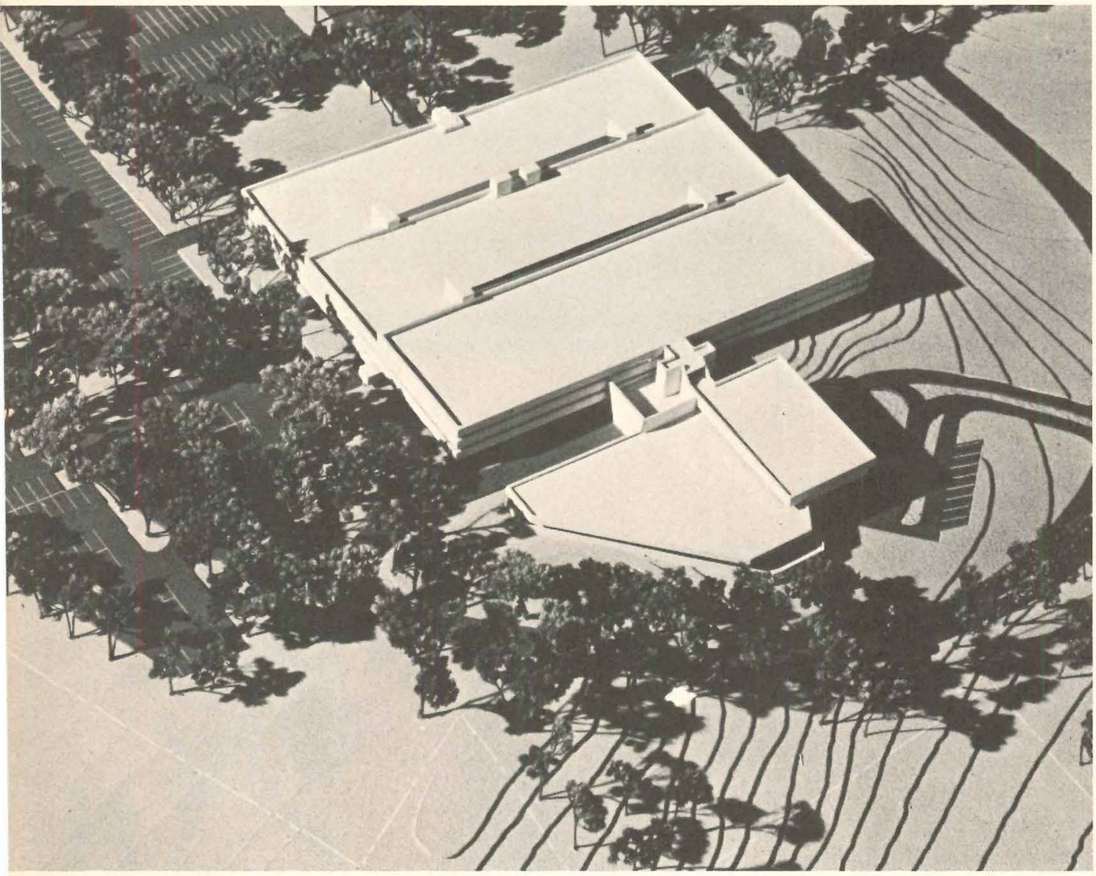
After a community planning board registered its strong feelings about a proposed gift by George T. Delacourt, Jr., the New York City Art Commission turned the gift down. The gift in question was a 125-ft stainless steel obelisk designed by Edward Durrell Stone and Associates.

The Art Commission said its rejection was on aesthetic grounds, but the local planning group had had other objec-
[continued on page 34]



Obelisk? No thanks

Buildings on the way up



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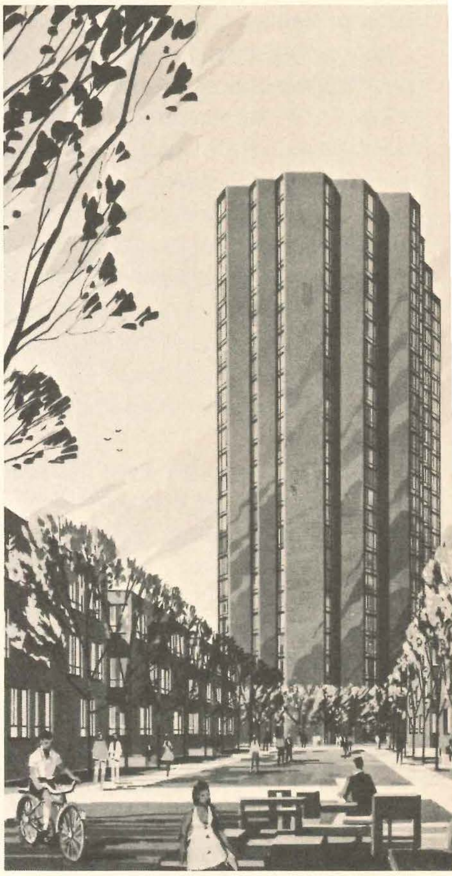

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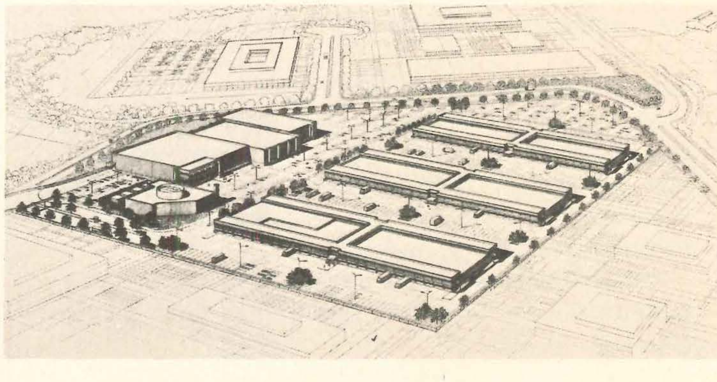

1 Large skylit courts bring sunlight into office spaces of headquarters building for Western Union Telegraph Co. in Upper Saddle River, N.J. Low-rise building steps down sloping site and provides 350,000 sq ft of space for offices, labs, cafeteria and other facilities. Frame is steel with composite slabs; exterior is precast concrete and glass. Kahn and Jacobs are architects; Lloyd Doughty is partner in charge, Der Scutt, project designer; Abbott, Merki & Co. are engineers. Parking for 1600 cars is provided on site. (Jay Hoops photo)

2 Close to a circle, but not quite, 26-story tower designed for Lake Village East, Chicago, will have 36 sides of varying lengths. Architects Harry Weese Associates and Ezra Gordon-Jack M. Levin made the tower roughly circular in plan to reduce perimeter; 200 apartments are to be included, 8 to a floor. Tower is part of third phase of construction for development, which includes a number of completed townhouses, the first of 100 planned for the project.

3 New wing for old hotel: the 75-year-old Homestead Hotel, Hot Springs, Va. will get an $8 million addition designed by The Providence Partnership. New facilities will include 200 guest rooms, convention meeting rooms, swimming pool, bath house, entrance road, terraces and landscaping; convention center will have large room for 1150 people and six smaller rooms.

4 Smoked ham, pastrami, sausage: sounds like the corner deli but it's really the stock in trade of Hunts Point Cooperative Market, designed by Brand and Moore to be the country's largest meat and poultry market. The $25 million market, located in the Bronx, will include almost 700,000 sq ft of processing, distribution, cold storage and service space in five buildings on a 37-acre site. The steel framed buildings will have concrete block exteriors insulated with foamed plastic; a 2400-ton refrigeration system will keep everything fresh. Engineers are Robert Rosenwasser (s) and S.W. Brown & Associates (m).

5 Park will take up most of 4.2-acre site for Security Pacific National Bank building on Los Angeles' Bunker Hill. Parking for 2500 cars will be provided, along with 1000-seat cafeteria, 400-seat auditorium, and concourse level shops. Albert C. Martin and Associates are architects for 55-story tower, which is placed on 45 degree angle to site for good views and sun control. Sasaki, Walter Associates, Inc. are landscape architects. Around 8000 people will work in $85 million building, scheduled for completion late in 1973.

6 Flaring base, with cut out corners, surrounds 37-story Fort Worth National Bank Building designed by John Portman & Associates. Tower will be glazed with some 3540 sheets of gray bronze reflective glass; linked with it is a 5-story drive-in bank and garage. Segmented reinforced concrete columns house elevator and mechanical shafts; floor slabs will be poured in place. Engineers for $20 million building are Britt Alderman, Jr. (m) and Morris E. Harrison (e). (Clyde May photo)

7 Women's dorm for Cook County (Ill.) Department of Corrections will include 180 individual sleeping rooms, as well as classrooms, infirmary, dining hall, visiting areas, offices and conference rooms. Designed by A. Epstein and Sons, Inc., building will have reinforced concrete frame with brick and concrete block walls. Security windows will have bars concealed in window frames; sleeping rooms are arranged in wings with an outdoor exercise court between them.

8 Urban renewal plans for downtown Cincinnati includes a $40 million office and retail complex designed by RTKL Inc. and Harry Hake & Partners. Above a 400-car underground garage will be two 15-story office towers, two retail levels providing more than 54,000 sq ft of shopping space and a 5-story main office for a bank that is a subsidiary of the developers, Western-Southern Life Insurance Co. Towers will have gray glass on three sides, and there will be a glass enclosed court kept open at all times. Complex's second story will connect with second level covered walkway that will eventually link major downtown areas.

9 Tenants in 14-story elderly housing project will have views of Rock River and Rockford, Ill., thanks to slanted walls in design by Knowland & Smith, Inc. Building has concrete frame and precast concrete exterior walls; a total of 170 apartments are provided. (Graphica photo)

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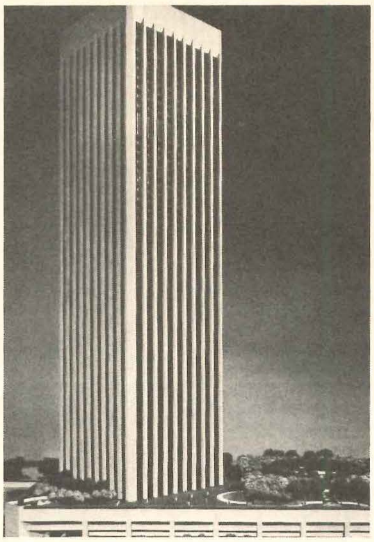

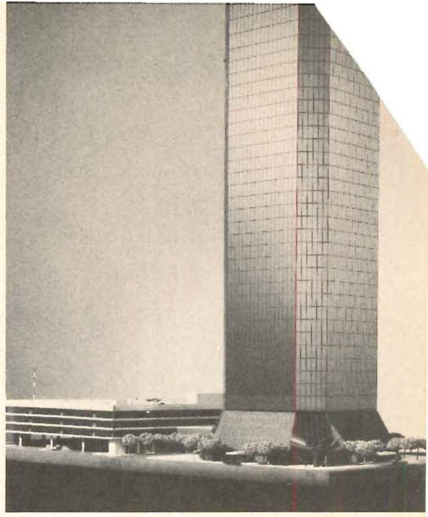

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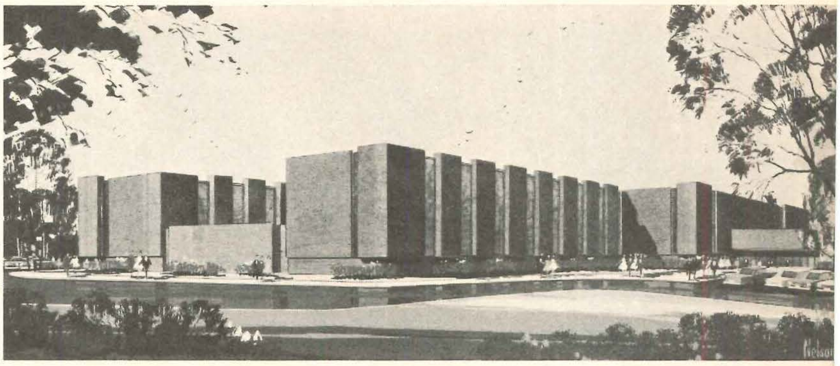

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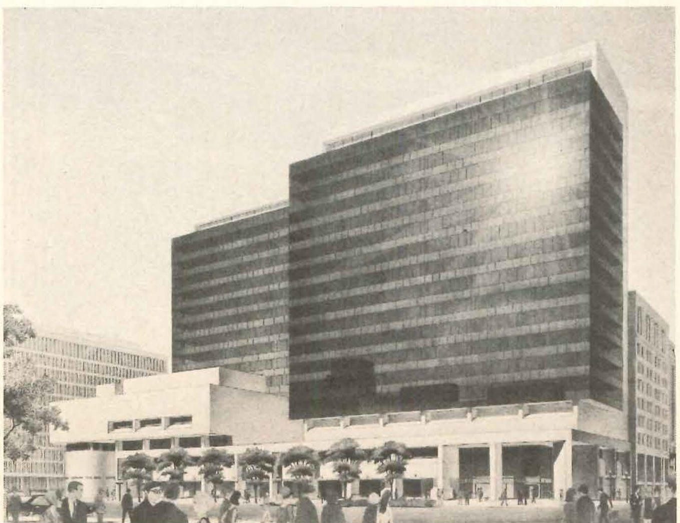
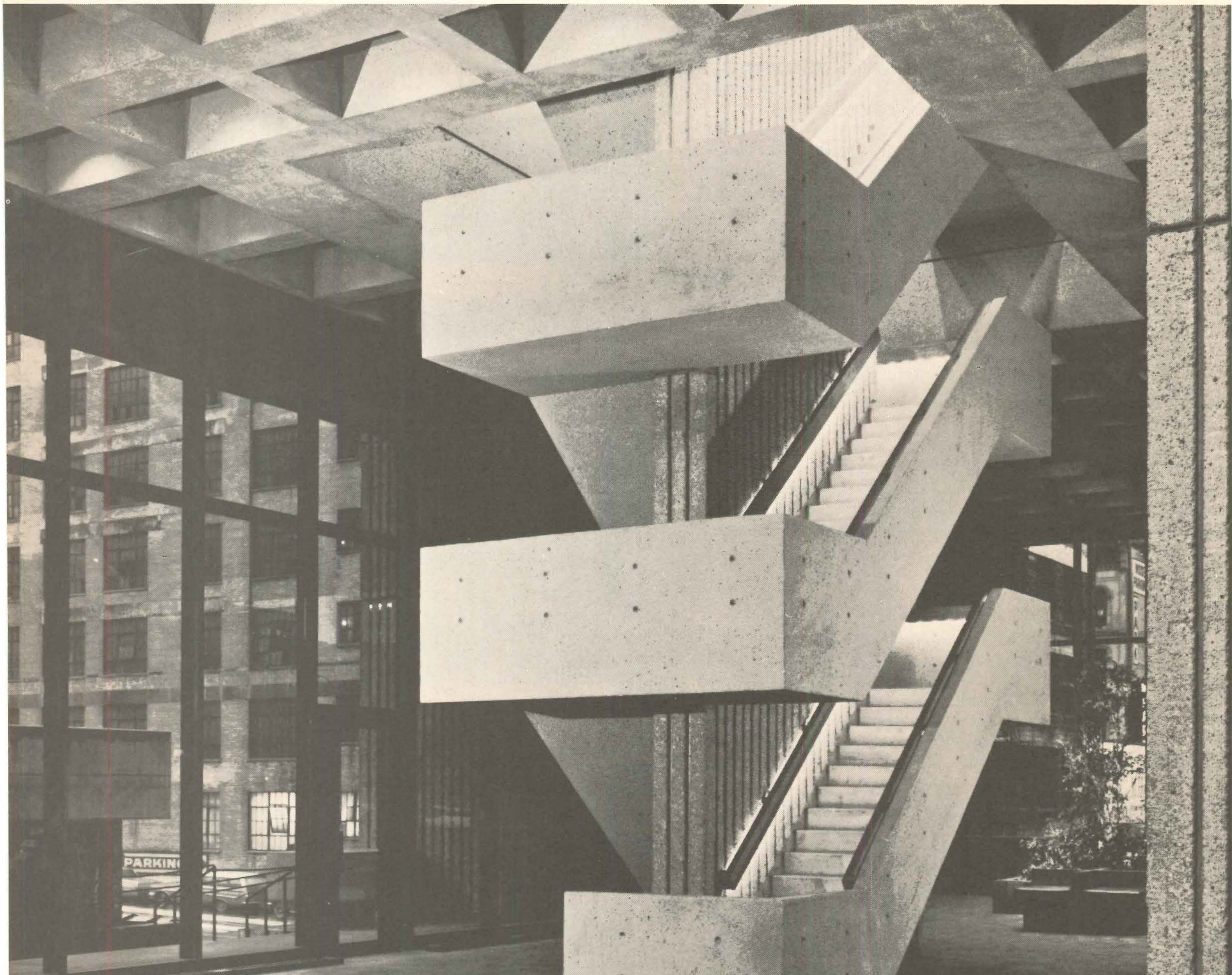


Natural beauty and rugged strength—heightened by concrete with POZZOLITH



The Blue Cross-Blue Shield Building on Chicago's Wacker Drive stands as a striking contribution to the city's famed skyline. Imaginative forming, exposed aggregate textures, and coloring to earth tones add architectural interest inside and out.

The cast-in-place concrete structure is a nearly-square 15-story tower. Its dominant horizontal lines are bonded by twin pilasters rising from ground to above roof level on all four faces. Fluted walls and waffle slabs punctuate the surfaces and blend the warm concrete with the wood, tile and floral accents.

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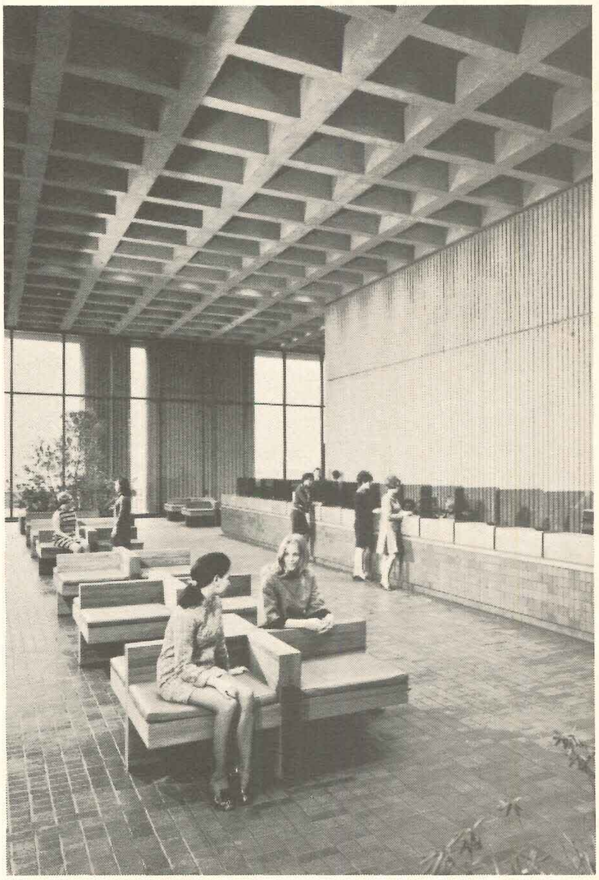

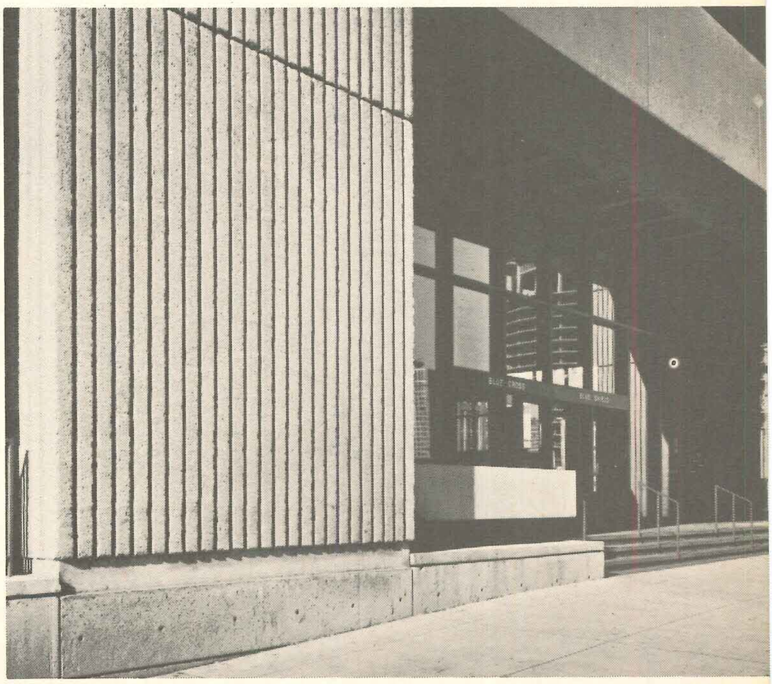

Owner: Hospital Services Corporation. Architect & Engineer: C. F. Murphy Associates. General Contractor: Paschen Contractors, Inc. POZZOLITH Ready-Mixed Concrete: Vulcan Materials Co., Mid-West Division.

News report continued from page 29

tions. The Park Ave. site, they said, was inappropriate and the shiny surface would reflect sunlight into drivers' eyes, while the obelisk itself would block vision. Then, too, said the board, the steel shaft would set a precedent letting wealthy people erect their own memorials at the expense of open space.

Mr. Delacorte has already given the city a theater, statues and an animated clock in Central Park and two fountains. Together they all seem to back up his statement, quoted in The New York Times, that he just likes to "beautify and to do the unusual."

19th Annual Design Awards Jury chosen

No sooner is one Design Awards Program over, it seems, than it is time for the next one to begin. This year's program is P/A's 19th, and like last year's, it will have two juries—one for architectural projects and one for urban planning.

The general architectural jury will include Moshe Safdie; John C. Parkin, head of one of Canada's best known firms; Earl Flansburgh and Louis Sauer, both frequent P/A Design Awards winners; and Richard Bender, professor of architecture at the University of California at Berkeley and an outstanding authority on systems design.

The planning jury will consist of Charles A. Blessing of the Detroit City Planning Commission; Ian McHarg, landscape architect and outspoken ecologist; and M. Paul Friedberg.

The presence of two Canadian architects—Safdie and Parkin—on the jury marks a broadening of the Design Awards Program. For the first time, Canadian architects are being invited to join in the competition. Judging is set for September 21 and 22 at P/A's Stamford offices.

One of Bruce Goff's last houses up for sale

Every so often there's a Frank Lloyd Wright house up for sale; now, for a change, there is a house available designed by Bruce Goff. It's in Cobden, Ill., which is south of Carbondale, on a 116-acre piece of farm and forest land.

The sandstone house sits on a hill overlooking the rolling countryside; nearby are three lakes for fishing, caves and rock outcrops. The stone for the house was gathered from surrounding creekbeds, and the walls are studded with artifacts gathered from old Sullivan, Wright and other Prairie School architects' buildings. For instance, says Mrs. Hugh D. Duncan, the present owner, "part of the outside arch decorations from the Garrick Theater are in the wall over the fireplace in the living room, and the wrought iron gates from the old elevators in the Chicago Stock Exchange Building are on the doors."

The house, says Mrs. Duncan, is simply too much for her to maintain and live in alone. She is looking for a buyer who can "appreciate the house and use it appropriately."

P/A business survey turns up signs of growing pains

Many firms on the borderline between small and large may be experiencing growing pains, judging from data developed in P/A's 1970 business survey. The basic study covered 1268 firms and provided a business profile of the profession during a rather slow period. In looking at the numbers, P/A's research director, Walter Benz, spotted a relationship between

← On Reader Service Card, circle no. 322

ıe number of professionals (principals and employees) in a rm and the amount of business done. It yielded a "fairly rderly progression," he said, but within it there was a good eal of variation. There were noticeable "interruptions" mong firms having 5 to 17 professionals, with the sharpest ıterruptions among firms with 7, 8, 14 and 16 professionals.

The 185 firms having 5 and 6 professionals enjoyed an verage volume of $8,709,000; the firms with 6 averaged 10,616,000. But instead of rising at the next level, the aver-ge dropped: 112 firms with 7 and 8 professionals showed an verage volume of $8,484,000. Firms with 7 professionals veraged only $8,374,000, or 21 percent less than those vith 6.

The next group of firms, 123 of them with 9 to 13 profes-ionals, reverted to the orderly progression of volume to pro-essionals, with those with 13 averaging $14,950,000. But gain there was a sharp drop at the next highest level: firms vith 14 professionals averaged $9,150,000 and those with 16, 9,567,000. Firms with 15 professionals, on the other hand, veraged $14,620,000, and the progression continued in fairly rderly fashion from 17 professionals on up.

It looks like the firms with 5 to 16 professionals are suffering ome sort of growing pains. There are other figures in the tudy to back up that view. The ratio of principals to staff pro-essionals ranges from 1 to 1 in the very smallest firms to 1 to in the largest; firms with 5 to 16 professionals showed a ra-o of 1 principal for every 3 or 4 staff professionals. There is t the same time a great overlap in functions in these firms, ıough not as great as in smaller firms. Both situations are to e expected; they are really just functions of size. What is un-sual is that firms with 5 to 16 professionals farm out more vork of all kinds (except architectural design) than do firms ither larger or smaller.

Taken all together, these figures suggest growing pains. 'erhaps staff additions are being made too quickly, and ıaybe they aren't being put to the best use in growing firms. might be that too many professionals are wearing too many ifferent hats, and it looks like an inordinate amount of work s being sent outside. Perhaps the root of the problem is a ıatter of scale: management methods that work for small rms don't always work as the firms get larger.

'orrest Wilson to head school at Ohio University

Forrest Wilson, who last month announced his leaving P/A ɔ return to teaching, will be the new director of the School of ırchitecture, Design and Planning at Ohio University. He will tart in Athens, Ohio, in mid-July after a six-week stint teach-ıg a graduate course at the State University of New York at ;uffalo and the Buffalo Organization for Social and Tech-ological Innovation (BOSTI). During his tenure as editor of '/A he taught and lectured at numerous schools and prior to ıat had been a faculty member at Pratt Institute.

)ld New Orleans gets ready to fight off a new threat

Four years ago it was the Vieux Carre, threatened by a riv-rfront expressway; this time it's the Garden District, once the ome of Creole planters and then wealthy Americans, that is ı danger. The threat this time is a bridge.

There are only two bridges across the Mississippi at New Or-eans and one of them is so far upstream it is almost useless ɔr most people. The proposed bridge would feed into a riv-

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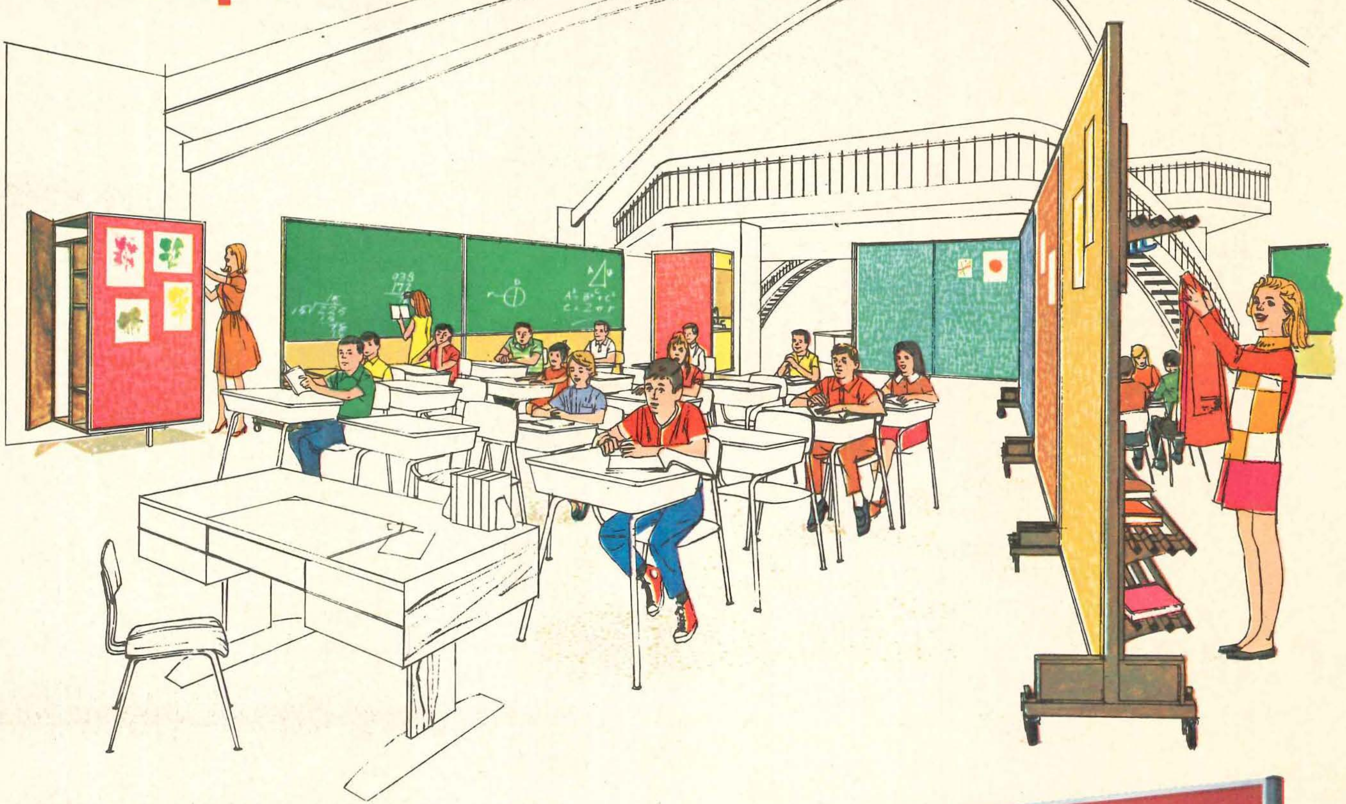
Vogel-Peterson RDF's help School Planners keep an OPEN mind



One moment they're handsome wardrobe racks, chalkboards or tackboards . . . a few seconds later they've converted an open plan school room into efficiently arranged classrooms to accommodate any size class or teaching requirement! Trust Vogel-Peterson to bring you the room-making magic of dual purpose RDF (Schooline Room Divider Wardrobes) . . . 6 or 8 feet long sections that move silently and effortlessly on large rubber-tired casters . . . sturdily made, beautifully detailed and finished in colors that complement the most modern decor. Have them in any combination you wish—tackboard both sides, chalkboard both sides, or tackboard/chalkboard combination or tackboard side can be accessorized with wardrobe racks and book or boot shelves. School planners welcome their versatility . . . teachers like their efficiency and kids can't hurt them. Look into these versatile units—they're designed with you in mind.

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News report continued from page 35

erfront expressway with six exits onto major uptown streets. The resulting auto pollution is one reason there is opposition to the bridge; the other is what the bridge might do to the racial breakdown of uptown New Orleans. The area is one of the few thoroughly integrated residential areas in any U.S. city, and the planners and sociologists fear that the bridge will speed up the flight of whites to the suburbs.

Leading opposition is the Environmental Defense Fund, represented by Richard O. Baumbach and William E. Borah, who feel that the bridge could mean the end of the New Orleans they know. The highway department, Chamber of Commerce and the mayor, who lives uptown, all maintain that the bridge wouldn't be as bad as its opponents say. And, they say, it has to be built.

Columbia U. staff housing rises from NYC cliff

It's a little strange to think of building on the edge of a cliff in the midst of New York City's urban wilderness, but Columbia University found one for its Bard-Haven staff housing project. The almost finished project rises from an outcropping of bedrock 70 ft above Riverside Drive.

Designed by Brown, Guenther, Battaglia, Galvin, the three apartment towers will provide 410 apartments for staff, faculty and married students at the University's College of Physicians and Surgeons. Besides apartments there will be day care facilities, parking and a wide terrace shared by the three towers, one of which is already occupied. Below one of the towers is some 30,000 sq ft of office space to be used by the medical school.

MOMA holds tent show

If the sculpture garden at New York City's Museum of Modern Art looks like a tent show, blame Frei Otto and Richard Larry Medlin. The large tent, suspended from a 50-ft mast, was designed for the museum by Medlin as part of an exhibition devoted to Frei Otto's work. The tent went up in June and will stay up through September.

In precise terms, the structure consists of a prestressed tensile membrane of vinyl-coated polyester fabric; it is carried by the main 50-ft V-shaped mast and two smaller ones held by suspension cables to anchorages in the ground. It floats over the garden's upper terrace and stairs, covering an area roughly 64'x36'x21', or about 2300 sq ft. The translucent fabric filters sunlight, resists ultraviolet rays and repels water.

Preliminary design was done by graduate students in Medlin's Lightweight Construction Studio at Washington University, where he is the director of the Lightweight Construction Center. Medlin is a former associate of Frei Otto's. The exhibit will include 99 giant photos and many drawings covering 54 individual projects. A Museum publication dealing with Frei Otto's work will be available in the fall.

Urban renewal down under

Younger than the U.S., Australia is not far behind in urbanization; almost 20 percent of the country's population is in Sydney and the pressures of the nearly 2.75 million people are prompting the same sort of urban development and renewal that is changing American cities. Consider, for example, the plan for the depressed East Rocks area of Sydney: commercial development, shipping facilities, expressway links and historic buildings, all wrapped up in a program that will take $560 million and 15 years to complete.

The site is 53 acres on the west side of Sydney Cove, near one end of the Sydney Harbour Bridge. In 1788 it was the site of the first settlement by Captain Phillip; Sydney's oldest existing house, built in 1816, still stands, and the Rocks today represent a history of the city.

What is planned is a two-part project—commercial development, including a convention hotel in the southern section, and residential and entertainment facilities in the northern section. The commercial complex will include six office towers (up to 40 stories high) and smaller buildings, providing space for some 30,000 workers; there will also be shops, stores and the hotel. Residential development will include medium rise buildings and town houses, providing dwelling units for some 1200 people. A full range of entertainment and recreation facilities is planned, including a good amount of open space. Pedestrians will be separated from auto traffic, and nearby expressways and the bridge will be linked with the area by a system of roadways. And across the harbor is the opera house.

AIA Honor Awards

Ten buildings, ranging from a small church in California to the U.S. Pavilion at the Osaka fair, have brought AIA Honor Awards to their designers. They were selected from a total of 550 entries.

Winners are: **Ulrich Franzen** (Christensen Hall, University of New Hampshire, Durham); **Hartman-Cox Architects** (Florence Hollis Hand Chapel, Mount Vernon College, Washington, D.C.); **Quinn & Oda Architects** (Church of our Divine Saviour, Chico, Calif.); **The Architects Collaborative** (Children's Hospital Medical Center, Boston); **Richard Meier** (Westbeth Artists Housing, New York City); **Davis, Brody & Associates and Richard Dattner & Associates** (Estee Lauder Laboratories, Melville, N.Y.); **Benjamin Thompson & Associates** (Avco Everett Research Laboratory, Melville, N.Y. and Design Research Building, Cambridge, Mass.); **Wolf Associates** (North Carolina National Bank Branch, Charlotte); **Davis, Brody, Chermayeff, Geismar, De-Harak Associates** and co-architect **Ohbayashi-Gumi Ltd.** (U.S. Pavilion, Japan World Exposition, 1970, Osaka).

The 25 Year Award, given to buildings at least that old in recognition of enduring design, went to Crow Island School, Winnetka, Ill. Designed by **Perkins, Wheeler & Will** (now Perkins and Will Partnership) and **Eliel** and **Eero Saarinen**, the school represented a radical departure from then current school thinking when it was commissioned in 1940. The design reflected the town's philosophy of progressive education: it was zoned by age groups and had a community center at its core; classrooms had glass walls and their own play yards.

Calendar

Aug. 17–29. Det danske Selskab seminars on Scandinavian architecture with stays in Copenhagen, Oslo, Stockholm and Helsinki. For information contact Det danske Selskab, Kultorvet 2, DK-1175 Copenhagen K.

Aug. 21–Sept. 3. XIII International Congress of Refrigeration, Washington, D.C. Sheraton Park Hotel.

Aug. 22–25. Annual meeting of the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE). Shoreham Hotel, Washington, D.C.

Aug. 31. Deadline for mailing P/A Design Award entries.

Missisquoi Valley Union High School District, Swanton, Vermont

Merging the student bodies of three outdated a overcrowded Vermont schools, this new juni senior high school enhances the countryside w its flowing curvilinear form.

Interior flexibility is the keynote of the desig basically an alignment of six rounds in a crucifo plan. Steel framing is skillfully used to create la clearspan areas within the individual buildir Movable partitions permit a variety of spatial rangement.

At the functional center of the cross are the ministration facilities and library, and these bordered on three sides by circular classroom bu ings. The cross's stem consists of theater and gy nasium structures. Tapered steel rigid frames circular plan support the various roofs.

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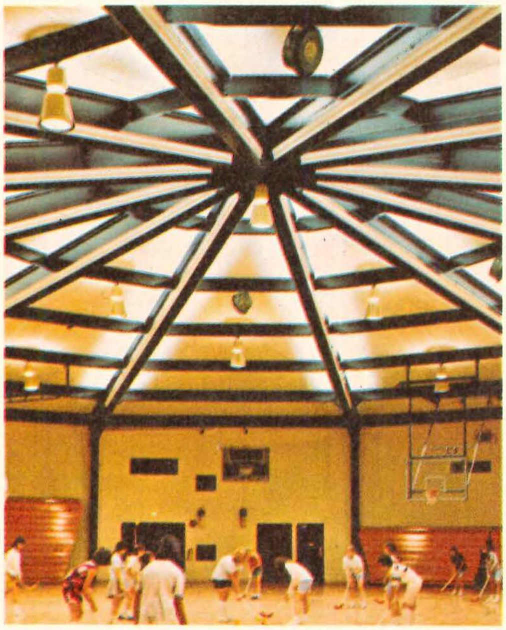
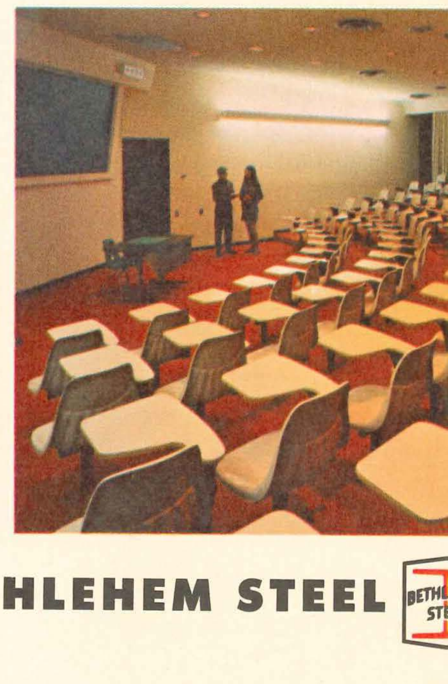


steel frame helps achieve



BETHLEHEM STEEL

nterior flexibility

chitects: Shaver & Company, Michigan City, Indiana and Salina, Kansas

uctural Engineers: Carl Walker Associates, Inc. Kalamazoo, Michigan

el Fabricators: Bancroft & Martin, Inc. South Portland, Maine

neral Contractor: Wright & Morrissey, Inc. Burlington, Vermont

News report

Architecture west

Who's hurting here? Almost everyone. This is the first recession in which the established offices are hit harder than the new ones, and the middle aged are at a greater disadvantage than the more mobile young.

Many recent graduates bypass architecture and enter allied fields, some out of disenchantment with a profession they call anti-social. Planning departments in small cities, offices of developers, product design take care of many defectors. Carl Maston was astonished to find a former student of his at USC checking his plans for a building on the UC Irvine campus; a plan checker earns more than a project architect.

Enough California and out-of-state students are applying for work, however, to make a 2-in.-high file in A. Quincy Jones' office, and Cesar Pelli of Gruen Associates reports 10 or 12 applications a week. "A surprising number of these are chief designers or men who've had their own offices for some 10 years," Pelli said.

This will be the first summer many offices have not committed themselves to take student draftsmen. The USC placement office has had no calls for the class of '71 or undergraduates. Scholarships are off, which has eliminated two minority students and reduced support for others. Requests for draftsmen are down at the AIA office.

Two offices here—Becket and Associates and Luckman Associates—reported expansion during the last 12 months. According to their p.r. departments, volume of work and number of employees both rose 10 percent at Becket's—some due to the acquisition of a Chicago office. The development company which bought the Luckman office several years ago "helped out with big jobs," said Ralph Jackson. Their clients, he added, have not been hit—banks, stadiums, convention centers.

Arthur E. Mann of Daniel, Mann, Johnson and Mendenhall, and AIA chapter president, said, "Across the board, everyone is hurt. Most jobs are not happening. Housing starts are down, manufacturing plants down. Inflation may be slowing but the wage rates are unchanged." In 1933, it was the earthquake, he observed, that saved the architects, many of whom were digging ditches at $2 a day during the Depression.

"Lowered interest rates haven't helped," said Albert C. Martin of Martin Associates. "That isn't as important a step as building up confidence on the part of business. Improvement will be a slow process. What would help most is getting out of Viet Nam and regenerating our cities through encouragement by government and by tax incentives."

Robert E. Alexander called Viet Nam the "number one sickness," which had dried up matching funds in health work and university projects and had turned the faucet off on 235 rent-supplement housing.

"The backlog of work doesn't exist in the offices today," A. Quincy Jones said. "A few things can keep our office busy but the hazard is that they will stop."

"The great difference between today and other depressed periods," Pelli remarked, "is that architects can't project ahead today; the old averages and percentages of chance have ceased to operate."

Dworsky & Associates have taken on work they might otherwise have passed up, Daniel L. Dworsky said. With government and institutional work down and speculative building up, the typical client, he said, is not interested in a fine building. What he misses is "spiritual leadership in government. No inspiration, only inertia."

"The greatest sufferers are those who specialize in creating better architecture, many of whom are now keeping their offices open on borrowed money," said Carl Maston. Their only hope lies with the man of taste with private money.

Work under construction has kept Craig Ellwood's small office afloat, just as two- and three-year projects have tided over many a big office. He is starting work on an office building, a type which most agree is overbuilt. Eighteen months ago Century City couldn't meet the demand for office space, and now there are vacancies. A saturation point has been reached in the new downtown financial-commercial center. Martin predicts that old buildings will be remodeled as new needs arise. The high-rise boom is over.

Few offices are closing. For most of the architects quoted, 1970 was a fair year. But the 14 percent rise in construction costs and 10 percent on materials, plus the uncertainty, makes cancellation of buildings regular occurrences. Diversification, the coat of armor of the 1960s, has helped. One good job a year in planning, public works or architecture keeps the gross up in the small office of Kahn Kappe Lotery. Raymond Kappe talked about the need of a young office to relate to fiscal policy and money availability and the "ability to swing between the public sector and private."

On the other hand, Raymond Girvigian's 14-year-old, one-man office in South Pasadena flourishes with a small volume of municipal projects. Girvigian, a local and national officer in preservation work, complains that product manufacturers who are hurting badly are retrenching rather than developing sorely needed new products—especially in masonry.

Jones emphasizes that the profit dollar is worth less today. "Everything takes more time and costs more. The payroll burden is now 15 percent of the draftsmen's salaries. Consultants fees have gone up 40 percent, the engineer's fee is more than the architect's, the carpenter makes more than the draftsman. The contractor has solved the problem by becoming a broker; he farms out work at zero risk."

In a buyer's market, fee cutting has risen. Although difficult to prove, accusations mount. It has a new angle. "Fee cutting usually goes with quality cutting," said the principal of one large firm, "but there's a case of good buildings being produced at a loss. The X firm had some free cash and reinvested it in the office by cutting fees, which keeps the work going and the office together." [Esther McCoy]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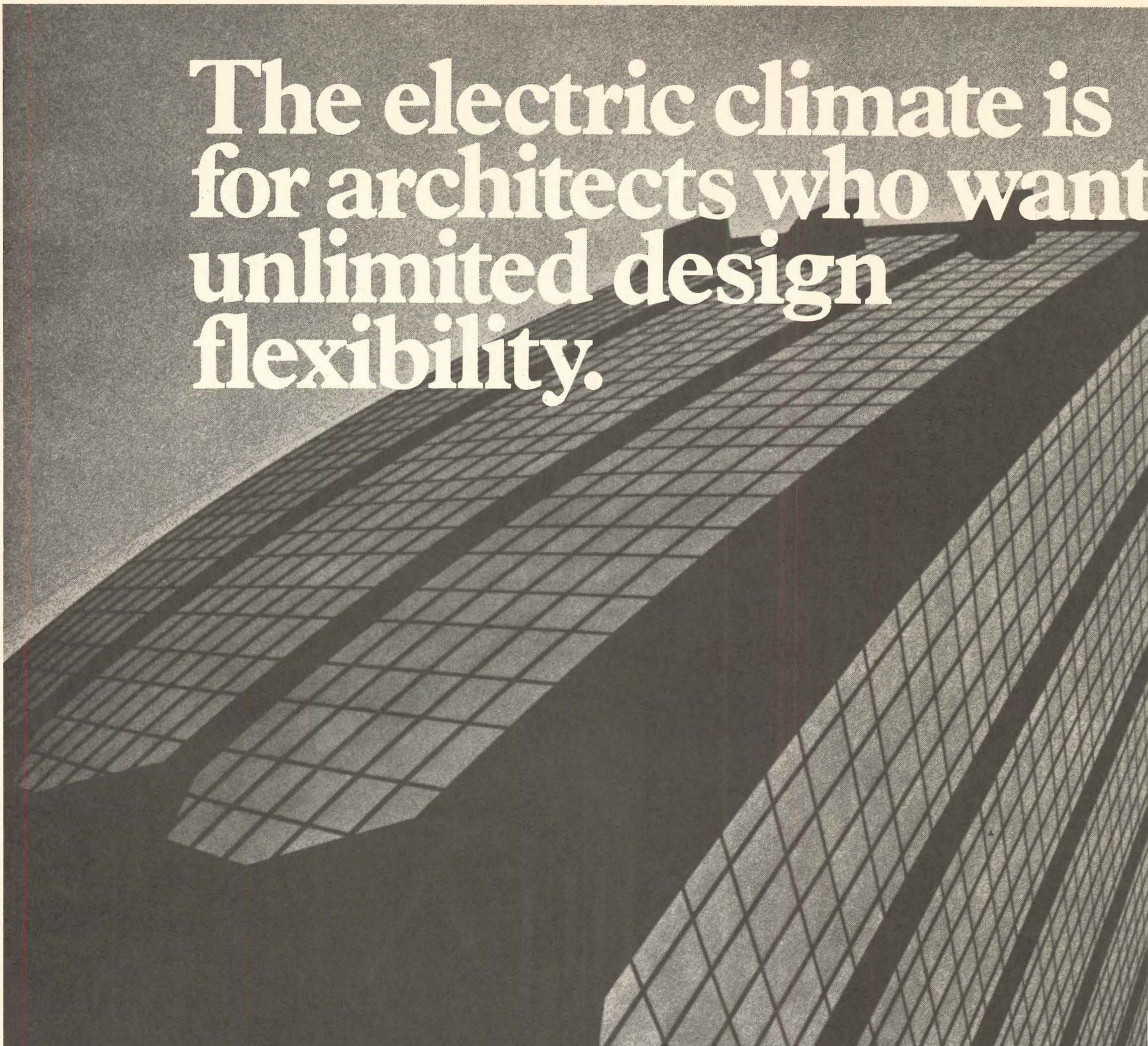
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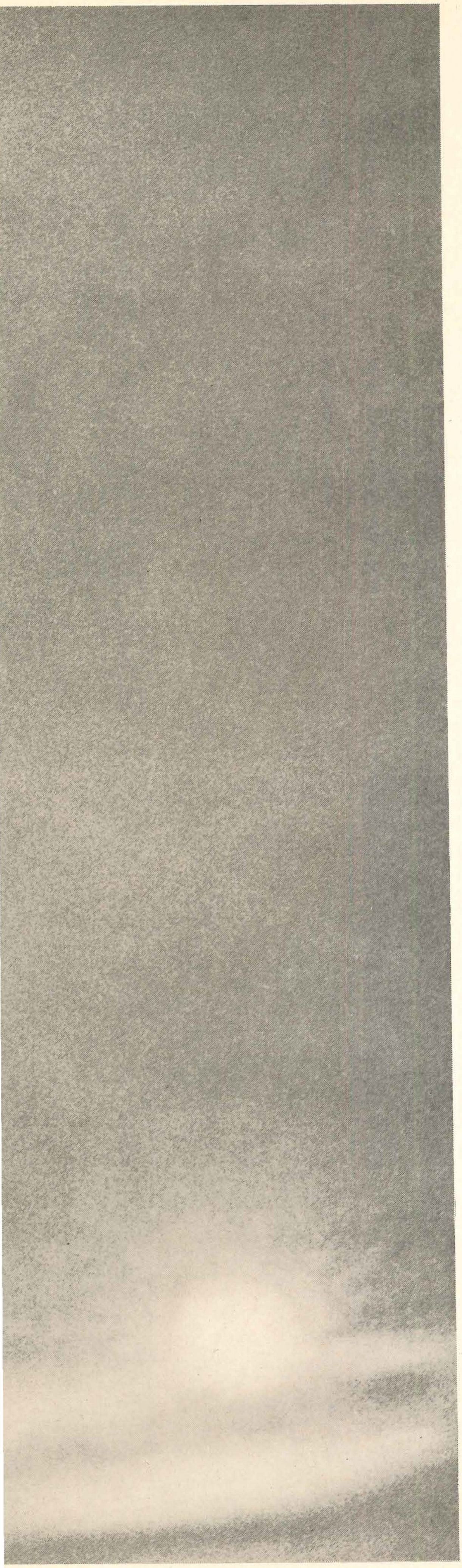
for architects who want
unlimited design
flexibility.



Here's how it helped Harwood K. Smith & Partners design an 18-story building that saves its owners thousands of dollars every year.

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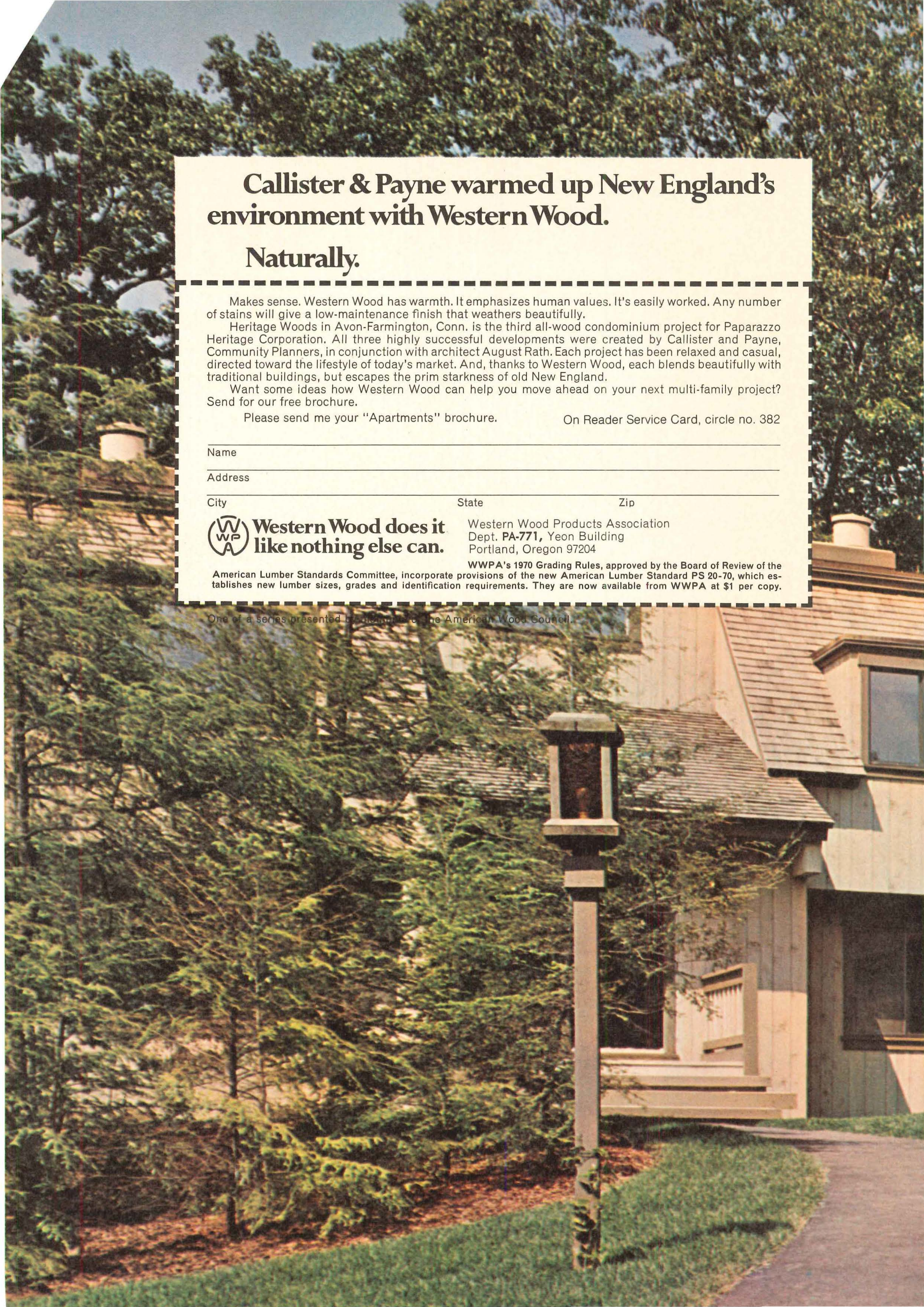

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Heritage Woods in Avon-Farmington, Conn. is the third all-wood condominium project for Paparazzo Heritage Corporation. All three highly successful developments were created by Callister and Payne, Community Planners, in conjunction with architect August Rath. Each project has been relaxed and casual, directed toward the lifestyle of today's market. And, thanks to Western Wood, each blends beautifully with traditional buildings, but escapes the prim starkness of old New England.

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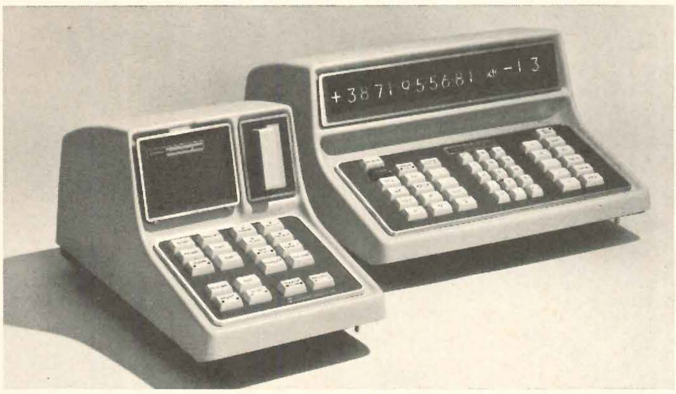
WWPA's 1970 Grading Rules, approved by the Board of Review of the American Lumber Standards Committee, incorporate provisions of the new American Lumber Standard PS 20-70, which establishes new lumber sizes, grades and identification requirements. They are now available from WWPA at $1 per copy.

One of a series presented [illegible] the American Wood Council.

Products and literature



Easy does it

Floating drafting head

Carry it

Easy-to-use programmer. A programmer capable of looping, branching, editing and storing programs designed to be used with company's Scientist 909 and Statistician 911 computing calculator is said to offer solutions to most problems that can be handled by a scientific computer, at considerably less cost. A deep knowledge of programming techniques is not required, codes or conventions are not needed to operate the keyboard. Cintra, Inc.
Circle 101 on reader service card

Automated drafting. Designed to minimize equipment investment while allowing individual components to be formed into specific requirements, this drafting system is described as a "building block concept." The central block is the flatbed table with a floating high-speed drafting head riding on an air cushion. The computer controlled head is maneuvered by magnetic force over the drafting surface on a two-axis plane and along any desired vector. Xynetics, Inc.
Circle 102 on reader service card

Portable computer terminal. Capable of speeding construction site data to computer centers, this portable terminal consists of a self-powered tape recorder and standard typewriter keyboard housed in a unit no larger than the smallest portable typewriter. Any form of construction site activity—timekeeping, material deliveries, progress reports, inspection approvals—may be input on the keyboard, recorded on magnetic tape and transmitted over ordinary telephone lines to a central computer. MSI Data Corp.
Circle 103 on reader service card

Computer-calculator. The manufacturer of this equipment claims that data goes in easier and answers come out quicker—extensive mathematical calculations are performed at the touch of a single key; no special language is required. Up to 392 step programs can be recorded and stored on business-card-sized magnetic cards. Described as a low-cost system, it should answer statistical, mathematical, engineering, physics and surveying problems. Hewlett Packard.
Circle 104 on reader service card

Static control for floorings. As a result of combining carpet fibers with the most suitable static reduction system, this company is able to offer static control in all grades of their carpet. They also offer conductive floor tile that combines sound-deadening properties with a crack- and dent-resistant surface. Called Condulite, the tile is said to completely dissipate electrostatic charges generated either by human bodies or by equipment in electrical contact with the floor. The tile is recommended for application in hospitals, laboratories, industrial plants and computer rooms. Burke Rubber Co.
Circle 105 on reader service card

Templates. A variety of widely used symbols, usually found on several different templates, has been incorporated in one for single general purpose use. It contains circles, squares, hexes, deltas; 3 sizes and 2 styles of brackets; 2 north arrows; 2 sizes of arrowheads, and 30, 60, 90, and 45 degree triangles. RapiDesign, Inc.
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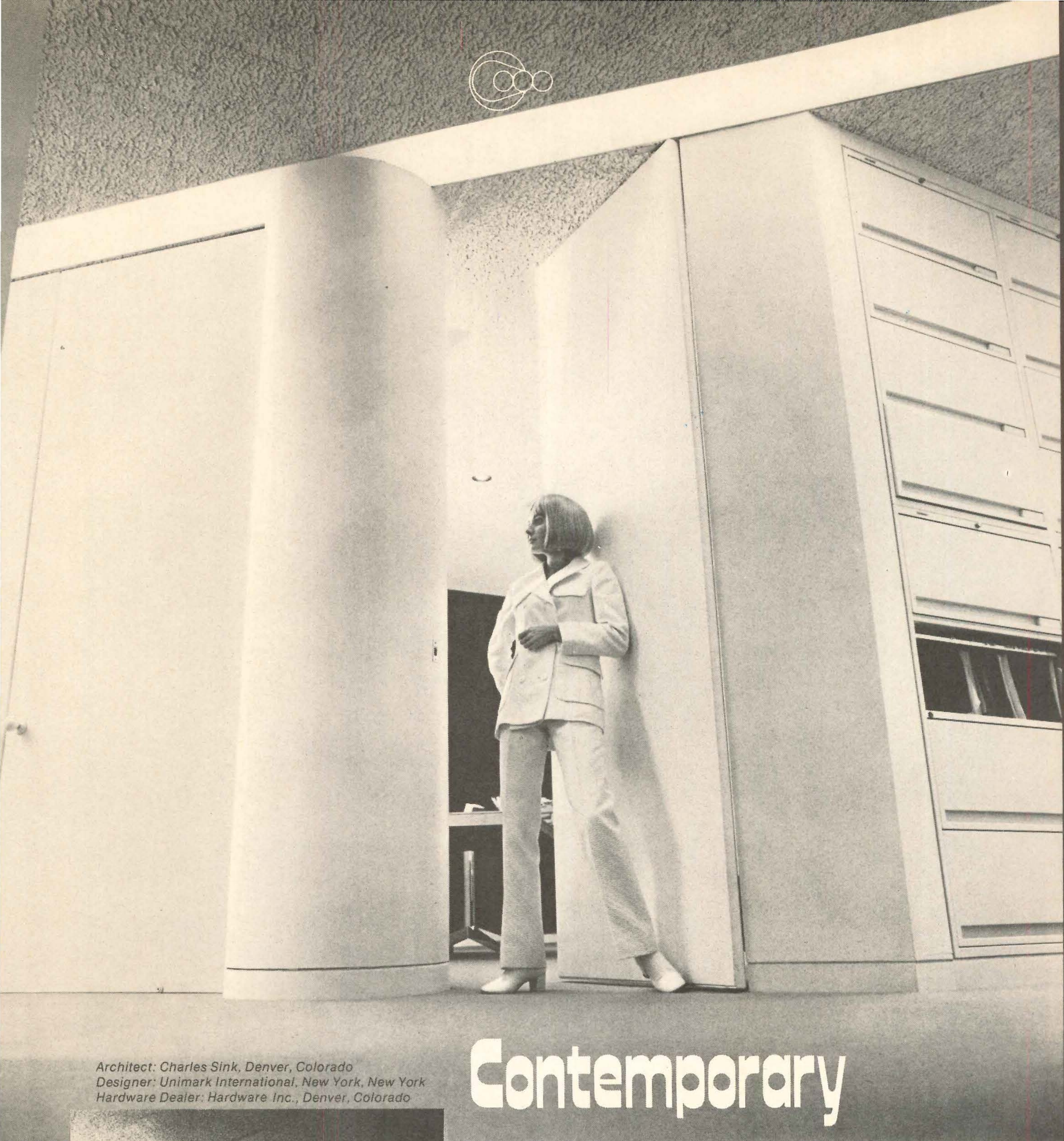
[continued on page 52]



Architect: Charles Sink, Denver, Colorado
Designer: Unimark International, New York, New York
Hardware Dealer: Hardware Inc., Denver, Colorado

Contemporary

The Great Western United Corporation. Denver, Colorado

The clean, sweeping lines of today's office interior; a design statement of functional superiority. No door closer is seen, yet no more positive control could be provided. Unseen, Rixson X-5 closers control these high, unframed office doors . . . Rixson 28's control these giant entrance doors of heavy glass. Here, no compromise was made.

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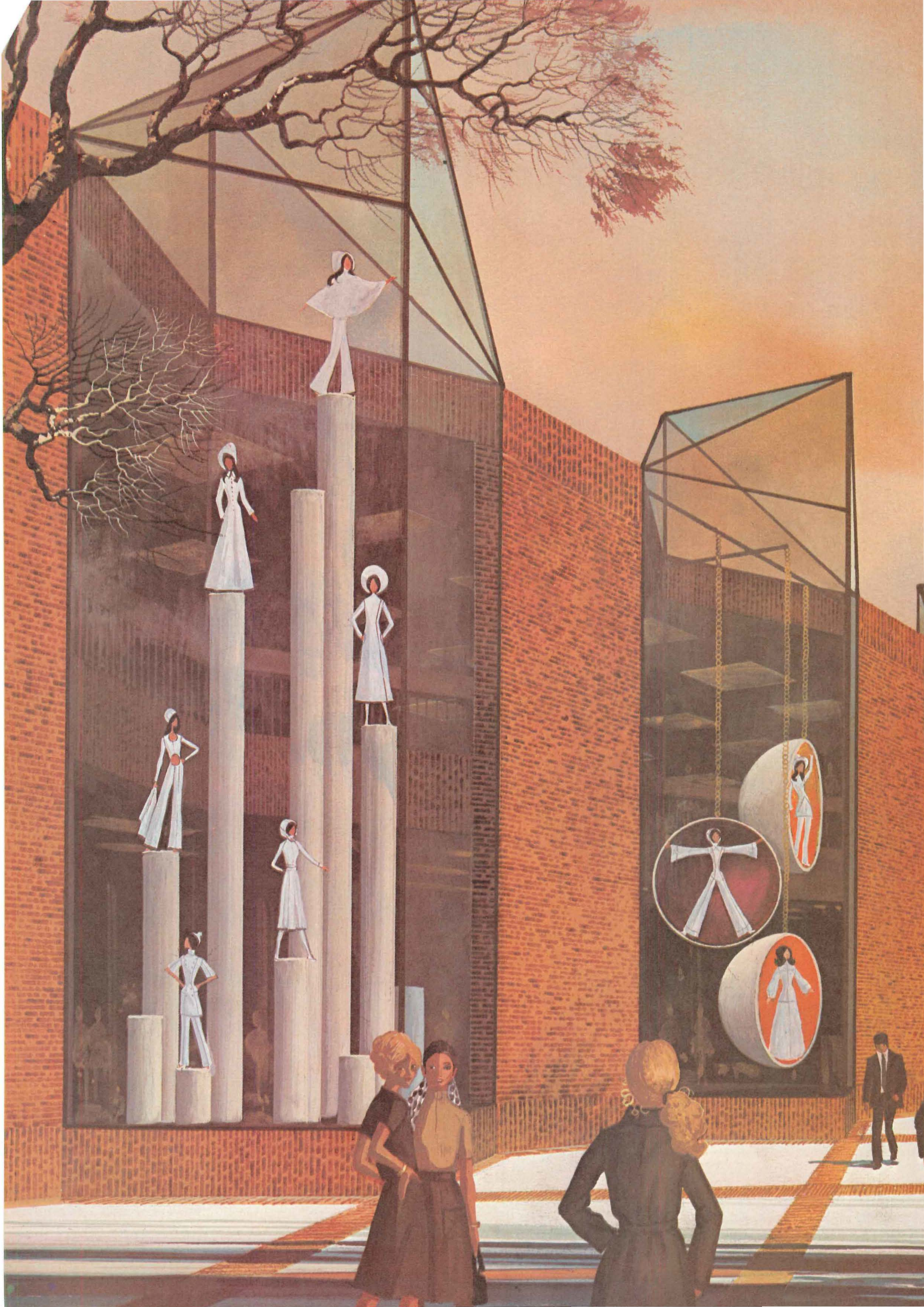
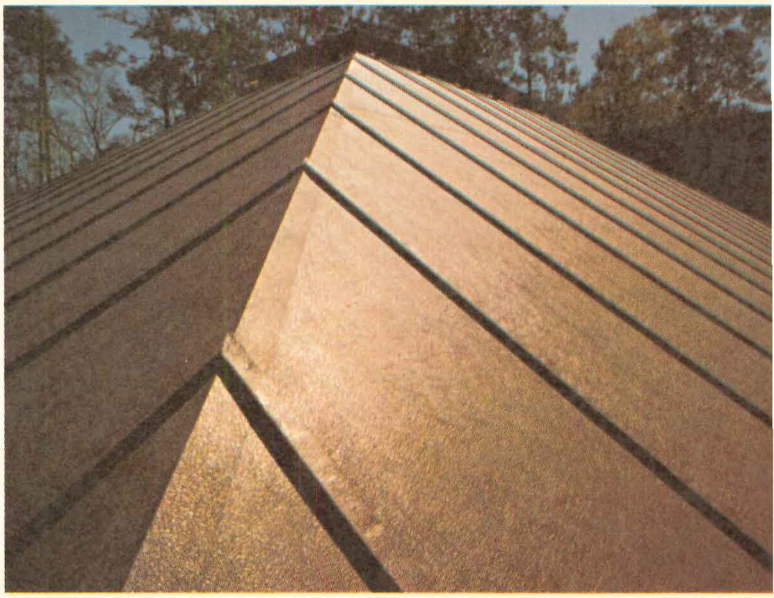
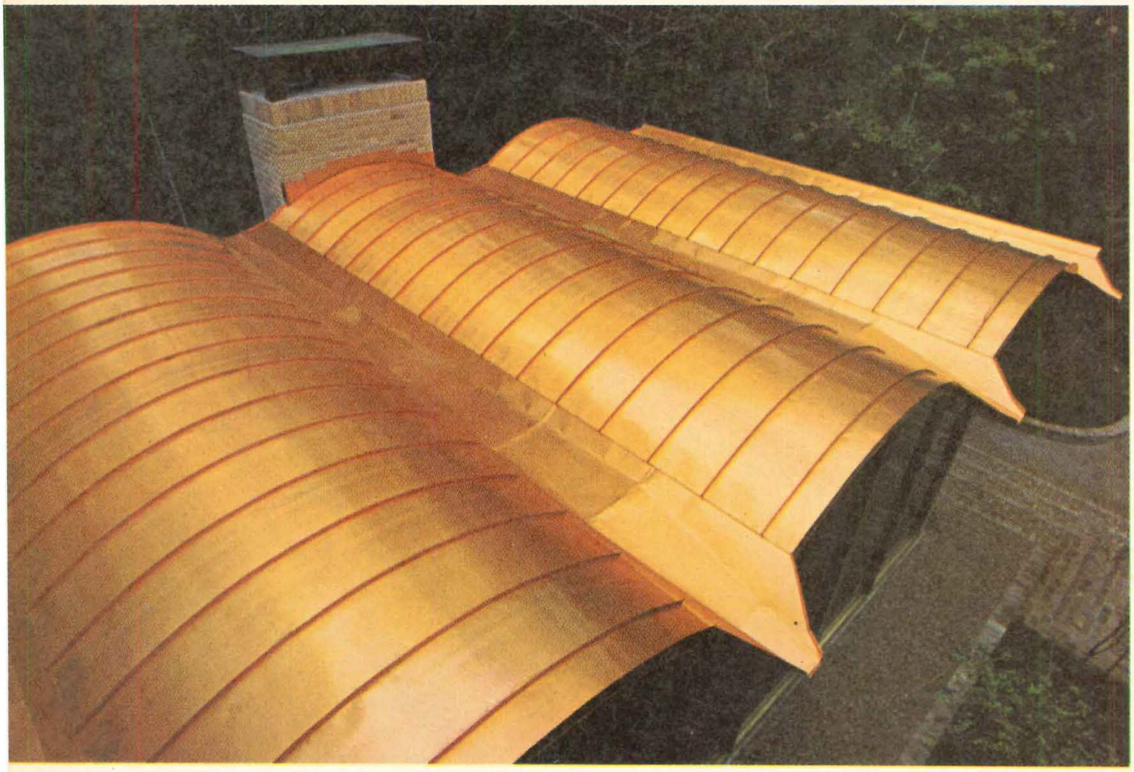


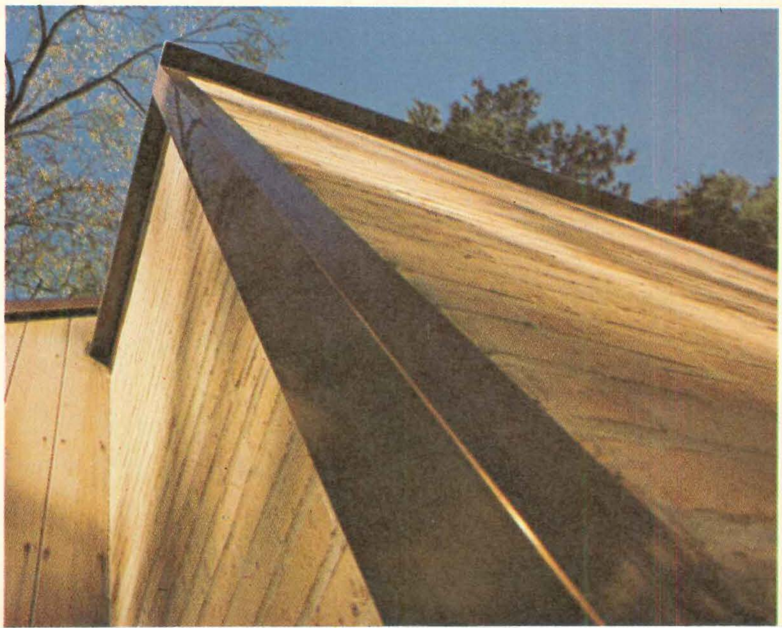
Copper sheet. Obviously beautifu

Here are some economical uses for copper that may surprise you. Using standard sheet copper. Available now. Every bank, restaurant, hotel, office building, house of worship and residence can be made more attractive and elegant with the quality features of copper. Feast your eyes. **New copper/roofing system** (right). Large copper sheets bonded to plywood. Quick, easy to apply. Needs no special tools. **Clear film-finished copper roof** (below). Copper sheet laid over plywood deck in a vaulted design. Secured with hidden clips. Factory coated to preserve natural color. **Bronze sliding glass doors, windows** (below right). Brings the outdoors indoors. Beautifully framed in roll-formed bronze, a rich looking copper alloy. Quiet elegance that lasts.



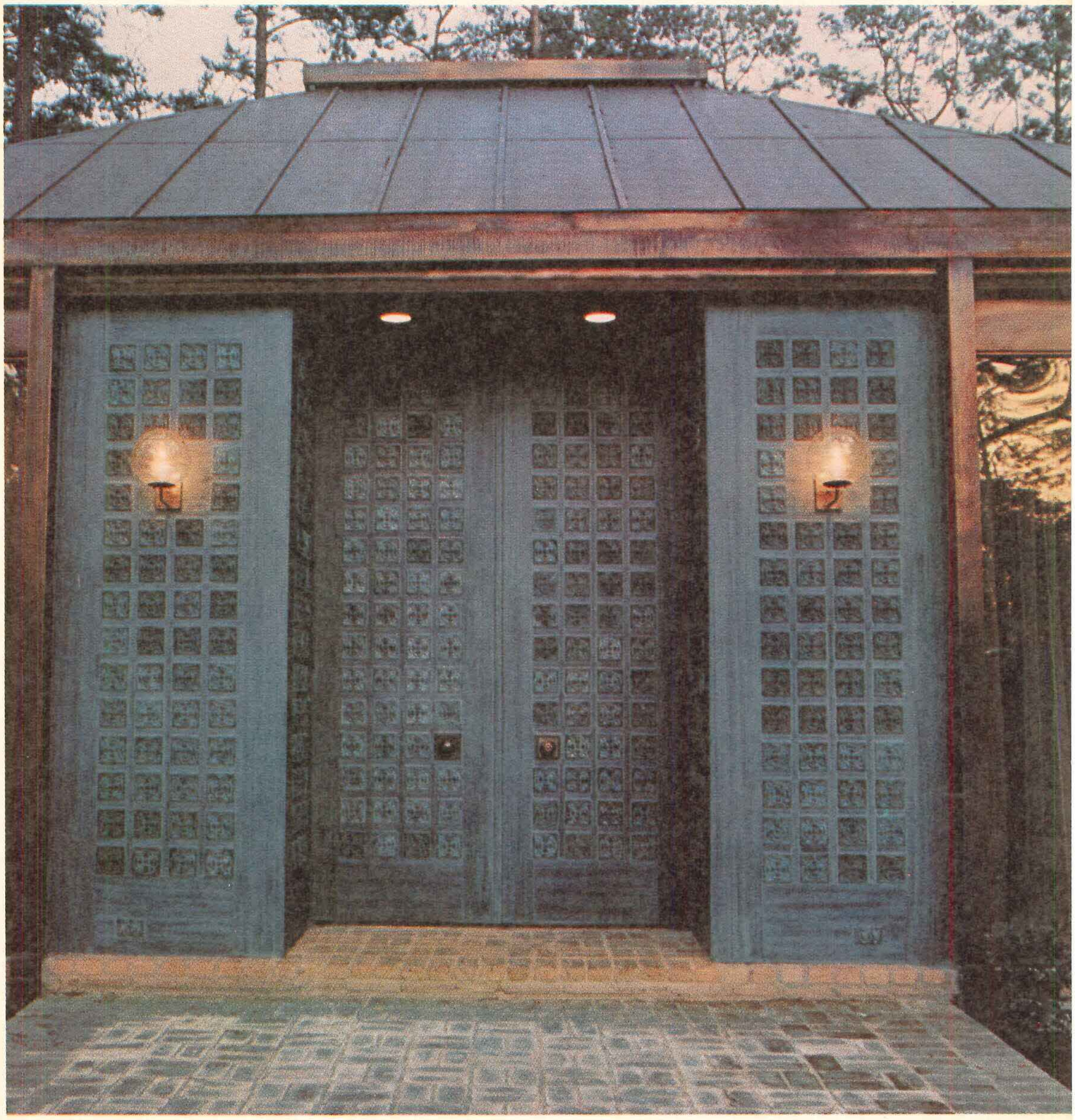


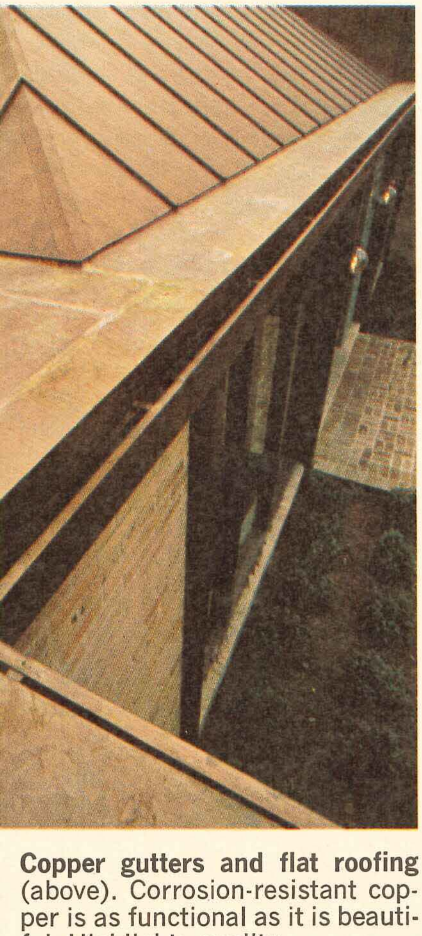
Copper leaders that are an integral part of the design (right). Copper's resistance to corrosion especially valuable here. Painting eliminated. Weathers naturally to a russet brown. **Copper vent hoods** (far right). Long-lasting, good-looking. New high-strength and economical copper strip is perfect.



Naturally durable. Readily available.

Bronze floor tiles (left). Pebble textured bronze on copper sheet applied directly to concrete or plywood. Needs only minimum care. Foot traffic adds varied highlights of muted gold tones.





Copper gutters and flat roofing (above). Corrosion-resistant copper is as functional as it is beautiful. Highlights quality.

Copper-accented entrance (above). Stamped copper rosettes with a patina finish. Easily applied. **Copper-clad ceiling** (left). Chemically etched ultra-thin sheets of copper and brass in a kaleidoscope of tone and color. Every pattern unique. For walls, counters too.

For details on these—or any other architectural uses for copper, brass and bronze—just write us.

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Products continued from page 46.

High fire retardance urethane. A noncombustible urethane-type rigid foam insulating material KODE 25 is said to offer the advantages of urethane, such as a low K-factor, lightness, strength and permanence, as well as to provide a fire hazard classification flame spread rating of 25 according to UL 723 Test, which means it meets most building codes. CPR Division, The Upjohn Co.
Circle 107 on reader service card

Literature

Minicomputer. A 12-page brochure described the SYNCOMP MICRO/1 Computer—low-cost equipment specially geared to the data processing requirements of architects and engineers. At high speed, it performs such full computations as those for surveying, subdivision design, profile/earthwork, highway design, soil analysis, hydraulics, and others, in addition to individually tailored management reports and accounting functions. It is a combination of minicomputer hardware, formware and software. Synergistic Computer Systems, Inc.
Circle 108 on reader service card

Silicon-based coatings. Color brochure describes silicone coatings said to eliminate the problem of chalking and fading colors and to offer years of protection when used on steel and aluminum siding, panels, roofing fascia and trim. The designer of pre-engineered metal buildings now has a wide choice of colors and finishes. Dow Corning Corp.
Circle 109 on reader service card

Waterplug. Brochure describes how even the most unconventional water leakage problems can be solved with Waterplug. Whether water is pouring in under pressure or seeping in as a slow leak, the manufacturer claims that the flow stops immediately when this cement is pressed into the hole. It is also said to seal masonry cracks, holes and spalled concrete; forms a durable waterproof cove at troublespots where walls and floor are joined; plugs and seals construction holes. Comes in dry powder form, mixes easily with water. Standard Dry Wall Products.
Circle 110 on reader service card

Glass acoustics. Sound-reducing qualities of flat glass, as well as basic acoustical principles pertaining to glass, are defined in "Breaking the Sound Barrier," a nontechnical booklet. Also discussed are sound transmission loss with various types of glazing, characteristics of certain types of sound, and calculation of sound transmission loss with combinations of glass and opaque wall. Libbey-Owens-Ford Co.
Circle 111 on reader service card

Geodesic domes. The advantages of these domes are described in a seven-page booklet giving specifications, design diagrams and applications. Domes are made of aluminum, are erected by specially trained crews. Using Buckminster Fuller's geodesic geometry, the triangulated great circle framing makes the domes equally strong under eccentric and symmetrical loading. Temcor.
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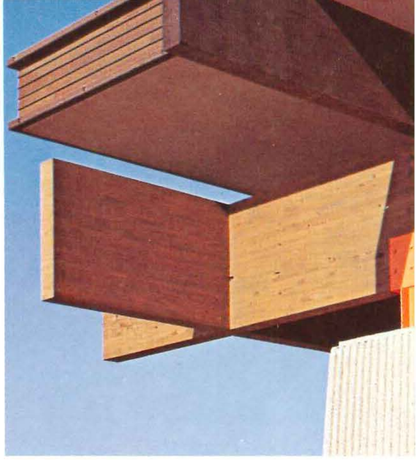
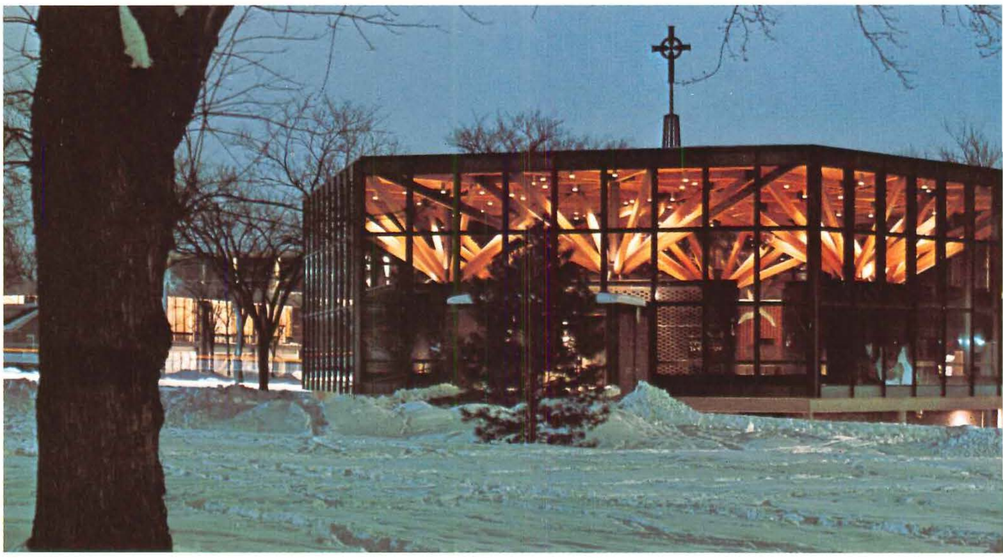
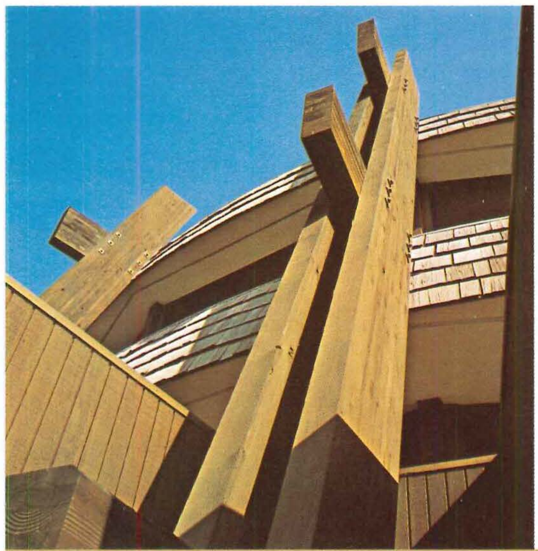
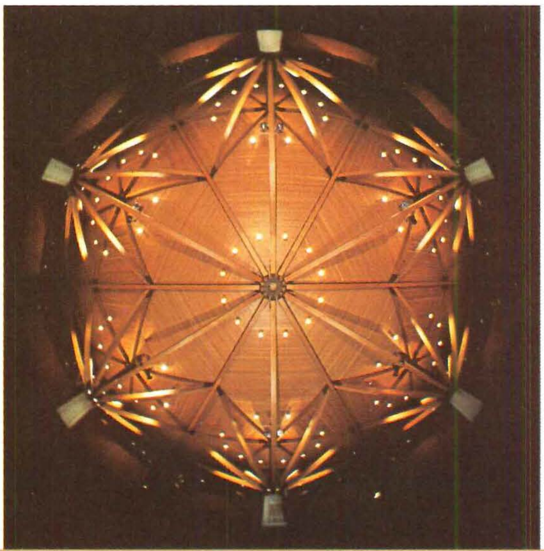
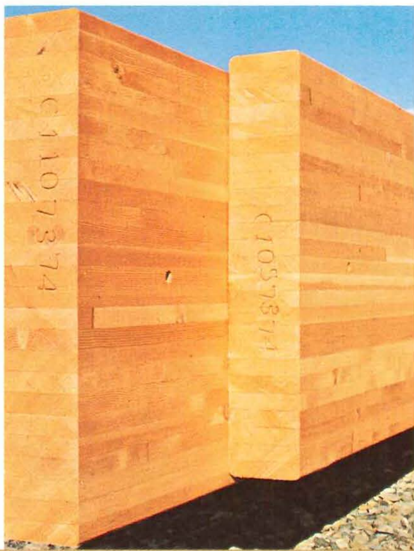

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Editorial

Progressive Architecture

July 1971

There's hardly a man, woman or child who doesn't come in almost daily contact with a computer—although the technology keeps it at an often-frustrating distance from most of us. We can only respond to its commands: pay that bill, obey that stop light, make a decision based on the data in File 2446. Others, on the opposite end, command the "lovable idiot" to do wondrous things: watch over all the control points and let us know if the air conditioning, steel producing or chemical processing equipment is working all right; tell us which highway route is cheapest, taking into account terrain, present land values and local hourly wages; draw us a picture of the urban renewal plan and/or its proposed buildings.

Engineers took up with the computer first, using it as an extension of their slide rules. Planners first saw its possibilities for compressing huge amounts of data into manageable bundles. Then the architects.

They started, in the best classical tradition, in the universities. During the early 60's word began to trickle out that not only were the students taking elective time in computer programming and operation, but that they were "defying the authorities" by indulging in not-so-unserious games of tic-tac-toe with the monster. This seems to have become old hat, though, in a day when six-year-olds regularly sit down to a typewriter terminal to learn "See the ball" and "Two and two and three take away one are. . . . ?" And when the new math has become so standard that Base 5 and Base 2 are just a couple of more things that you have to learn before recess.

But there are those in the design professions to whom Base 2 is still the symbolical stumbling block to taking advantage of the computer as a valuable office and professional tool. As the authors of the article on p. 64 of this issue point out, there are some 300 architectural firms larger than theirs who could presumably afford to computerize, given the incentive to dedicate years and manpower to implementing the process. It doesn't even take a working knowledge of computer techniques to get started, as the roundup article on software services points out on p. 74.

This issue is necessarily limited in scope and, to the experts, what is omitted might have been more important: hardware; research reports describing new programs for special purposes; the education of computer specialists; blue sky and not-so-blue sky predictions about what the computer will do for architects in the future; the latest automated aids for specification writing, graphic production and engineering calculations. To touch all bases we would have to publish nothing but computer-oriented articles from here on out.

What we sliced out of the hundreds of possibilities is a progress report on what's happening now: one firm devises its own interactive series of programs; another applies its engineering-oriented computer to internal office problems; a third uses the computer to upgrade the data base for decisions in planning community colleges. Interior designers are also catching on.

One of the best indications of growing interest and activity by the design professions is the Eighth Annual Design Automation Workshop held June 28–30 in Atlantic City. Sponsors were the IEEE Computer Society, ACM (Association for Computing Machinery, Special Interest Group on Design Automation) and SHARE (An IBM User Group, Design Automation Project)—groups that heretofore had been primarily interested in computer techniques per se. This year the Workshop was expanded to devote five complete sessions, about 40 percent of the program, to "the emerging field of architectural design automation." Most of the 15 experts chosen to present papers in these sessions described individual programs worked out for specific design tasks, but papers were included on the history and future of computer applications in architecture and on the interface between automated design and automated production processes in housing.

Most of the 100 to 150 architects signed up to attend presumably are already computer oriented, but it is encouraging that special-interest groups such as these sponsors are actively trying to get more information out of the labs and into the hands and minds of the professionals. [The editors]

Prologue

The history of the computer in original documents, machines and photographs has been collected and presented by Charles Eames for IBM's Computer Perspective. The documents, beginning with those of 1890, are displayed in a three-dimensional collage along one wall. Eames has traced three separate types of machines—logical automata, statistical machines and calculating machines—showing their simultaneous development, the impact these machines had on business, industry, science and government, and the evolution of these three types of machines into the electronic digital computer. The following is an outline of that history. P/A wishes to thank Charles Eames and IBM for their help in gathering this information.

1890–1900
Figures from the 1880 census are still being analyzed in 1887. The 1890 figures will be obsolete before they are studied.

Census bureau competition won by Hollerith with electric tabulator.

Steiger's "Millionaire" first commercially successful electric calculation machine for big business.
Nine thousand people provide Galton with information about their personality characteristics and capabilities. Beginnings of the statistical measurement of man.

Hollerith sells his machine to the Russians who have never taken a general census.

Navy uses comptometers in warship construction.
Galton develops system of fingerprinting for criminal identification.
"I knew that many accountants could mentally add four columns of figures at a time," Dorr Felt says, "so I decided that I must beat that in designing my machine."
Michaelson finds speed of light to be constant. Builds Harmonic Analyzer to study light waves.

1900–1910
U.S. Steel first billion dollar corporation.
Binet and Simon administer anthropometric tests to children introducing the concept of mental age and a basis for standardized psychological testing.

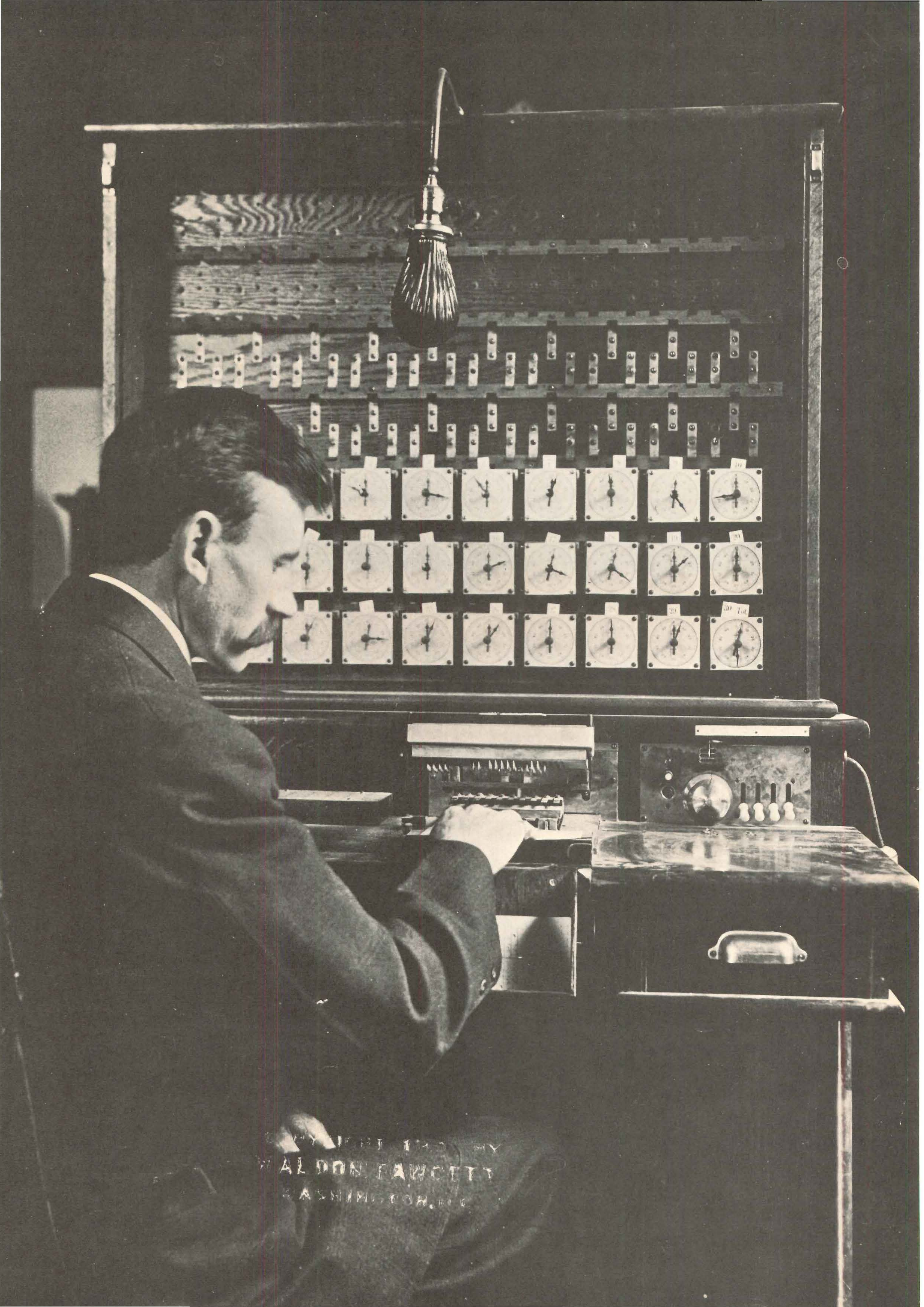
Railways, insurance companies, public utilities use Hollerith machines for data handling problems.

Engineering observes that manual bookkeeping "would need the personal attention of someone of marked ability, but when the data are punched on cards, the job could be put in the hands of a girl."
First flight of Wright brothers.
The use of calculating machines for astronomical computation is slow in beginning as they require trigonometric tables which are not available. They were discarded 300 years ago in favor of logarithms.
Hourly work week for children reduced to 48 hours.

Gyroscopic guidance used to control path of torpedo. Effective range increased 2½ times.

Three Cadillacs are taken apart, the parts mixed up, and then the cars are quickly assembled and driven away—all done to demonstrate the high level of standardization.
Hollerith devises first automatic punch card sorter.
Flexible plugboard installed in tabulator. Allows information to feed into different categories without rewiring.

IBM exhibit "A Computer Perspective," designed by Charles Eames, includes an original Hollerith Tabulating Machine (opposite) designed and built by Herman Hollerith to record the census of 1890. Photos courtesy of IBM.


WALDON FAWCETT

The Manchester Automatic Digital Machine, an experimental computer filling an entire room, began operation in 1949.

Barth develops slide rule. Gives immediate solutions to speed and feed problems of production. Allows systemization of factory work.

1910–1920
Tores builds first decision making automaton—a chess playing machine—designed to show that machines could be built to simulate human action and eventually replace man in industrial tasks.
Great brass brain tide predictor for U.S. coast and geodetic survey.

Russell and Whitehead. Logic is the foundation of math.

Warships use tidal data to elude German warships in shallow water. Germans quickly respond by building one of their own.
War declared on Germany.
Lewis Richardson in "Mathematical Psychology of War" applies mathematical concepts and techniques to examination of human conflict.

Combined bombsight and electrical-mechanical computer developed by U.S. Army and Navy. Calculates correct time to release the bomb.

War Industries Board to regulate production of industries.
U.S. Army conducts first large-scale application of psychological testing to problem of using human resources efficiently. Alpha and Beta test designed to discover special skills and identify recruits likely to be dangerous in battle.
Selective Service Act.
Steel strikers are defeated. Denied reduction of 12-hour day.

Mathematicians at Aberdeen to apply techniques to preparation of precise gunnery tables.

"For many years after the war," says Norbert Weiner, "the majority of significant mathematicians were found among those who had gone through the discipline at Aberdeen."

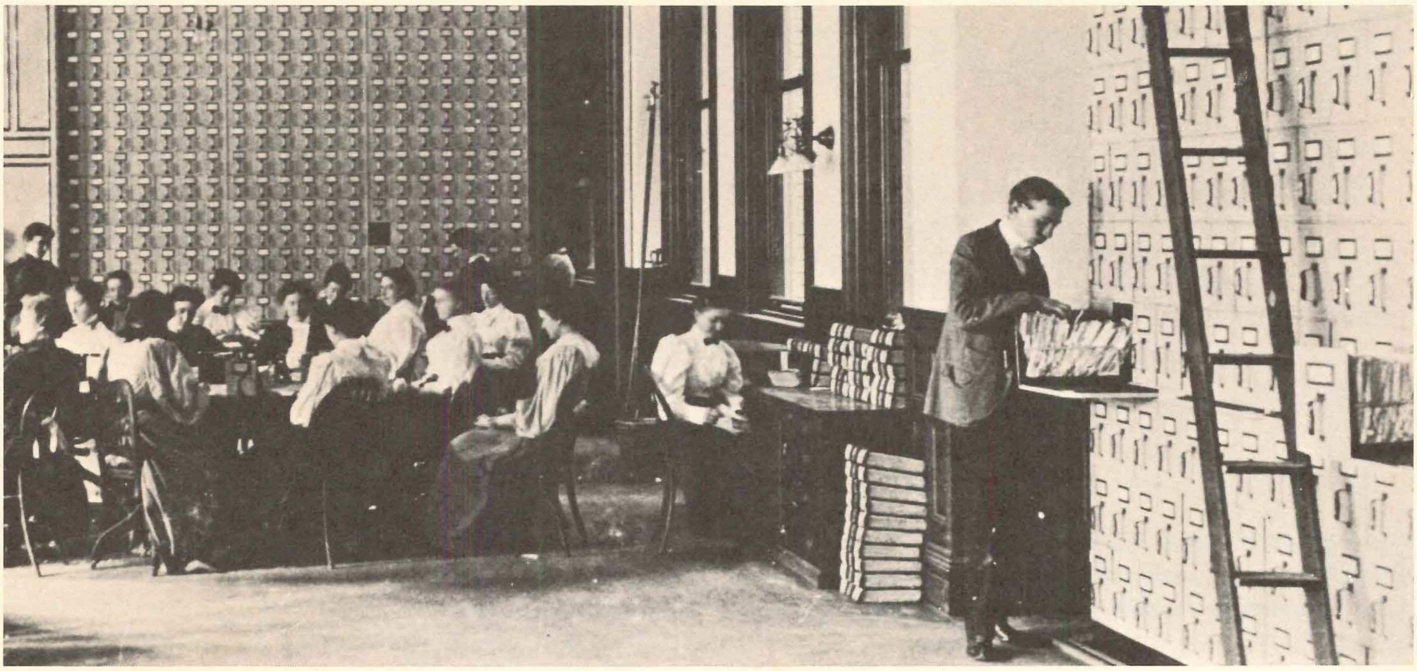
1920–1930
Friedman connects cryptography with mathematical statistics. Leads to new code breaking techniques. Punch card installations at Pearl Harbor, Corregidor and Washington.
Soviet Russia starts economic experiment. Five Year Plan for total control of industry, agriculture, transportation, power and government. Russia is third largest user of tabulating machines following the U.S. and Germany.
National Prohibition Act.
Fritz Lang's *Metropolis* shows the growing suspicion of machines, their power and their dominance.

First gyroscopic device used to control steering of ship.

Intragraph solves problems in advanced electrical theory.

Columbia statistic bureau first lab for educational statistics
Stock market crash.

1930–1940
School teacher develops machine to sense handwritten pencil marks. Makes large scale testing financially feasible.
Aldous Huxley publishes *Brave New World.* Chaplin's *Modern Times* says, "The mechanized individual goes mad and proceeds to turn a factory into the madhouse it always has been."



Punch card storage (top) in the home office of the Metropolitan Life Insurance Company around 1895. The first Ford assembly line (below) was installed in the Highland Park plant in 1913. (Ford Motor Co. photo).

Hooton studies relation of criminal's physical make-up and nature of his crime.

Bush develops Differential Analyzer to solve equation associated with power failures.

FDR promises social justice through social action.
Social Security Act makes it necessary for government to keep 26 million employment records.
First Gallup poll successfully predicts election results.

Servo-mechanisms invented. Use output to control process.

Leontief develops mathematical model to predict consequences of economic decisions.
Shannon simplifies electric adder to the base-2.
Mark 1. First general purpose digital computer at Harvard.

1940–1950
Navy uses Mark I for ballistics and ship design.
Army's Differential Analyzer calculates ballistics tables.

Air Force supports development of UNIVAC. Begins project to speed up planning and deployment process.

Pearl Harbor attacked. War declared on axis powers.

National Bureau of Standards undertakes crash program to build computer when UNIVAC is not completed.

B.F. Skinner demonstrates automatic homing device that guides bomb directly to target.
Relay calculators use teletype tape for input-output.
MANIAC begun by Atomic Energy Commission.
Industry using 10,000 tons of punch cards.

ENIAC begun. Would do ballistics calculation in half the time of the projectory's flight.

Von Neumann concept of stored program. Translation of data into mathematical model.

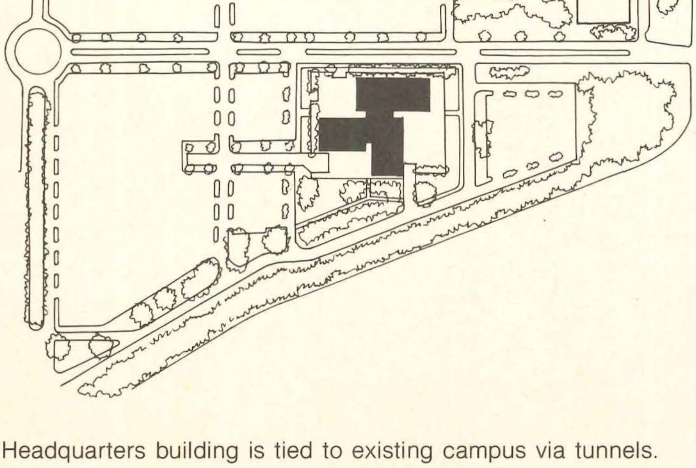
IBM builds SSEC. Used for calculations for thermonuclear bombs.
Builders of UNIVAC adapt magnetic tape to store quantities of information.
American Airlines installs first computer to keep track of reservations.
By 1950, ENIAC, EDSAC, SEAC, MANIAC, MADM, BINAC, UNIVAC are completed. ☐

The computer said 'mirrors'

Practicing what the client preaches, an a-e firm uses computer studies to determine size, curtain wall specs and space planning for a computer company's headquarters

When a fast growing computer manufacturer sets out to build a corporate image right along with a corporate headquarters, the structure has to be, according to the program, "young, clean and dynamic" and must "relate to its surroundings, the community and to human scale"—all 580,000 sq ft of it. The architects began by breaking up the square footage into three towers and, for a "clean expression," sheathed the entire exterior in reflective gold glass. This, it was felt, would add warmth, make the building become part of its surroundings by reflecting the landscape and further break down the scale by reflecting the towers back on each other.

The towers, one 15 stories and two 13 stories, were placed on a common base, with service and parking below. A first floor colonnade, central lobby and circulation core tie the towers together. On office floors the plans read as three wings of a single building rather than three separate towers.



Headquarters building is tied to existing campus via tunnels.

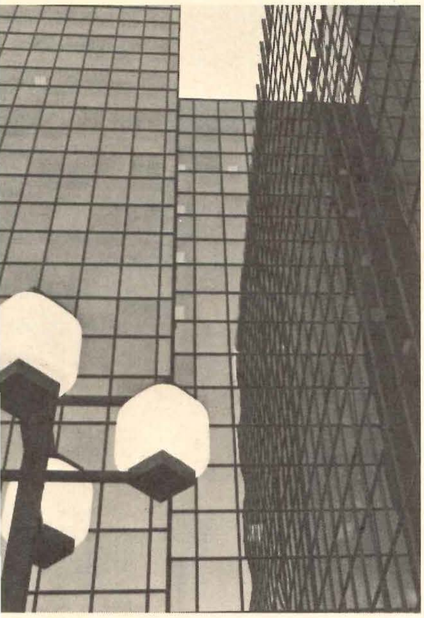
Scheduled for completion last month, the Control Data headquarters is located on the south side of an office park in Bloomington, a Minneapolis suburb. The towers were sited on the southeast portion of Control Data's 100 acres, where they could be linked to traffic patterns and to the company's five existing buildings (including a central power plant) via underground connections. To the south are woods, fields and a lake.

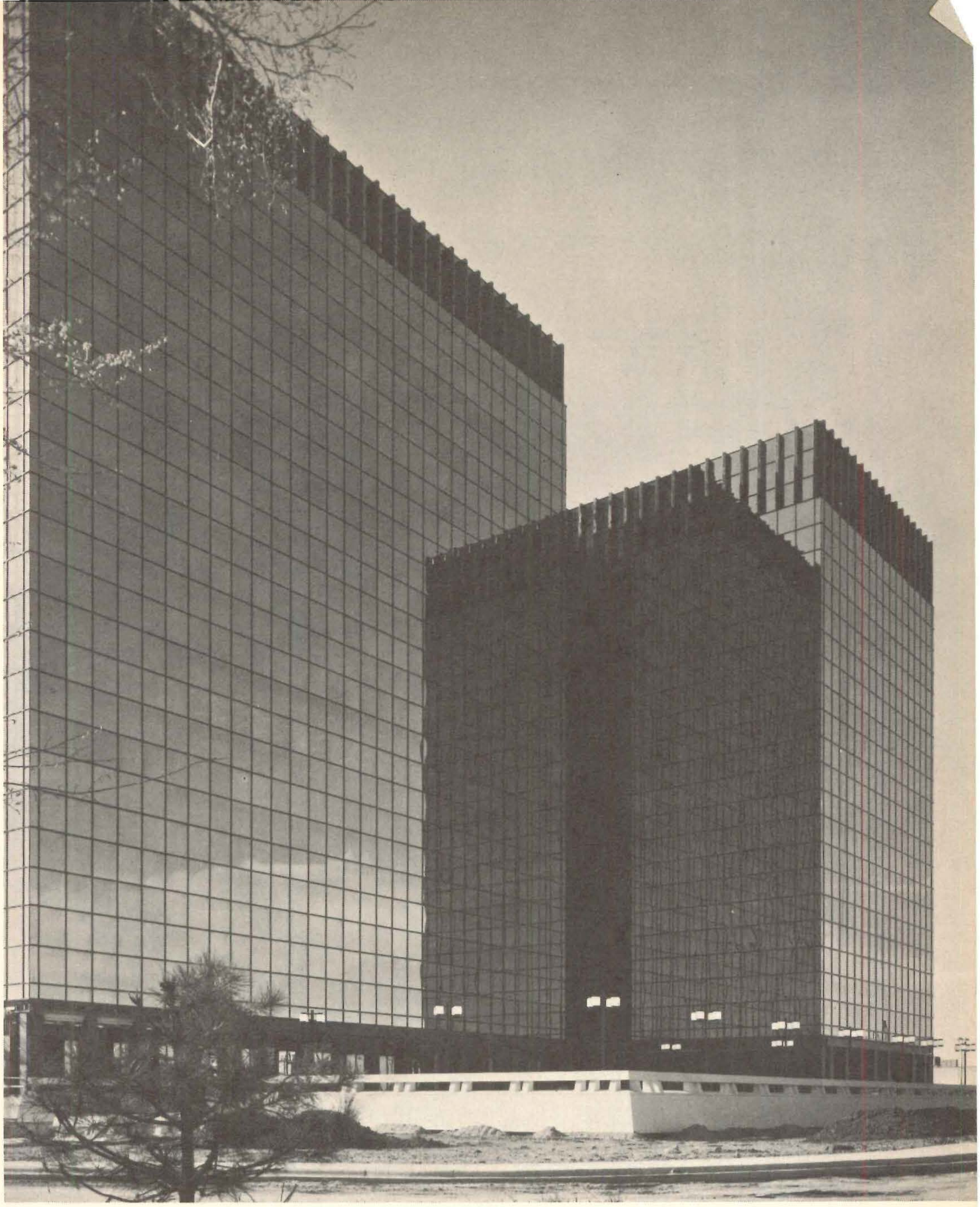
Henningson, Durham & Richardson, architects and engineers, used computers in all three planning stages: a master plan of the entire office campus; the architectural concept of the new headquarters; and space planning for both new and old buildings. In developing architectural schematics they studied four structural systems, three mechanical systems and two lighting systems to determine which would be most economical. Final design of steel members and reinforcing systems was also computerized, as were the final lighting layouts.

Space planning dictated the size and shape of each tower. It began with an assumption that each worker would need a 150-sq-ft office, except general managers (225 sq ft), vice presidents (300 sq ft) and secretaries (who could be spotted along 10-ft-wide corridors). A 5-ft module fit these assumptions neatly, and questionnaires filled out in meetings with each department generated data for computer punch cards. The returns gave such information as numbers and categories of existing and projected personnel, existing and projected square footage requirements, intra-departmental relationships and inter-departmental relationships.

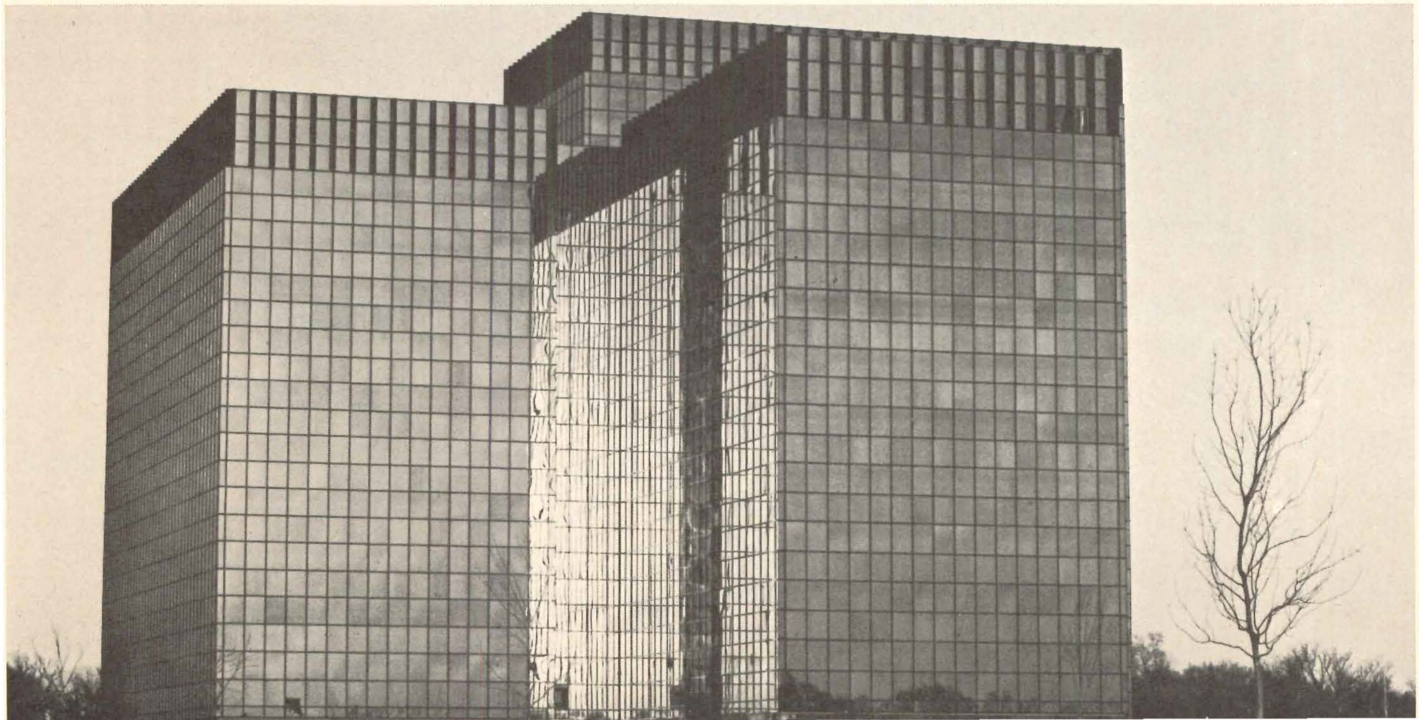
These relationships were given on a numerical scale from one to four, according to various functions and adjacency requirements, and the computer program acted on such information as "department A has 52 modules and has a 3 relationship with department B."

Floor plans arranged by computer established the width of each tower at 80 ft. Later interior design decisions were based on criteria that "worker at level X gets a 60-in. desk, two chairs and a credenza; a worker at level Y gets a 72-in. desk, three chairs, credenza, bookcase and wall unit." Four coordinated color schemes—for carpet, vinyl wall covering, ceramic

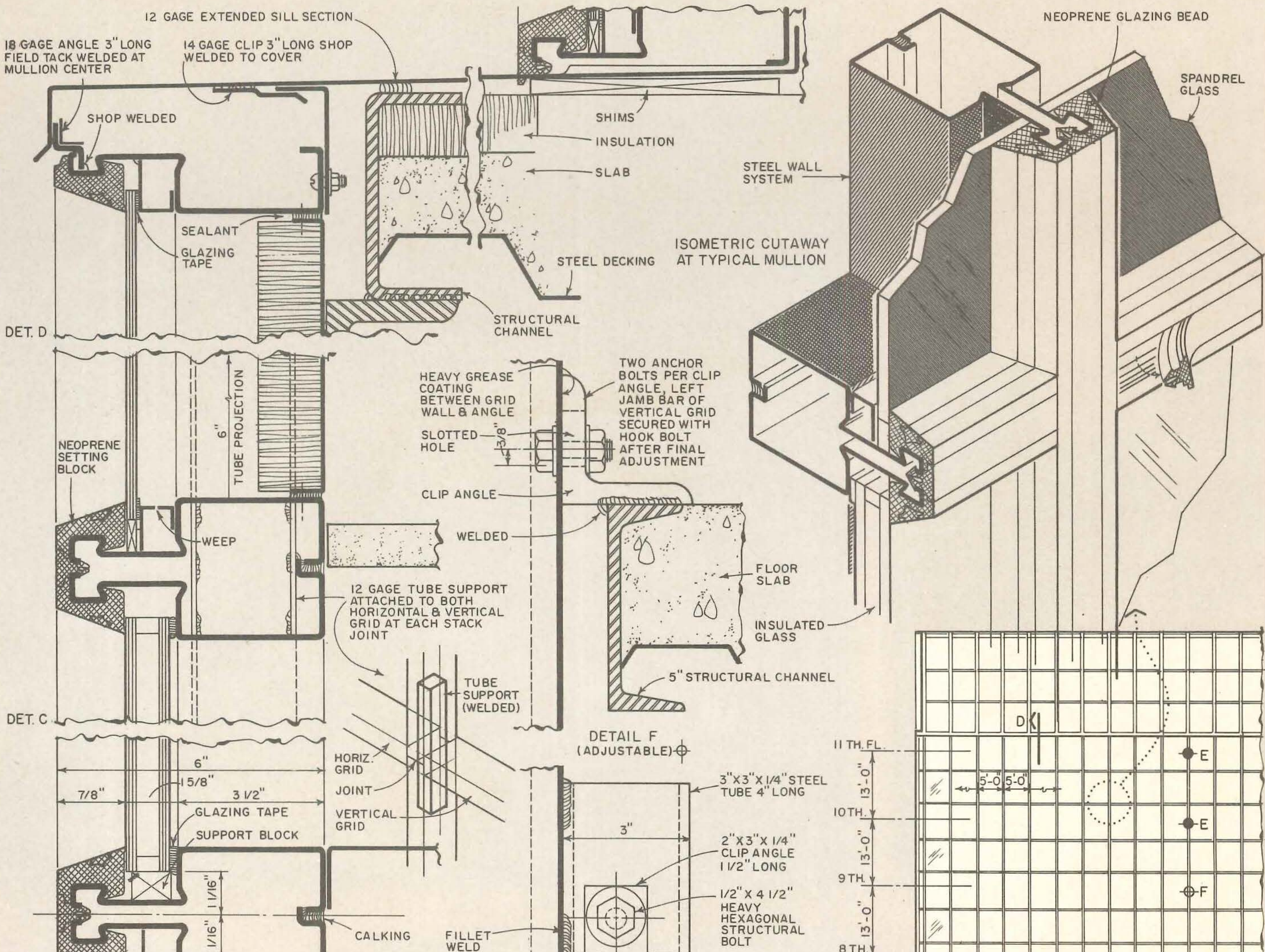




Gold mirror glass curtain wall used for entire façade
reflects the three interconnecting towers back on each other.



Construction details



tile, elevator doors and computer art—were used on alternating floors to provide variety yet retain consistency.

Choosing a curtain wall

Faced with selecting some 200,000 sq ft of curtain wall, HDR analyzed (by computer, of course) heat loss and gain studies of various available systems. Design criteria, among others, were wind load, minimum deflection, weather tightness and a U value that would allow humidification of the entire building without frost forming on the inside of the grid during typical Minnesota winters. A shop-fabricated steel curtain wall from Fenmark, Inc. with LOF gold reflective glass met the criteria. Each section was designed to a 5′ x 26′ grid, trucked from Ohio (in 90 loads) and erected on a 20-hour-a-day schedule; workers on one 10-hour shift did the precise measuring necessary and those on the other shift hoisted the sections into place. The curtain wall was designed to withstand a wind load of 30 psf, with a maximum allowable deflection of $\frac{1}{360}$ of the clear span.

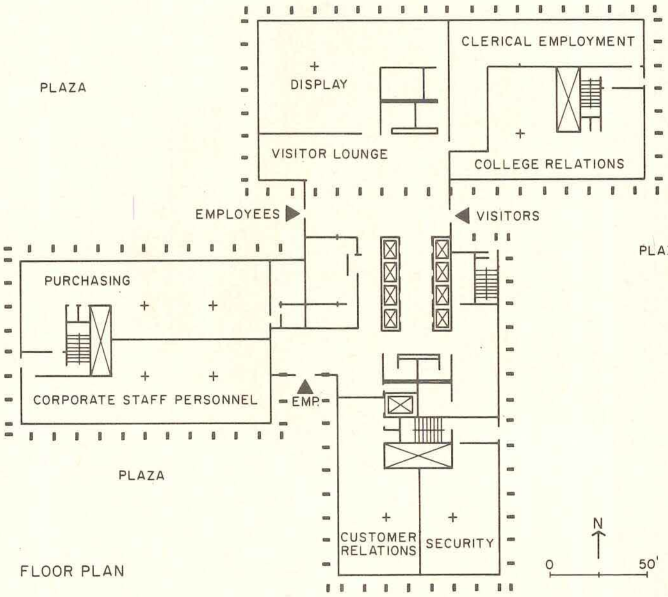
The all-air humidity control system has spray coils at the air handling units and a single duct, high velocity unit with a variable volume reheat box at the end of each duct. Each office has a return air grill and a diffusing center. Perimeter offices are equipped with under-window units and ceiling air supply ducts serve interior offices. All air handling units are located on the top floor of each tower, supplied from a central plant that serves the entire Control Data campus with hot and chilled water. The ceiling module contains a 2′ x 4′ fluorescent fixture within a 5-ft module; the entire building is equipped with sprinklers.

A slipformed core takes most wind loads; the rest of the structure is steel beams, steel deck with lightweight concrete topping in a composite design, and steel columns. Fireproofing was required only for the beams and columns. Slipforming "saved" about two months over conventional construction, allowing construction time to be compressed to some 22 months. A final computer touch: CPM scheduling of the construction process. [RR]

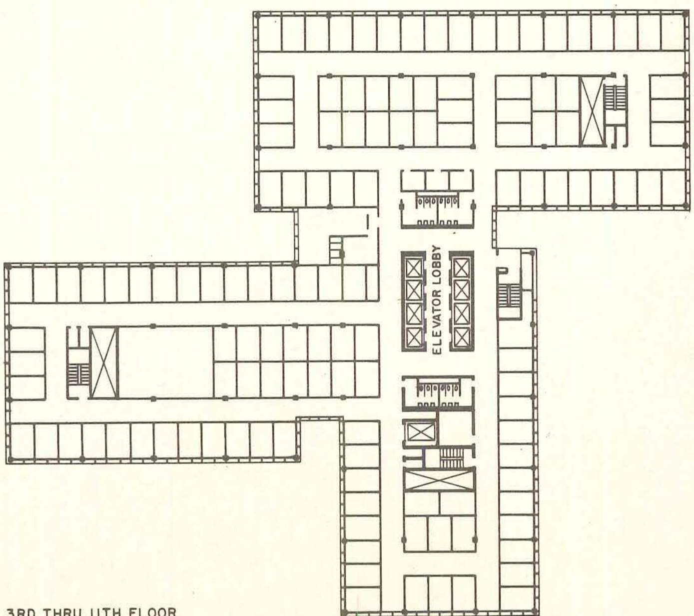
Data

Project: International headquarters, Control Data Corporation, Bloomington, Minn.
Architects and engineers: Henningson, Durham & Richardson.
Site: adjacent to company's existing buildings in an office park.
Program: 580,000-sq-ft office space in a building that would express the corporate images as youthful and dynamic, relate to its surroundings and to human scale.
Structural system: slipformed core, steel beams, composite design floors with steel deck and lightweight concrete topping, steel columns.
Mechanical system: single duct high velocity with variable volume terminal reheat boxes; entire building humidified; central plant supplies hot and chilled water to air handling units on the roof of each tower. Fluorescent fixtures incorporated into ceiling grid designed to 5-ft module; entire building sprinklered.
Major materials: steel and concrete with curtain wall of steel and gold reflecting glass; interiors have four color schemes on alternate floors for carpet, vinyl wall coverings, ceramic tile.
Costs: budgeted at $15 million, bid at $15.4 million, actual costs were $15 million, including fees, site development, parking and all interior partitions.
Consultants: Ted Harris—Minnesota Tree Inc.
Photography: Hedrich-Blessing.

Arcade ties the towers together at lobby level. A 5 ft module and a computer study of needs determined layout of interiors.



FLOOR PLAN



3RD THRU 11TH FLOOR

Commitment to an in-house computer

Can a 54-year-old architectural firm find romance and happiness with an interactive computer system?

Clifford D. Stewart and Kaiman Lee

It took five years to set up and another year to shake down, but Boston architects Perry Dean & Stewart have devised an in-house computer system and interrelated programs that multiply their approaches to design

In the excitement some men forgot to take their coffee break and others were quite disturbed. Several drafting boards and some low partitions had to be moved to make way for a beautifully detailed, but somewhat ominous looking, black box about six feet high and eight feet long which was rolled with tender care down to the newly prepared computer area. Reactions were as predictably varied as those of a group of pedestrians watching a fat lady in a snowbank; some men looked on with half hidden amusement, some studiously avoided looking up at all, and some came to help push. Reactions of these same individuals in the past 12 months of the computer's active use have remained remarkably similar.

Planning and orientation for the computer's arrival had been going on for some three years. We had organized our data files, structured our methods, created a master specification on an MTST typewriter and published handbooks explaining computer operation and our specific programs. We had also been running several graphic programs on a batch process with a service bureau. Why then the uneasiness at this late date?

Our office is not large by national standards, with a staff of about 100 in the architectural and planning disciplines and their support. There were, at last count, about 300 larger offices in the United States. Our equipment leases for $27,000 per year. Programming costs have averaged about $30,000 per year over the last three years. The bulk of the programming work is about over and we think that from now on we can budget a total of about $35,000 per year for the total computer package. While this does not quite qualify as chicken feed, we are confident that the system itself will generate sufficient specialized work to pay its own basic costs without interfering with its day-to-day applications to office projects. This annual cost, not much more than the gross pay of a hard working electrician, could probably be afforded by 300 to 1000 offices in the United States.

The real problem limiting expansion of computer aids to architects is that not every office is willing to make the ancillary commitments, such as the structuring of information collected over the years into a useful data base, development of more systematic work techniques and more, not less, involvement in projects. The factors which have most restrained computer applications to systematic design planning are not, in fact, technical or procedural, but spiritual and pedagogical. For instance, the power of the computer when applied to architectural problems allows and promotes a more personal and professional relationship between the architect and his client.

Our philosophy on this subject is simple. Since technology has created many of the problems that we now face and will face in the near future, we must apply technology to the solution we seek. We must then design the "system" which will describe, monitor and encourage the complete design of the actual projects. In more and more cases the design itself has been an inevitable outcome of the program and the strategies which were developed to perform the design process. The key designer of the future may no longer design in the sense we have come to know, but will design the system methodologies which, in consequence, will produce good designs when applied by others who may not be as talented or experienced in overview and understanding.

Application of computer technology allows us to develop a multifaceted, multilayered approach to design rather than a single design philosophy. These design philosophies can then be used as ingredients in the search for a strategy for design solution, a process which we call "design for design." We are not stuck with a single "best" design process, computer assisted or not; rather, we have a set of possible alternative processes which, depending on the criteria for each individual project and the weighting of those criteria, can be used effectively by the designer. Ultimately, the selection among alternatives rests with the architect and the owner.

What is needed then is a better understanding by the designer/user of his own needs and, from this, a better statement in more understandable terms of his specification of

Authors: Clifford D. Stewart heads the design group and Kaiman Lee the computer operations at Perry Dean & Stewart. Stewart wrote on his first brush with computers in P/A, July 1966 in an article co-authored by Frank de Serio.


computek

those needs. This specification of the interaction between the computer and the designer has absorbed a great deal of our energy and is reflected in the usefulness of the computer programs that have been developed.

We began our computer activities in 1966 on a batch-process, remote-action basis. We filled out input forms, a professional keypunch operator entered the data on punched cards, someone from Design Systems, Inc., a Boston software firm, took the program and the cards off somewhere—we often thought to a small speakeasy on a dark side street—knock the magic code, hand in the data and wait. As often as not some simple problem arose to queer the entire run such as all "n's" being printed as "f's", or a mathematical bug that multiplied every number by "O".

Our experiments with remote terminals, the next stage of involvement, developed imagined and real questions of "is big brother working over there or is it asleep?"; "is this the answer to my program or someone else's?"; "did it hear me?"; "who put the ham sandwich under the electronic coupler?" We decided the best answer was to do everything in our own office within the limits of the dollars available.

Here, as through all of our work, Design Systems played an important role. Created by a consortium of architecturally, mathematically and electronically able young men led by Eric Tucholy, Design Systems' sole business is to create computer programs and provide computer services for architects and others in the construction field.

Now with all this glamorous equipment sitting right in the office, no-wait, full-time use, no meter running to discourage the user from creative play, easy to mount tapes, simple instructions and normal use techniques, we should be beating off the crowds of potential users with a stick, right? Wrong! The same 20 people who showed an interest from the beginning show interest now. This is somewhat fortunate, since we have only one work station. The computer is, one way or another, permeating all large projects in the office.

Too many programs

At first we thought of the computer programs as distinct and tailored entities for each specific task. The starting point was the normal design process: feasibility, programming, preliminary design, design development, working drawings, specifications, supervision and office management. We specified the numerical/verbal, the drawing and the logic tasks for each segment. Our intention was to make each program act like a cube which could be connected to another program from any of its six faces, a building block system with no expansion constraints. With no trouble at all, we arrived at specifications for some 40 different computer programs. The most apparent difficulty was to establish a method to control and encourage the logical interface of all of these programs. In trying to solve this linkage we found instead that we were on the wrong track.

Rather than innumerable specific programs, various program types could be grouped into three basic sets: those dealing with interactive drawings, those dealing with a system of logic, and those in which numbers and words are massaged, edited and displayed. In each of these sets there are three further possibilities: create something new, edit what may already exist, and store or copy for further work. Just as the same pencil can be used to sketch, draft and write specifications, the same computer program can be used in several phases if it is general enough and generic to the tasks.

This simpler understanding of the potentials of the computer programs allows a single program, at the same time that it is applied to several phases of the design process, to react, to reform and to suggest a new structure to that process. We are not really yet certain of the complete ramification of this except that it may be the most valuable result of the entire effort.

One of the naive syndromes that affects all neophyte computerniks is the "name game." The initials or the condensation of a word-descriptive title of a computer program must, according to the rules of the game, mean something by itself. Under this system a program, for instance, to estimate the solid waste collection requirements for a series of dwelling units must be called "The Rationalization of Applied Service Hierarchies," just so the initials could spell TRASH. There were numerous, pompous, facetious, blasphemous or downright indecent names suggested from time to time as our programs developed. About the only remaining vestige of this fearsome, if jolly, waste of time is the name of our overall system. Architectural Kinetics—Man and Machine, or ARK/TWO. The programs themselves are all labeled "Comp" (for computer), "pro" plus a one-word description of the task, such as Comprowork (manpower allocation), Compronet (critical path network), Comproview (perspectives).

One of the basic criteria for the operation of our system was that it must be used by the designers with a minimum of special technological training and in as natural and comfortable a manner as possible. When a decision had to be made between simple programming and simple operator use, we always opted for the latter. Using the computer work station is a simple three-step operation. First the designer logs in by entering through the keyboard the job name, his initials and the date (so we can properly assign time charges to the various projects). This information, along with the drawing number and scale, appears on every drawing thereafter. He then selects the appropriate computer program from the titles displayed on the left screen (screen one) of the work station. Selections are made with a special pencil and electronic tablet. There is an absolute minimum of typing other than direct entering of text.

Currently we have two data storage disks, each having two sides with a capacity of 125,000 data "words" each. We can double this 500,000 words with no difficulty except money. The four sides are assigned as follows: one side for systems programs (languages, editing and basic mathematics), two for operating architectural programs (Comprograph, Comproview, etc.) and one for "scratch" or what we are used to as yellow tracing paper work.

While the selected program is being activated, the designer mounts his data tapes on the face of the machine. Usually tape deck one is reserved for the record tape of his last work on the project. Tape deck two stores standard graphic elements (SGE's) such as furniture, fixtures, window and wall details, graphic formats and the like. Tape deck three can be used as either a scratch tape, a numerical data tape such as a complete hospital area program, or as storage for new design

ARK 2 software

		Special					Manipulate/Manage						Collect/Sort			Draw	
		COMPROGRAM	COMPROSIGN	COMPROPARK	COMPRORATE	COMPROSTAIR	COMPROSPEC	COMPROCOST	COMPROAREA	COMPRONET	COMPROMAN	COMPROWORK	COMPROPLAN	COMPRORELATE	COMPROGRAPH	COMPROVIEW	COMPROSPACE
Predesign	Check similar projects	•		•			•	•	•						•		•
Predesign	Estimate schedules									•		•					
Predesign	Estimate manpower needs										•	•					
Programming	Review similar room types	•							•						•		•
Programming	Model area program	•							•						•		
Programming	Work out relationships													•			
Programming	Establish parameters	•			•		•			•	•					•	•
Schem. des	Develop plan layouts											•	•	•	•		•
Schem. des	3-dimensional studies					•										•	
Schem. des	Establish cost goals			•			•	•	•								
des development	Start outline spec						•				•				•		•
des development	Review room details								•			•	•	•	•		•
des development	Mech studies				•											•	
des development	3-dimensional studies															•	
des development	Revise cost goals			•			•	•	•								
des development	Redo outline specs						•				•						
Working drgs.	Plans sections elev.		•									•	•	•	•		•
Working drgs.	Mech. studies				•											•	
Working drgs.	Construction network						•			•							
Working drgs.	Estimate						•	•	•		•						
Specs	Edit master spec						•	•				•			•		
Specs	Print specifications						•			•	•						•
Bid	Cost review						•	•	•		•	•					•
Construct	Construction monitor									•		•					
Construct	Cost monitor							•	•								
Construct	Shop drawing monitor				•												

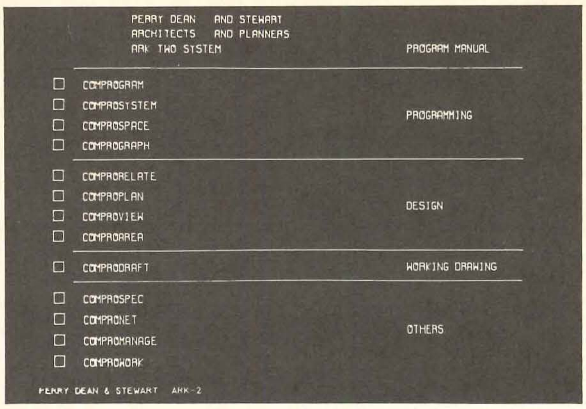
mputer hardware system

5/20 computer system
A 2–4K core memory
A 2–4K core memory (total 16K)
extended arithmetic element
DEC tape control
DEC tape transport
paper tape reader and punch
A positive to negative bus converter
DEC disk control
disk
card reader
teletype

display system
00/15 cathode ray tubes including:
vector generator
character generator
keyboard input module
tablet input module

vite printer
) electrostatic printer including:
transport unit
electronic unit

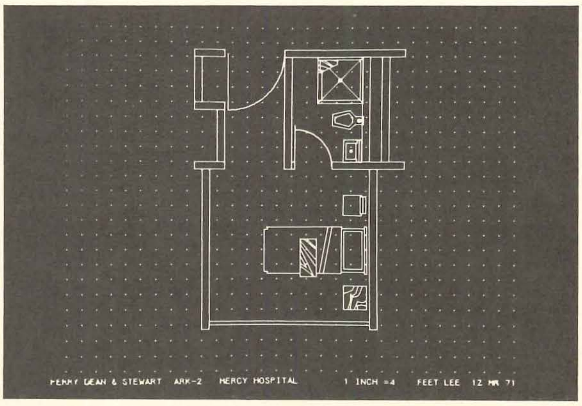
gitizer
) data control and display console
9 X–Y recorder and table
927 easy reach panels
key punch
key punch



Screen displays programs for selection.

Master operational menu is known as MOM

from which designer can elect to draw,



using lines, arcs or standard graphic elements.

developments which the designer may want to keep separate from the previous set.

Comprospace, the basic graphic program, illustrates the interactive aspects of the graphic system. The first selection list which appears on screen one is the Master Operational Menu. Affectionately called MOM, it is the listing through which we select all the subsets of drawings, calculating, zooming and so forth. Each subset is represented by a new list, and some have further subsets each with a more detailed menu. Every subset has an escape back to MOM if we get into trouble (very comforting to know "she" is always there). The first task is either to call for a drawing which we want to work over from our previous tape, or to select the box labeled "Create a new drawing." Finding a drawing on tape and displaying it on the screen takes about 15 seconds.

Once the drawing is on the screen, the designer can do a number of things with it. He can overlay it with a variety of grids, move any part of the drawing, add new lines, add a standard graphic element, add notes and dimensions.

The drawings can be on tape under the original title or, if we wish to keep both an original and an edited drawing, we can change the name of the new drawing. If not, the new drawing will automatically replace the drawing of similar name in the tape to keep it up to date. At the same time, we can request hard copy of the drawing to be produced by the Gould printer. This electrostatic dot printer produces drawings or text made up of tiny dots that touch and create lines, characters or tones, at the rate of one 8½" x 11" page in less than two seconds. For larger drawings we create a punched paper tape that is used to run an XY plotter off-line, usually an overnight time delay.

There are two very powerful and flexible subprograms to MOM that are worth looking at in some detail because they represent the power and capacity of computers to do valuable tasks. Up until now, in the Comprospace program, the computer has been acting like a very accurate and high speed assortment of pencils, erasers and rubber stamps.

The "Zoom" subprogram allows us to enlarge or reduce the drawing, left, right, up or down at the same or any scale. While the face of the cathode ray screen that we are actually looking at measures 8" x 10", "Zoom" encourages us to think of our projects at immense, overall scale, even full size. By zooming out like a rising helicopter, we can see and draw the entire project in simplified terms. By zooming back into the drawing we can work on it at middle scale, section by section, and by zooming into the drawing further we can design even the smallest pieces at reasonable size. All the data entered on one scale is available at any other scale, calculated and displayed with speed and accuracy at any other scale. A 3-in. bolt entered at full size is still there holding two pieces of metal together when the drawing is displayed at the scale of $\frac{1}{32}$ in. equals 1 ft and can be zoomed up to, say, ¾ in. scale, examined, changed or repeated at any time with ease. We are not sure what effect this capability may eventually have on the overall design process, but we can already see how it changes a designer's attitudes about the potentials of design involvement in very large and complex buildings.

The Calculate subprogram began as a part of Comprospace to do the dimensioning and multiplication of areas.

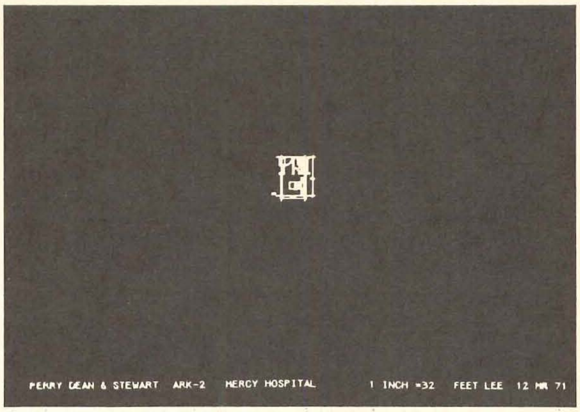
It does that very well. With the pen and tablet we identify the end points of a line, and its dimension down to the nearest $\frac{1}{16}$ in. is immediately identified, taking into account the scale at which the drawing is displayed. Identifying all the corners of a space or object produces a similar instantaneous calculation of the area, even of complex nonrectilineal configurations with 20 or more corners and with enclosed areas which must be deducted. By making the linear dimensioning cumulative, we can trace the path length for circulation routes, and by adding vertical dimension from the keyboard, we can trace the path length for circulation routes. By adding vertical dimension to areas, we get cube calculations. By adding vertical dimension to line, we can get the areas of vertical planes either singly or cumulatively. All this may seem of less than surpassing value until we consider the number of problems that the building industry, of which architects are one part, faces today in cost estimating, program area requirements, ordering of materials, etc., which such dynamic methods of calculation can assist and rationalize.

The Comprospace program then is a single versatile interactive graphic program which, among other things, allows us to draw any subject at any variety of scales; use standard graphic elements singly or in groups; manipulate and repeat parts of the drawing independently; calculate areas and dimensions; make progress prints; create final drawings. And then there are tasks to which it is also being put, each one of which could have been conceived of as a separate program: lay out sign graphics with automatic spacing and proportion; lay out stairs that meet code and convenience and draw them in full detail; lay out auditoria seating with good sight lines and every seat drawn; compare actual areas with program areas to pinpoint discrepancies; compare travel distance with desirable norms; mapping with "zipatone" patterns for demographic studies. This list is by no means complete nor do we have any idea yet of how many different applications exist for the program. We do know that we will continue to find new applications for old problems and at the same time seek to define new problems to which this program can be applied for the improvement of our art and our service.

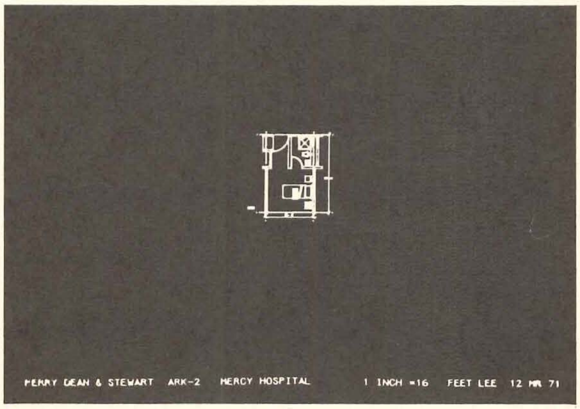
Getting a perspective

The other program which we can classify as graphic is the Comproview program for perspective drawing. Three-dimensional data about a building, a space or an object are digitized and entered into the computer storage. Once this data is accurately entered, it can be used over and over to create new views from any vantage point. By entering the name of the object and answering specifically requested data about distance and angle of view, we create a new and accurate one, two or three point perspective. These are outline perspectives only and do not have tone or texture, which can be added later by the designer. Our equipment is rather small to attempt to solve the hidden line problem, so we avoid the problem by digitizing the building's four sides and top separately and combining in the perspective only those parts which are seen from the desired vantage point. Therefore, three faces at most are usually shown at a time.

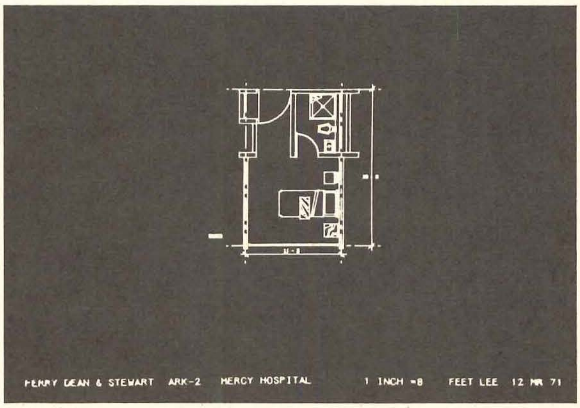
We can enter into the perspective such standard graphic elements as cars, trees or people. We can create specific re-



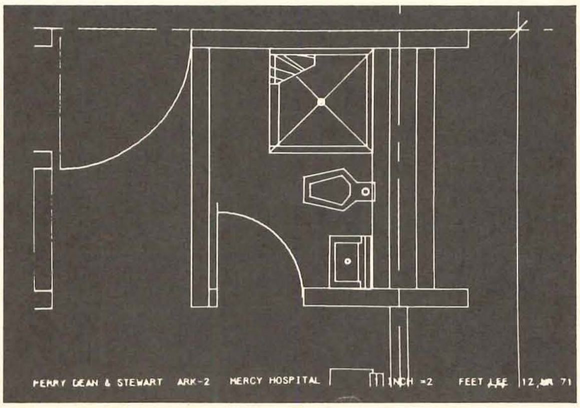
Zoom subprogram allows designer



to reduce, enlarge



or work on drawing



at any scale.

petitive elements such as window details and wall panels which can be repeated as often as required.

In addition, we can pre-specify multiple station points which traverse a given route and display the building from specific angles. This series of instructions creates an automatic sequence of views, as close as 1 in. in distance and 1° of angulation, which allows us to drive by, walk up to and through, or fly over an object. While the basic intention of this program is to let us examine the building from any view and select the most telling one for further elaboration in hard copy, we have found that by photographing the screen with motion picture equipment we can simulate excellent motion effects of buildings and sites of great complexity.

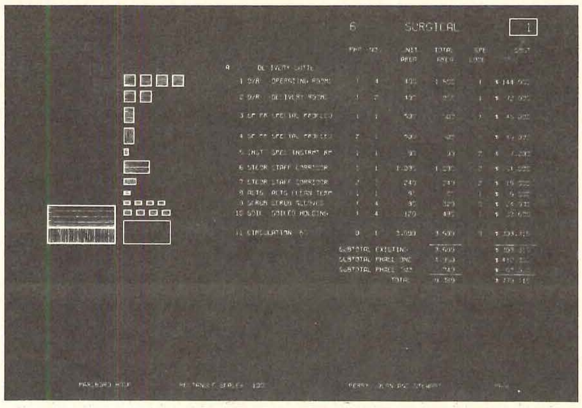
Of the various programs that allow for the massaging of data, some are merely arithmetic, such as cost estimating, economic feasibility, stress analysis and special analysis of elevators. Some deal with words, like specifications, job reporting and key-word search. One, "Comprograph," deals with both arithmetic and words while at the same time providing the major data base for several other more logic-oriented programs.

More than any other single effort, the Area Program for a building tends to predicate the design of the building. A well defined program is based on careful area study, appropriate adjacencies, an understanding of the environmental, functional and material quality of the spaces and a reasonably detailed estimate of the cost characteristics of each space. This establishes the constraints, the potential and the criteria for an effective design. While it will not guarantee a lively, ingenious and delightful result (for these are still human factors) it will prevent a building which does not function well, costs too much and cannot meet the demands of the future.

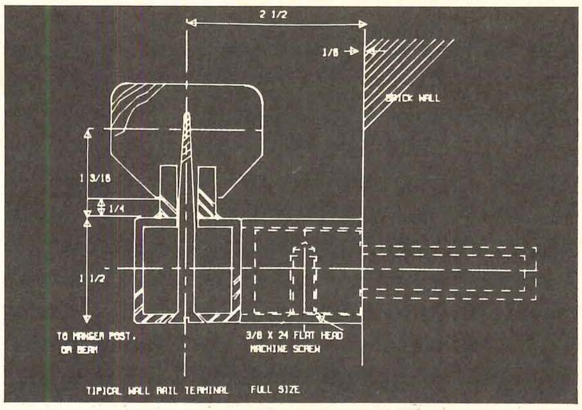
We have continually enlarged the amount of data stored in Comprograph for each room as our experience indicated the need. We now include the following data about each programmed space: the name of the general functional zone (surgery, administration, etc.), the name of the subgroup (staff area, social services, etc.), the name of the space itself (radioisotope storage, conference room, etc.), the quantity of such similar rooms in the group, the desirable dimensions, the required ceiling height and the desired relationship to the outside wall (parallel or perpendicular). Professional cost estimators give us the probable cost per sq ft in today's prices and we also list pertinent qualities about the space such as high utility service requirements, special control utility and flexibility requirements and the major required characteristics such as quiet or social, or connection to outdoor area, or to daylight and such. Further, we can assign the space to any one of three different development phases. We can edit any data of any item of any Comprograph interactively at any time.

The output is presented in alpha-numeric tabular form, each subset complete with its circulation factor multiplied through and added, both divided into various phases and in total. It is also displayed graphically with every space drawn to a specified scale and toned to indicate the phasing. A "total" block is drawn to scale to illustrate the sum of each subprogram and also divided by tone into the various phases.

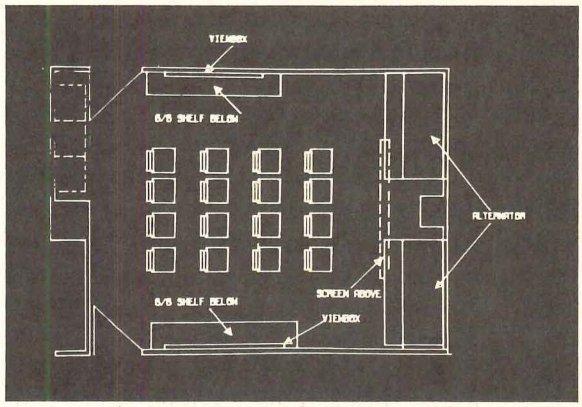
These clusters of spaces in the Comprograph data bank become the basic data for the Comprorelate and Comproplan



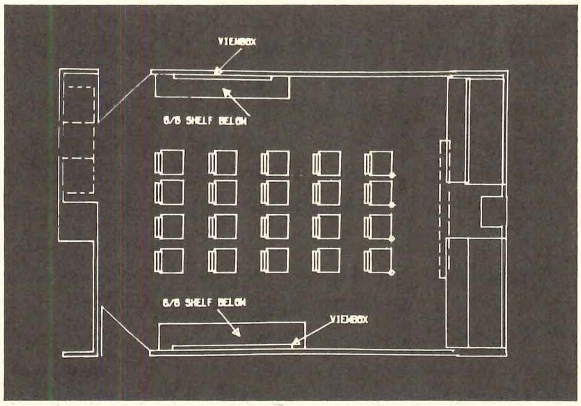
Comprograph program used for space planning.



Standard detail can be used at any scale.



Command to manipulate a subprogram



moves walls, adds seats to classroom.

programs. Comprorelate is a relationship program which produces bubble diagrams based on data entered into a matrix which is automatically displayed, one pair of items at a time, from the Comprograph list. In this way, the designer considers the relationship between only two rooms at each time, not all 500 or more possible relationships at once. The various relationships, represented by numbers from 1 to 10, can be based on several criteria. It is very interesting to run a Comprorelate program for a space list with relationship indices based on adjacency, and the same list then based on visual connection indices and then on distance or frequency of interaction or hierarchy of privacy and so on. The similarities and differences between the several bubble diagrams produced for various matrix criteria can be very telling in the reinforcement or destruction of the designer's bias based only on preconception or previous experience. The architect and owner have the opportunity to edit each matrix input, to remove careless errors and preconceptions which may have produced ridiculous diagrams. New diagrams are produced in seconds to reflect these changes. By setting certain key items in a specific geographic screen position and then allowing the computer to set the remaining items, a sense of direction or of geographic planning layout can be achieved which is useful in using the next program in the series, Comproplan.

Of course, the designer and the owner should be completely unbiased in the matrix information they enter. Interestingly enough, those designers who have tried to create preconceived relationship diagrams by careful juggling of the matrix data very often have been foiled by the program, which is alert to second level interactions the designer has missed.

Having arrived at a careful inventory of the ingredients of the program through Comprograph and a reasonable understanding of the relationship between those ingredients through Comprorelate, the designer can ask the computer to replace the bubbles in the Comprorelate diagram by the areas and dimensions stored in the Comprograph data base. This program is called Comproplan. The designer can then begin to manipulate the individual spaces to abut, to form corridors, to articulate interior spaces or to fit various attempts at structural or systems modules. While we are not creating the final plan at this time, a carefully manipulated Comproplan is reproduced on hard copy for further work at the designer's desk; built into it are the appropriate room or space dimensions arranged in a function manner and resulting in a known and acceptable gross square footage. Many of the basic requirements for a successful design result have been assured, the process has taken remarkably little time, often less than one-third of the time required to achieve the same results by hand, and the designer has been able to work with several alternatives out of the perhaps 2000 alternatives that the computer has reviewed internally. While our thesis is as yet unproven, due to limited experience, our hopes are still alive and well that intelligent people, competently abetted by the computer, can accomplish vast amounts of important work, accurately and reasonably, in a relatively short period of time.

Working with numbers and words

Not as glamorous, but equally hardworking, are the number and text manipulation programs. Number manipulation leads in two directions: office management and numerical nodeling of program alternatives.

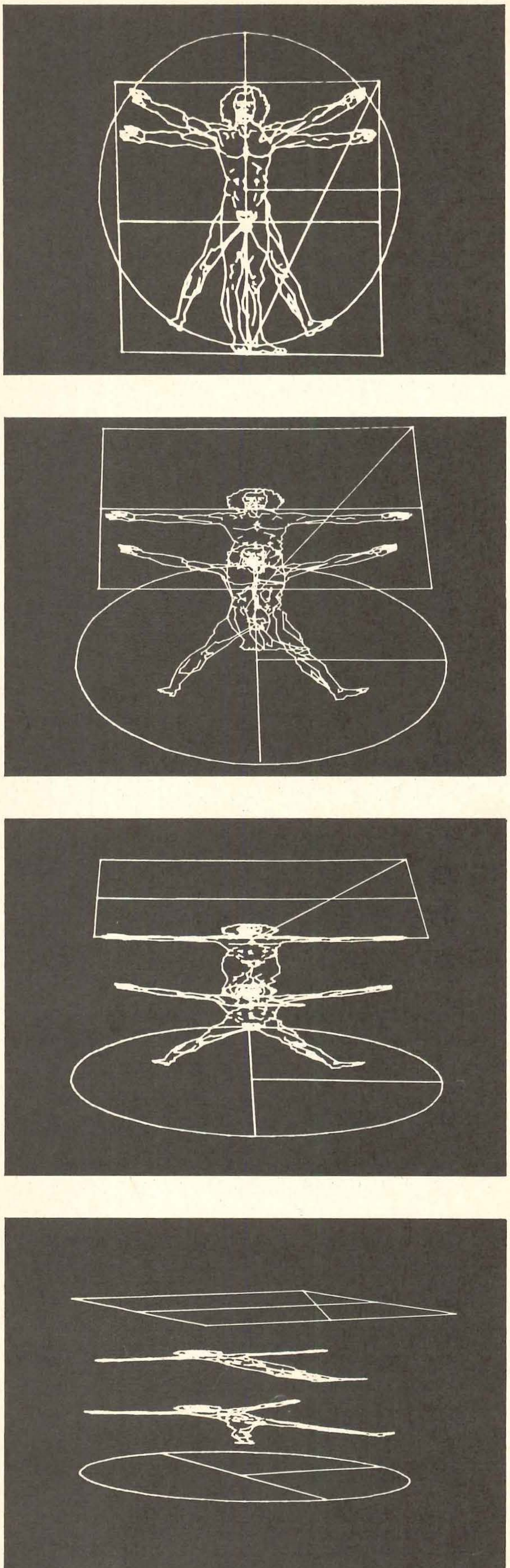
Office management reports show progress weekly or monthly of every project within office; the people who were assigned, their hours, the progress against goals and the team size required to complete. Manpower needs are developed by project and by task in a time scaled chart to illustrate, across the office, the number of individuals by type, draftsman, designer, apprentice, and so forth needed for all the jobs which we can foresee to be active, say next Sept. 11. Of growing value are the special design strategy matrices that help us plot the most useful way of helping the individual client with a special program on a unique site or with special time requirements by modifying our normal precedence schedules.

Text manipulation deals largely with specification and report writing. The computer also allows us to improve the product by inserting flags and notes about recent experience. We can edit the master copy at any point and to any amount of detail. Our system produces hard copy in upper and lower case for direct reproduction at the rate of one page every two seconds.

In addition to repetitive and multifaceted tasks like these, some of our programs are developed for single purposes. As far as possible they draw on the basic graphic, mathematics and text programs for support. We can calculate, for instance, the most appropriate alternative stair layouts within a specific enclosure that meet the floor-to-floor dimensions and all applicable codes. We can select one and have it drawn at any scale with all the appropriate detail for working drawings. In the same way, elevators, sight lines and graphic signing are developed, both numerically and graphically. The program for signage, for instance, has been used to prepare full size mockings for testing on the site; it automatically adjusts the spacing between letters for black letters on a white background, white letters on a black background or illuminated signs.

Not the least use of the computer for specialized programs is a set of calculation models that we call our "What if" programs. For economic feasibility of structures from medical office buildings to parking garages, and for program development from college campuses to medical ambulatory care centers, standard models can be adjusted to reflect unique user, site or budget characteristics. They can illustrate in seconds the dynamic effect of decisions about area, square foot cost, interest rate, tax payments, quality, utilization rates and so forth. The results are displayed in terms of dollars, area program or specification, depending on the question asked.

Whatever systematic approach to design you choose, especially if it is computer-aided, let it be easy to use, requiring little or no training or retracing of reflexes or actions. It must be pencil oriented. Beware of manipulations based on intellectual dimensioning (move R 2 U 5 Equal X·3). Beware of delays in response time of more than 20 seconds for even if 200 tasks out of 201 are accomplished more quickly and with more accuracy than by hand, the single slow one will forever discredit your programs and your systems. Beware of inflexible programs, for designers will throw up their hands if they cannot demand plaid column grids, 5° arcs with 300-ft



Comproview program for perspective drawing...

radii, or 15 weighted variables in a relationship matrix, even though they may, in fact, never use them.

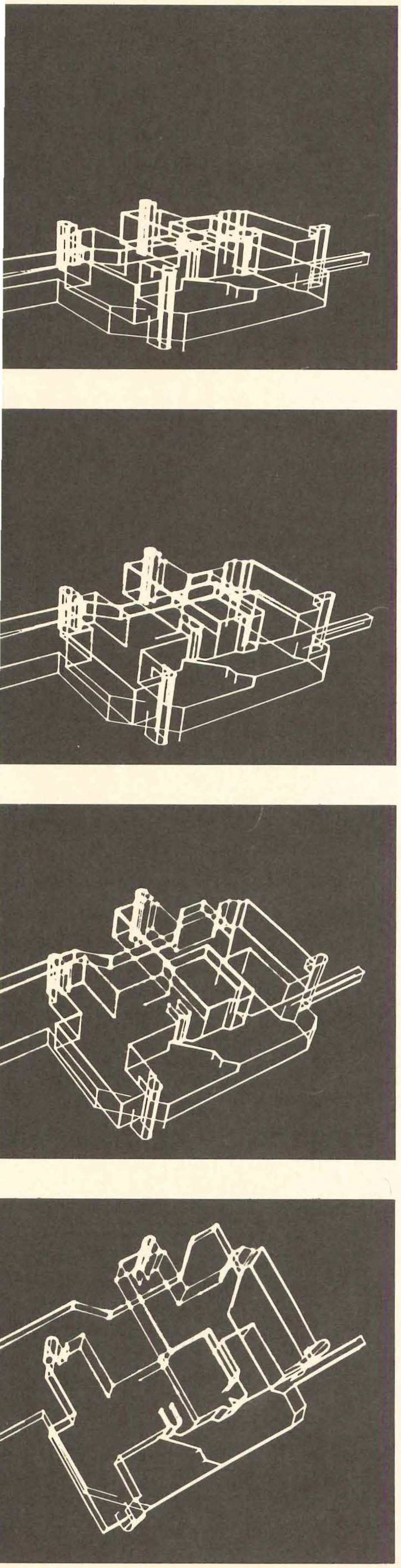
Since it took five years to get where we are, we must presume it will take five more years to reach the next stage and are planning for it now. We feel that at least half the value of the ARK/TWO system is in preparing our staff and our data to take advantage of stage two of our development.

On the broadest 10-year view, we can look forward to the expansion of the 8-in. screen size to a "plasma" screen less than 1-in. thick and covering an entire wall. We can foresee dynamic screens, perhaps like the NASA simulator screens, in tonal color which accurately create the effects of the finished structure. Laser holography may provide realistic three-dimensional simulation. Data bases, inhouse, will increase by a factor of 10 and remote data bases will be enormous and easily tapped. All of this will be done with surprisingly modest investment.

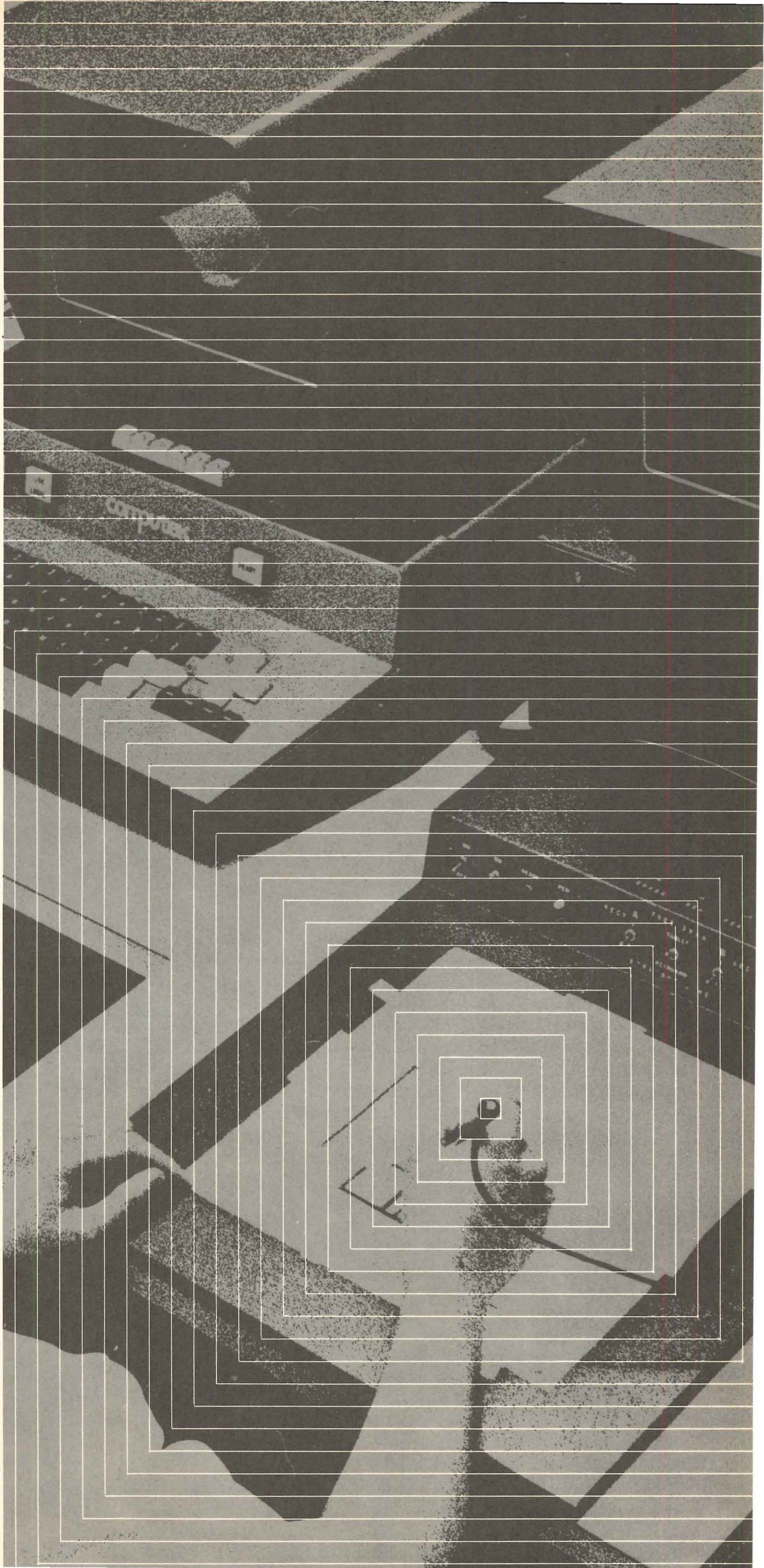
On the more short-range scale, we will this year add to our system a 30" x 40" plotter, next year expand the number of work stations to five. Our data storage can easily be expanded from the present half million "words" to a more reasonable one or two million. We shall continue to look with hope into the telephone connections (Ma Bell willing and hopefully able) which can provide swift and accurate access to larger data bases remotely located. All of this will cost us about $20,000 more in annual lease costs, which we feel will be a reasonable tariff to pay for a system that has already proved to be workable and some five or six times as useful as the one we now have.

We have been sorely disappointed with response from other professionals. University and graduate students have been somewhat eager to swap a single specialized FORTRAN adaptation of a generally accepted program for our entire repertoire. Other offices have shown an interest in using our system on their projects as a "free test" of the theories. But precious little serious interest has been evidenced by serious professionals seriously dedicated to serious application to real world problems. Our hope is that such cooperation can and will take place. We should at least be able to cooperate in the mutual development of a data base. We should at least be able to swap nonspecific data oriented programs. We should at least try to behave in an adult manner towards each other.

It is about time that our profession begins to look clearly into the mounting problems we will be forced to face in the next relatively few short years. It will take an understanding of complex problems as discrete, but coordinated, segments. It will take a commitment to understanding the meaning of and the criteria for social engineering, for biomedical engineering, for cybernation, and basically for a scale of excellence which we have not yet achieved in modern times. It is not really that such a goal is desirable; it is imperative. The choice has been taken away from us. The ability to array and interact with not only the thousands of conflicting criteria which face us in our current practice, but also with the added criteria and parameters which we will face by absorbing new social and scientific responsibilities, will be far beyond the capability of the architect. We feel that the computer will be our most versatile tool in the years to come. □



designer to look at project from all angles.



So you want to computerize?

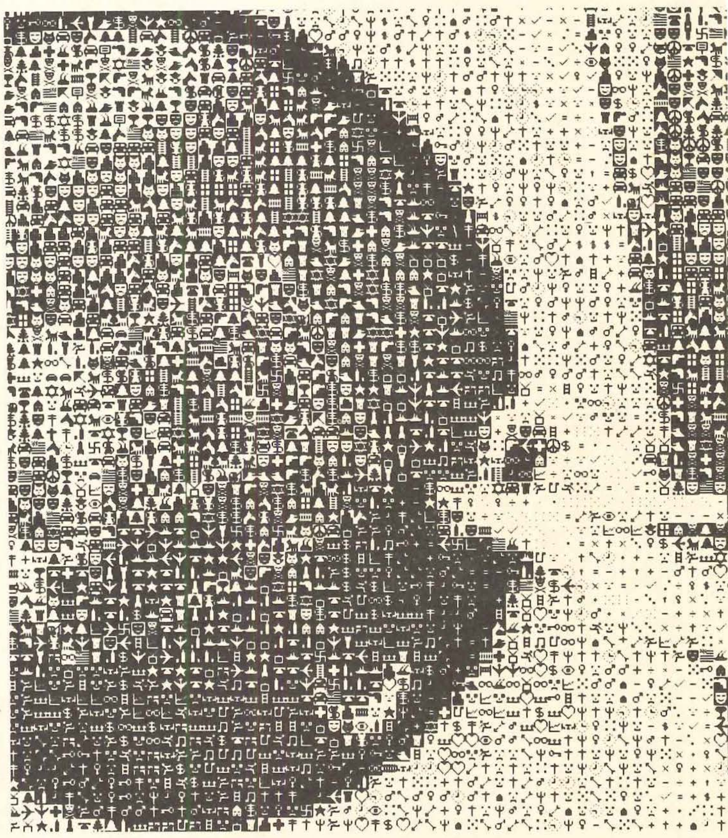
Tell you what I'm gonna do. I'm gonna show you how you can control your costs, digitize your drafting, manage your manpower and allocate your areas, all with just the push of a button. Yessir, in a twinkling of an eye, a mere fraction of a particle of a second, Amalgamated Esoteric Electronic Data Service can free your firm from hours of tedious repetitive work so that your architects can spend more of their time creating architecture and less of it on busy work. That's what I'm gonna do, friend. And you won't need any special personnel, no mathematical wizards, no highly trained programmers to make it work, and no complex equipment. No sir. All the programs you'll need to put your firm on stream today, right now, are on the shelf waiting for you. Now here's our deal. We'll provide our own tested programs, running in our own precision computer at our Esoteric Electronic Data Center, for the low monthly fee of. . . .

Computer service salesmen really don't talk like that, of course, but they all do say pretty much the same thing, which is basically that they can do anything. The big thing to remember, however, is that some of them don't really understand architecture, and others do. The ones that do, offer the firm that's not ready for its own computer a way to join the automation generation.

You might compare automating your firm to buying a suit. You can go for a custom tailored computer set up, just as you can buy a custom tailored suit; or you can get one ready made off the rack.

Let's say you want to put your specification writing on an automated basis. You could, if you wanted, buy or lease a computer and then write or buy a spec writing program. After writing up a master specification and storing it in the computer, you could retrieve the spec, in whole or in part, and edit it to fit specific jobs. Then the computer would take the edited copy and print out a final copy.

There is a danger, however, in going this route if your firm is really not ready for it. What can happen with people who don't really understand computers is that they get the feeling the machines are the answer to everything. So they run out and get themselves some hardware, which means a large overhead right from the start. Their next problem is what to do with all this hardware, so they run out and buy some software. Software isn't cheap: a firm can spend anywhere from $15,000 to $150,000 a year on software. So there's another

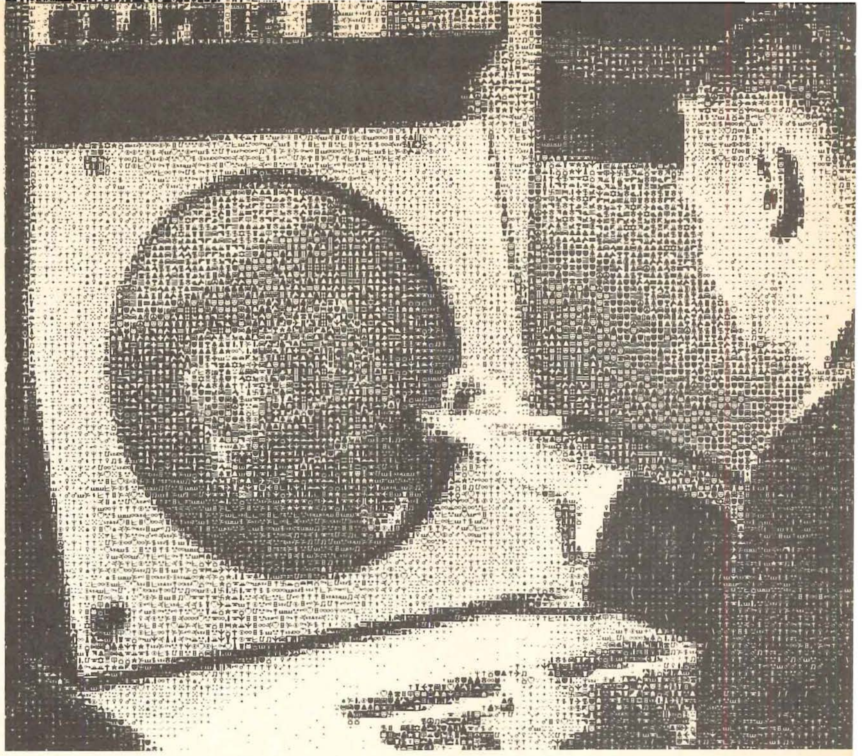


Photos courtesy of Leon Harmon/Kenneth Knowlton, Bell Laboratories.

big chunk of cash, and if there is not a constant regular demand for the computer's services, it's a big waste of money.

That's why firms, even some large firms, share time rather than owning their own computers. Time sharing gives the same results as owning your own computer, but the computer belongs to someone else. You have a terminal in your office, use the computer when you need it and pay for what you use. But you're still getting custom tailored specs.

And, of course, the salesmen for the service bureaus are right: they can do anything—if there's a program for it. The service bureaus have a wide assortment of programs to choose from, including ones for writing specifications, estimating costs, analyzing structures and mechanical systems, keeping books and managing a project or a firm. And even if



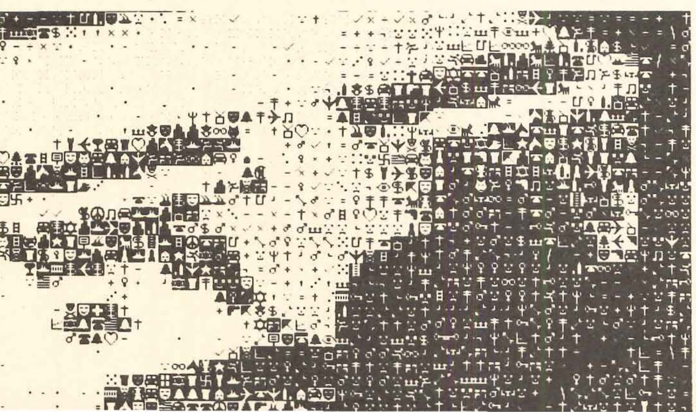
A conventional photo scanned by a computer and broken up into 14 different shades of white, gray and black by Leon Harmon and Kenneth Knowlton. They then assigned each shade its own tiny symbol (telephone, car, airplane). Up close the symbols are seen clearly, yet from a distance the photo resembles a regular halftone.

the service bureaus don't have what you need, the program might still exist; if it relates to architecture, the chances are that it is listed in *Computer Architecture Programs,* a three-volume set of looseleaf notebooks put out by Boston's Center for Environmental Research. Just about every computer program (over 120) having anything to do with architecture (there are so many engineering programs that they decided not to list them) is documented, illustrated and categorized. The programs are grouped by function: Building Type Modeling, Information System Analysis, Building Spaces and Area Analysis, Space Allocation and so on. The set costs $28, and should probably be worth every penny of that to any firm owning a computer or sharing time on one.

Computer time itself is available from a variety of sources. There are the service bureaus, who rent their technicians' skills along with time on their computers; there are university computer centers that have time available, and there are cooperatives—groups of professionals who share programs and sometimes equipment. Fees can vary greatly, according to services, equipment and even the time of day.

For the firm that is too small to take advantage of time sharing, there are companies that offer "computerized" or "automated" services. Dealing with them is a lot like buying a ready-made suit. It is their computer, and it is also their program and their master specification (to stay with specs for one more example). They just alter it to fit you. And, as in buying a suit, if the material is good, the cut is good and the alterations are done properly, the end result is good.

It works like this. You have a table of contents, a key to what's in the master spec. When you want a specification written for a given project, you look through the key list and select the sections you want. From that list, the computer assembles a draft copy, which you edit and return. They run it through the computer and the computer prints out the final copy, which is sent back to you.



Other programs for sale

Accounting and estimating systems are available from several sources. Computerized cost analysis and estimating systems store vast amounts of material and labor costs to provide the costs for erecting a given building in any local area. One accounting system includes a small terminal through which entries are made on magnetic tape during the day; at night the terminal sends the data to the computer, which processes it and prints out statements, balances and reports according to a preset format.

Other systems provide everything from product data to guidelines for running a complete project. For these systems the data bank stores product data, indexed and cross-indexed by manufacturer, performance and other criteria. The computer is used to store and retrieve this data, which can be presented on the screen of a microfilm reader or as a hard copy from a printer/reader. One system, with a data base of 5000 products (40,000 manufacturers), covers all phases of a project, providing forms and checklists for programming, design, project management and spec writing; part of the output is a list of all appropriate products for any of 115 building types. Systems like these are available for monthly or yearly leases at around $100 a month; special programs, when available, cost extra.

Obviously, with systems of this type, there is no such thing as an individual solution for an individual problem. There are, however, some workable solutions for the majority of problems faced by the majority of practices, just as ready-made suits come in sizes to fit most men. The computerized systems can simplify some of the tasks of practicing architecture, and in today's information explosion, the architect needs all the help he can get. [CP]

Computers: new decision making tools for managing the professional office

Maurice Barron PE

Can a computer replace a vice president? One consulting engineering firm applied its use to internal office management and found a data bank for executive decisions

Every new commission raises the same questions. Will this job be financially profitable? Which of my men can best execute it? How many manhours will really be needed to produce the drawings? Is it too far out of town for us? Will payments be prompt? What happens to these and a host of other factors if the owner's basic requirements change; will it still be a profitable job or will we lose money on it?

Accurately making these determinations is supposedly what senior partners are best at, but even the most experienced executive's judgment is based on educated guess and intuition. The computer can replace this; it can pinpoint exactly where to anticipate trouble, and what kind, on any commission. After having used computer analysis in our engineering practice, we extended the use of the computer to processing all time, payroll and billing records. On the basis of this simple, fantastic memory bank of manhours, costs and clients, we were able to go one step further and develop "Single and Double Random Retrieval Systems" for executive decision-making. The systems are not difficult to understand and could be duplicated by any design office.

Nearly three years ago our firm became the first structural engineering organization to join a time-sharing group of 26 engineers utilizing an IBM 1800 computer. The computer originally was for the sole use of the group and was programmed, maintained and operated by an independent service bureau, Omnidata Services, Inc.

The engineering programs employed by Omnidata fall into one of two categories. If a specific program is requested by a member engineering firm and developed by the service bureau under the member's annual fee, it goes into the program pool which is used by all members and time-sharing clients. If a member firm develops its own program or commissions Omnidata to custom design it for their exclusive use, it becomes a proprietary program that may be used only by that firm. After we developed our first 30 to 40 engineering design programs, we began to see the untapped potential of the computer as a potent office management tool. The problem was that there were simply no programs available for the kind of cost control and decision-making uses we had in mind. In addition, the existing computer forms were all too complicated and confusing for managers of professional offices to use or interpret or both.

As a first step, we devised simple employee and job data input forms that could be understood by anyone from a junior bookkeeper or draftsman to a senior partner. A typical job data input form contains the appropriate information under the following headings: name of project and job number (computer code description); client name; fee data—lump sum or payroll multiplier; estimated design costs—hours, dollars, drawings; and other items such as job location, extras, billings and payments (cards 1, 2 and 3). These designations may be reduced, expanded or modified by any design office for its individual needs. Many of these items are given code numbers and for the job data form, all information is oriented to the job as the central reference point.

To establish simple employee data and weekly time card forms, each new employee's number and name are entered on the data form with his regular and overtime payroll rate (Employee Time Report). Entered after each employee's number on the weekly time card are the project(s) on which he has worked for that week, the number of hours spent on each project (regular and overtime) and the type of work (Additions and Revisions to Employee File). Overhead time such as holidays, sick time, vacation, etc. are given code numbers and also listed (Additions and Revisions to Employee File.)

When all payroll and job cost records are fed into the computer, a host of specially designed programs allows us to print out whatever questions we want answered. (The computer actually prints our bills to clients and keeps a running record of work in progress including total fees due, percentage of fee earned, amount billed and amount due.)

The memory bank of information that any design firm must assemble if it computerizes job cost and payroll information

Author: Maurice Barron is one of the founding partners of Farkas, Barron & Partners, Consulting Engineers. He is a Fellow of the American Society of Civil Engineers and was responsible for designing the computer programs he discusses.

is, in essence, a documentation of its years of professional experience. By devising a simple new set of programs based on management criteria, this immense font of knowledge and experience can be instantaneously tapped to show past performance records on any basis or level.

Asking the right questions

A Single Random Retrieval system is used when only one management or potential project evaluation factor/criteria is called for. For example, we can ask what percentage of our current work represents overhead jobs and have our answer in 10-12 minutes in both dollars and cents as well as percentage of the total number of manhours expended during any given week. If we find we have a higher concentration of manhours for several weeks running on overhead jobs, we can adjust the work assignments in the office to better balance our production output. We can also ask the computer: on what size projects can we make the most money, and within minutes be shown the profit ratio between large and small commissions plus the percentage of profit for each job size. It can tell the profitability factor on any project based on its geographic location, type, single or multibuilding development, whether it is a pile or non-pile foundation, and almost any other basic criteria we wish to establish—including which clients we are consistently losing money on and even to what degree.

The program can provide analytical performance reports on each of the firm's personnel. Since our payroll and job costs records are established on a dual project-people, people-project relationship, the computer can show all the jobs where overtime hours have exceeded X, and the name of the job captain on each project. If one or two men's names are shown repeatedly they cannot immediately be condemned as incompetent; only one factor was considered: overtime. The results must be reviewed in light of the collective production capability of their design team(s), the nature of the projects on which they have worked, the temperament and peculiarities of the clients for whom they have worked, etc. The excessive overtime factor, in fact, may not be due to their incompetence.

Using only one factor as a basis for judgment can be dangerous. Recognizing this shortcoming, we went one step further and designed a Double Random Retrieval System through which the computer will supply the information on two or more sets of criteria and print out a comparison. For example, an architectural firm with a similar set of programs could ask the computer to show the comparative profit ratios of high-rise apartment buildings between 10 and 15 stories on the basis of steel-frame and reinforced concrete construction methods in the states of New York, Connecticut and Pennsylvania. The computer would print out what combination of circumstances and design requirements can guarantee sure-fire losses. By fashioning input forms on the basis of architectural design elements (i.e., plan shapes, types of exterior façades, foundations, lighting systems, etc.) the Double Random Retrieval System could determine profitability on the design approach which will best serve the client's needs. It is amazing how many professional firms cannot accurately tell how their time and money is being expended because they are too busy protecting their clients' budgets.

As our experience and programs grew, we found it necessary to devise an overall Master Control Program—a sophisticated directory of our 122 different programs that tells the computer which of these programs we want implemented at any given time. We now have computerized 396 individual building projects. Assembling the data is the most time-consuming aspect but once this groundwork has been laid, keeping the files up to date is a minimum effort. Updating equipment is equally important. The machine we now use is a three disc drive IBM 1130 32 K computer complete with a Cal Com plotter for plotting bar graphs, charts and graphic displays. It has automatic correction/omission capabilities; if information on a specific employee or project is requested, the computer will automatically tell us if it is not in the files. All punching, inversions and omissions are also accomplished automatically.

The computer is invaluable to the management of an efficient and profitable professional office, but the best machine and programs in the world will not be able to fully account for the last minute innuendoes, connotations, new facts and general changes in circumstance that are part of man's decision-making process. Only man can make the final decisions. What the computer does is to greatly increase man's accuracy and enable him to make more right decisions than wrong ones. □

Computer planning the community college

Donald G. Rapp and Dan D. Drew

The Community College Space Planning (COPLAN) System, which the authors have developed over the past two years, represents a practical demonstration of computer applications to design that was recently used to establish a preliminary instructional space requirement study

The community junior college, a uniquely American institution that is quickly becoming one of the most important forms of education in the nation, educates thousands of post-high school, college level and continuing-education students of all ages. Unlike most colleges and universities, the community college operates at full capacity for 12 months each year and, in addition, frequently offers many classes during the evening hours. It must participate fully in the urban life of the community and still provide the academic environment necessary to the higher learning concepts desired by those who attend and support the school.

In the future we can expect that more and more people will attend community colleges; some community residents will simply wish to widen the scope of their knowledge, while many others are increasingly recognizing the need to attain higher levels of educational achievement. Others will be attracted to various extra-curricula programs to refine and broaden their personal interests. But most important is that for many it will be the only form of college education available.

Because the problems of class and staff scheduling, financial administration and operation, faculty/staff procurement and new programs development are the prime responsibilities of college administrators, physical expansion programs, campus plan programming and other aspects of the physical/academic environment often cannot receive the priority and study they deserve. The architect becomes the key advisor to the Community College Board on matters of physical growth planning and phasing, building use and expansion, and proper space planning.

The complexity of today's architectural design problems is found in the increasing number of requirements that need to be simultaneously evaluated: the client's requirements and wishes, various long-range planning goals, local codes and aspects such as economic feasibility. The computer is the logical device to extend the architect's ability of information analysis and solution development. Through this particular man-machine relationship, the architect (and his client) use a properly programmed computing system to increase their ability to visualize a synthetic structure of requirement relationships. This structure can be built and rebuilt, and stored for later use by the computer. In community college design, the client would furnish most of the specific information used by the computing system while the architect would use his experience to "guide" the computer in structuring and establishing relationships among the pieces of data.

The Community College Space Planning (COPLAN) System is a group of computer programs we created to process and organize a large amount of information and make it available in easily usable formats.

The first phase, COPLAN1, is used during planning and programming, and in some cases in the early stages of schematic design. With information supplied from each academic department of the college, it makes use of basic data such as projected full-time equivalent (FTE) student enrollment, anticipated contact hours per FTE, department operational hours and space utilization desired or anticipated. Using the policies of the college as a guide, the departmental data is processed and organized as parameters to guide the architect early in the design process.

COPLAN2, the second phase, is based on fewer assumptions due to the more precise information gathered during the early stages of programming and design; students and contact hours are determined more accurately, results of departmental crossover studies are carefully analyzed, class size ranges and area factors are studied in greater detail. This gives a more accurate definition of the design parameters earlier outlined by elements of COPLAN1. The COPLAN2 phase will also account for such ancillary areas as maintenance, structure and service/support, along with other items of the college growth pattern in projecting space requirements for the school.

Available for use by others, planning by the COPLAN System is determined by the computing hardware available to the architect. Generally, two methods of use are found to be most

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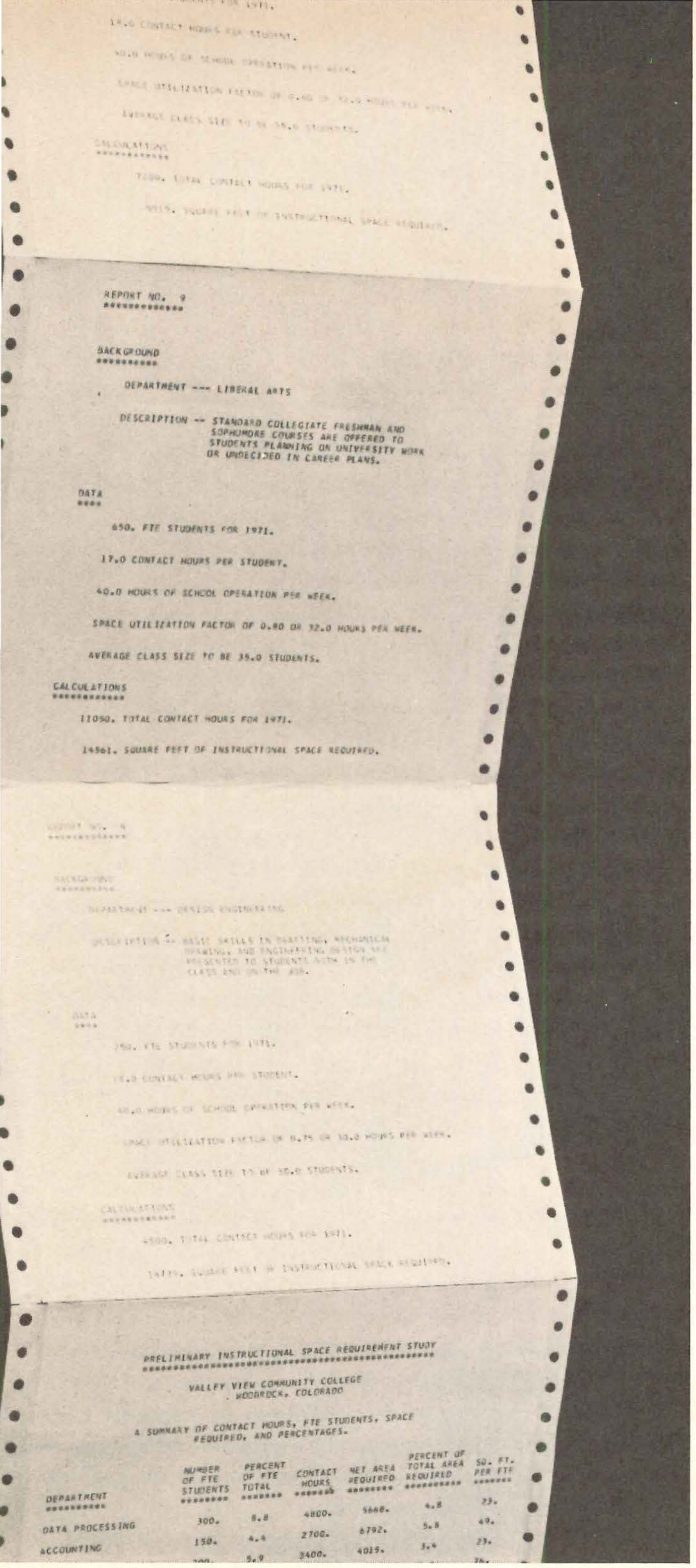
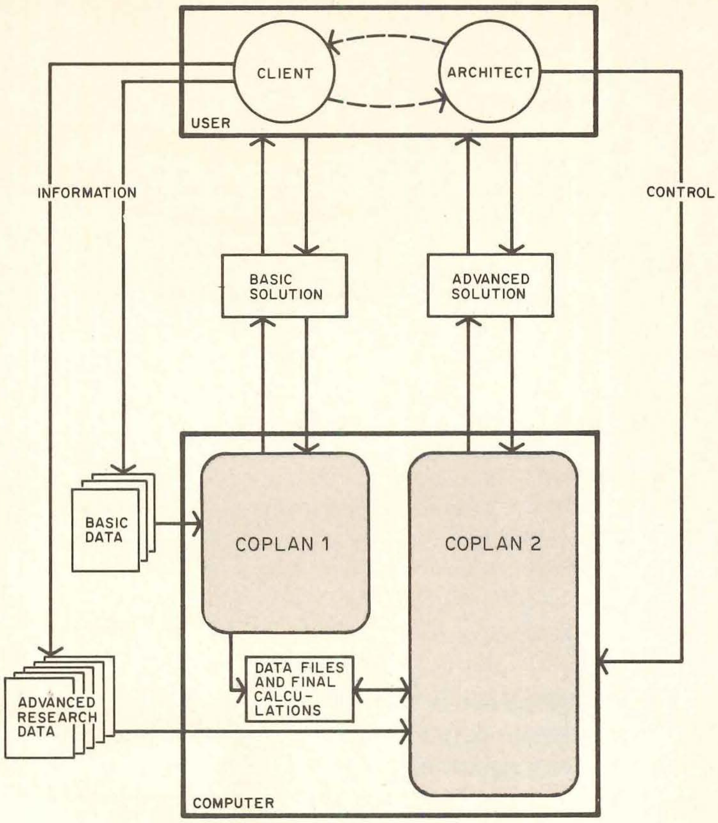




COPLAN SYSTEM USER-COMPUTER INTERACTION

popular. One economic method is that of remote processing in which information is gathered on special forms, punched into cards, and run on a computer at any service bureau selling the services of a computing system that can process data with the COPLAN System. Output is on a high-speed printer, or a plotter, and is used by the architect at his office. Additional "runs" can be made in the same manner with new, changed or additional data.

The second method is that of establishing a "conversational," or interactive, mode of communication between the user (architect/client) and the computer. This is accomplished through a typewriter terminal in the architect's office, through a computer's console typewriter, or through the use of an interactive display system composed of a cathode ray tube (CRT) display screen, lightpen and/or keyboard.

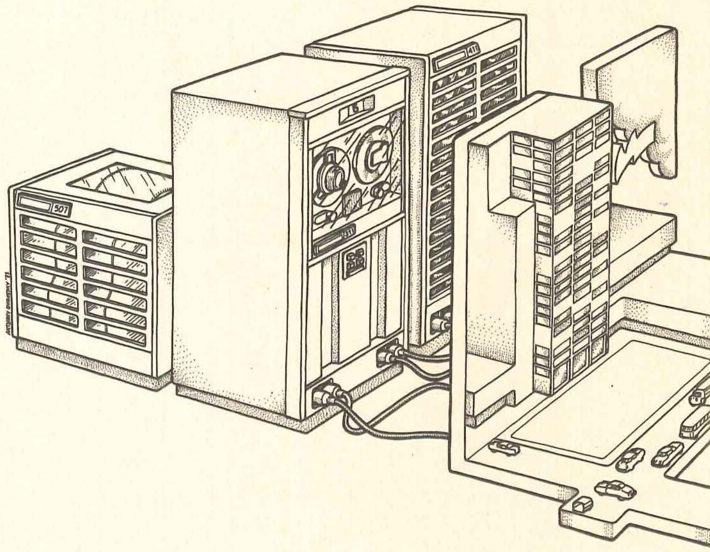
With a display screen, the user can supply information and guidance parameters directly in response to the computing system's COPLAN instructions. Computed data can be displayed in written and/or graphic form and can be altered as desired by the user with the lightpen or keyboard. Instantaneous answers are supplied to questions and immediate evaluation of all specified parameters is available in this type of COPLAN system user-computer interaction. It is possible to examine many solutions in a short period of time and to perfect the desired one(s) to satisfy many of the client's original needs and desires. Each variable can be examined singly or in combination with others as part of the entire concept, and each solution can be stored by the computing system to be printed or drawn on suitable hard-copy material for later use.

In recent years, architects and engineers have been aided by the development of computer-oriented systems that analyze and predict lighting levels, power, heating and cooling requirements, that analyze structural designs, test loading conditions, and predict critical structural members. Architects have benefited specifically with the project-cost and time-accounting systems; specification writing programs; cost predicting routines; geographical, geophysical and census data analysis systems; and economic feasibility analysis studies. Practical attention is currently being focused on development of systems to aid the design processes. Systems for relationship study of design elements are already being used by several firms, graphic communication techniques are being developed to give the architect greater ease in communicating with the computer, and many small design-oriented problems are being solved through automatic data processing. Through the application of rational methods of computer technology to architectural design problems, as demonstrated with the COPLAN System, the potential of the architect is increased, his design solutions become more thorough, and service to his client is improved. □

Computer simulation: a realistic assessment

Vladimir Bazjanac

Computer simulation is a valuable tool in architectural and urban design for predicting and evaluating performance but there can be unexpected pitfalls, costs and results



Simulation had been used in architecture and urban design long before the invention of the computer. Perspective drawings, architectural models, simple methods of cost computation, project scheduling, etc., are nothing more than simulations of some aspect of a building. They are used to predict and evaluate its performance. While perspective drawings and architectural models are still quite satisfactory tools for experimentation with form, something more accurate is needed for prediction of economic and functional performance.

Few designers have an opportunity to build prototypes or full-scale mock-ups and conduct physical experiments. Even when they do, such experiments are limited only to a fraction of the total building. Full-scale physical experimentation is hardly ever possible: its cost is prohibitive, its duration too long, and it is nonrepetitive (a new mock-up has to be built for every experiment). Digital computer simulation can be an aid to architectural and urban design because these design systems have one common characteristic: changes take place in time. Such systems are called dynamic, and this article is limited to simulation of dynamic systems.

Standard classifications of simulation models, based on technical characteristics of models, are not convenient for design simulations. A better classification would be problem-oriented: (1) accounting models; (2) models of functional performance; (3) visual simulation models; (4) residual models.

Accounting models are essentially models of economic performance, with money as the basic unit of measurement. Their operation generally centers around discounting procedures. Such models are essentially deterministic; that is they have unique outcomes for a given set of inputs. They usually generate exhaustive information which has to be displayed in its entirety to be fully understood.

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A typical example of such a model is the office building height simulation developed in the Houston office of Caudill, Rowlett, Scott. It simulated the economic performance of various heights of office buildings proposed for the same site. Performance of the building was judged on the basis of the rate of return on the investment as a function of its engineering economy characteristics, construction and operation costs and building efficiency. The output contained a table comparing total building cost, construction cost per sq ft, total project cost, equity required to secure mortgage, and the percentage of return on the investment for each simulated building height.

Models of functional performance are essentially non-numerical. Their operation centers around the change in state of the model and the manipulation of essentially non-monetary entities. They are mostly stochastic (contain a probability function) and are frequently dependent on simulation of human behavior. Such models generally require sizeable input information and very sophisticated display of output for easy comprehension.

One of the many examples of this type is the simulation of an industrial parking structure in Indianapolis by Eli Lilly & Co. The model was set up to see if a proposed parking facility could be vacated into the surrounding street system within 15 minutes. It simulated the arrival of employees in the garage, their movement to their cars and the movement of cars through the garage to the exit, all according to rules determined by the design of the garage. The model reported through time the number of people and cars at locations of interest.

Visual simulation models simulate the visual experience of movement through space. They use graphic outputs as the visual experience of movement simulated through a succession of individual frames. They are essentially deterministic and require very expensive hardware. Many visual simulation models from other fields are very well known. A typical one for architecture and urban design is Peter Kamnitzer's Cityscape. A configuration of buildings is read into the model and movement through space defined by these buildings is simulated. The output of the model is an illusion of movement through actual space.

Residual models defy definition. They do not fit the definition of any single model type, are nonconformative and always represent an unorthodox description of the real system.

The best description of a residual model can be given through an example originated by Horst Rittel of the University of California in 1963. Characteristics of typical housing units are described mathematically as a set of constraints, with site restrictions and the zoning envelope for a given site. Combinations of units that satisfy the constraints are generated at random. Such a solution is quite primitive, but the designer can immediately judge whether it contains potential for further design elaboration and development without the help of the computer. If not, the solution can be discarded and a new one can be generated at random at very low cost.

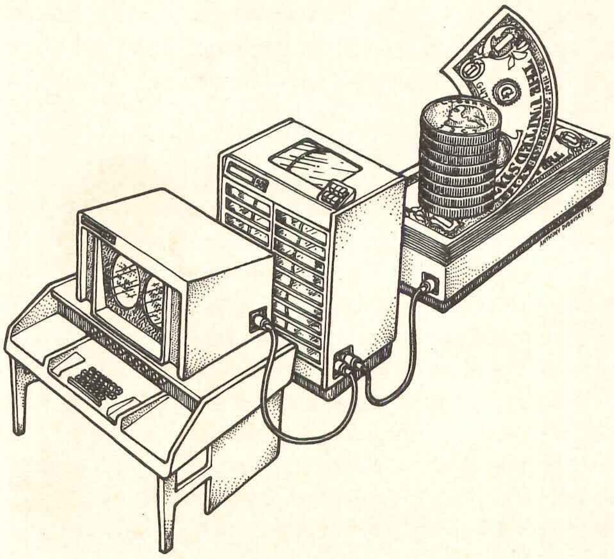
Quite a few simulation models related to architectural and urban design have been developed in recent years, but few are reported. When they are, they tend to appear in non-architectural sources, and tend to be reported primarily from the technical point of view (as a demonstration for a particular language, documentation of a particular written routine, etc.). When described in architectural publications, they focus on strategies for simulation rather than on successful experiments. Simulation efforts, however, must be analyzed from a practical point of view to find out how accurate such simulations tend to be, how practical they are and what they cost.

Accuracy depends on reality

Every simulation model is developed on a set of assumptions and contains a series of simplifying conditions. This limits the problems the model has to deal with, so that it can be made operational. In other words, the mathematically unclean systems have to be transformed into mathematically exact models. But no matter how logical and consistent assumptions and simplifying conditions may be, in most cases they reflect the real condition inaccurately. Their fallacy is often the reason the real condition of the simulated system cannot be recognized in the output of the simulation model. For example, in the simulation of the industrial parking structure, employees are assumed to leave their working stations according to a stable pattern. In reality, employees are always trying to beat the system according to their continuously acquired experience. Thus, they actually arrive in the parking structure in different and ever-changing patterns. Since the pattern of arrivals is a variable of major importance in determining the sequence of processes in the garage, this crucial assumption in reality eliminates the possibility for accurate simulation.

In order to make the model operational, additional simplifying conditions frequently have to be assumed as the model is developed. This is sometimes done to such an extent that it is no longer possible to achieve initial objectives. If the problem is redefined according to the capabilities of the model, it may become so oversimplified that it may be of no concern to the client.

Data describing phenomena influenced by human behavior is unreliable. Human behavior changes in time, and even when it results from high quality observation and analysis,

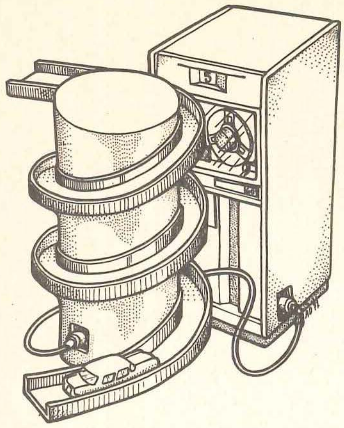


such data is collected by amateurs, without proper sampling and analysis; sometimes, in lieu of any feasible source for data collection, it has to be fabricated.

Validation of models can be very difficult. It requires records of performance of an actual system to which the performance of the model is compared. Such records sometimes do not exist, simply because no actual system suitable for comparison exists, or because it is not possible to record its performance. Validation then boils down to a confirmation of someone's intuition (usually the model designer's intuition) of what the actual performance of the system should be. Too frequently, the process of validation ends as soon as the intuition is confirmed for the first time.

A major obstacle is economics of simulation. Model development, programming, validation, sensitivity analysis and output analysis require high skills, and specialist's salaries by far surpass salaries of architectural designers. Serious data collection efforts tend to be very time-consuming and usually require ample staffing, unless data comes from in-house sources. Interestingly enough, the cost of machine time is very rarely considerable when compared to other costs of simulation. Simulation projects usually take a long time, and the total cost becomes substantial, frequently far beyond original estimates.

The cost of simulation for its largest part represents an im-



mediate cash outlay (because of the cost of salaries), which places an undesirable burden on organizations operating on low marginal profits. Unless the simulation project is funded separately (outside the standard architectural fee) it considerably reduces the profit of the organization. Frequently, it has to be funded as "office research" and charged against profit from projects which have little to do with the simulation.

At the beginning of a simulation project, relatively little consideration tends to be given to increasing cost. As the cost keeps rising beyond original estimates, additional cost controls and restrictions are introduced, most often in the form of cutting all procedures not absolutely necessary for processing the simulation. Such cuts are likely to affect validation and sensitivity analysis first, resulting in acceptance of models insufficiently validated.

Simulation models related to design tend not to capitalize on repetitiveness, the most essential characteristic of simulation, even when they are generalistic enough. Preparation of input describing a new set of conditions is usually very costly and time-consuming. Furthermore, architectural and urban design problems seldom offer continuous opportunities for repeated use of the model.

Design solutions, which the model is supposed to aid, sometimes change so fast that the model cannot keep up with the change, and simulation sometimes ends up trailing the development of the design. For simulation of the industrial parking structure, a new set of input data has to be prepared for every alternative design solution, describing its layout and the pattern of movement through it. This constitutes the largest part of the whole input and its preparation is very time-consuming. A team of designers can produce new design solutions faster than new input can be prepared. This, of course, becomes more drastic if the model itself has to be modified to meet the new set of conditions.

Are simulations practical?

Appropriate use of the model requires understanding of the simulation on the part of the user (especially a full understanding of all underlying assumptions and simplifying conditions). This means that it is sometimes necessary to train the designer, which is often impractical: he has little time to spare for training, does not feel the need for training, or tends to argue about the model rather than learn. Without the proper understanding of the model, the designer is liable to misinterpret received information. He is likely to read in it more than there is to it, usually reflecting his own image of what the model ought to do.

What benefits can we expect from simulation in architectural and urban design? It appears that its greatest value is educational—those involved usually learn more about the problem than they otherwise would. It helps to develop a better understanding of how the actual system works, and deficiencies and inconsistencies in design solutions are detected. It is a valuable aid to thought. Since simulation experiments are not plagued by fear of failure, simulation tends to encourage the investigation of alternatives which appear to be risky.

Its value as a tool for prediction is somewhat questionable. Quantities in simulation outcomes cannot be expected to match the reality exactly because the models are rarely accurate enough and the reality is continually changing. Designers in need of exact quantitative information as the basis for decision-making cannot really depend upon predicted values. Such prediction is useful only if supported by an understanding of its probability.

One interesting trend is that some large corporations are trying to break into the "urban market" by offering simulation services. Architectural offices increasingly tend to embark on simulation projects with the rationale that simulation capabilities will make them more competitive on the job market. Thus, simulation is becoming an important element in marketing.

It appears that quite a few architectural offices are willing to start simulation projects with very little understanding of what they are getting into. They acquire experience as projects develop, which is a very expensive way of learning. Perhaps they could reduce their mistakes and get more out of simulation if they exercised more caution at the beginning of the project.

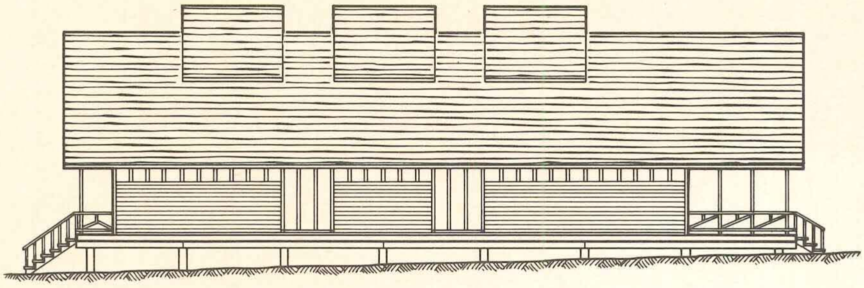
Here are a few practical hints to consider when faced with a problem which looks like a simulation problem:

1. Investigate alternatives before committing to simulation.
2. Be modest about expected benefits and generous in estimating cost, then evaluate benefits versus cost.
3. Secure independent funding for simulation.
4. Keep the model as simple as possible; a more complex model of a system does not necessarily yield more accurate results.
5. Expedite input preparation as much as possible.
6. Automate output analysis as much as possible.
7. Secure continuous interaction with the user of the simulation from the beginning to the end of the project.

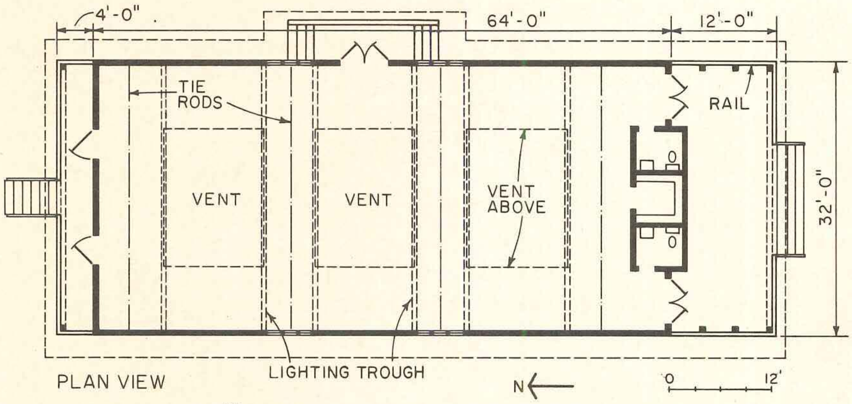
What can we expect in the future? New technology (larger and more sophisticated computers) is not likely to cause major breakthroughs in simulation techniques. Most useful achievements will probably be limited to new developments in simulation languages. A capability for interactive modeling would aid feedback and improve model design. A truly graphic simulation language could perhaps simplify simulation in architecture and urban design and so reduce its cost. The greatest improvements, however, should take place in the thinking processes and use of what is already available: more thoughful use of simulation and better reporting of what has been done. □

Selected details

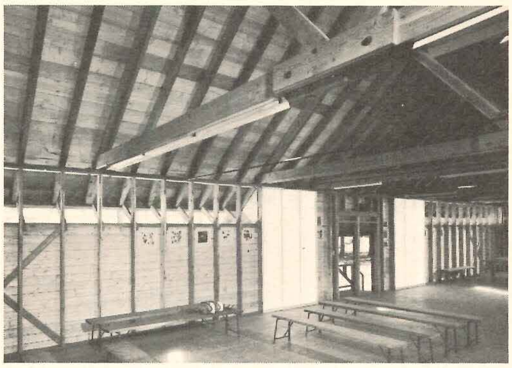
Recreation hall for a summer camp

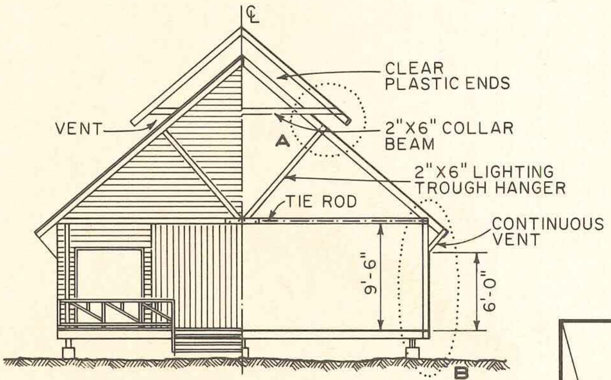


WEST ELEVATION

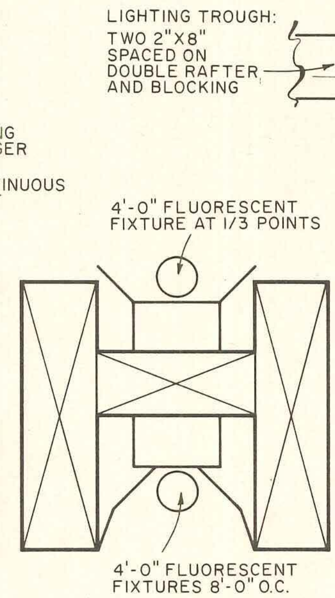


PLAN VIEW

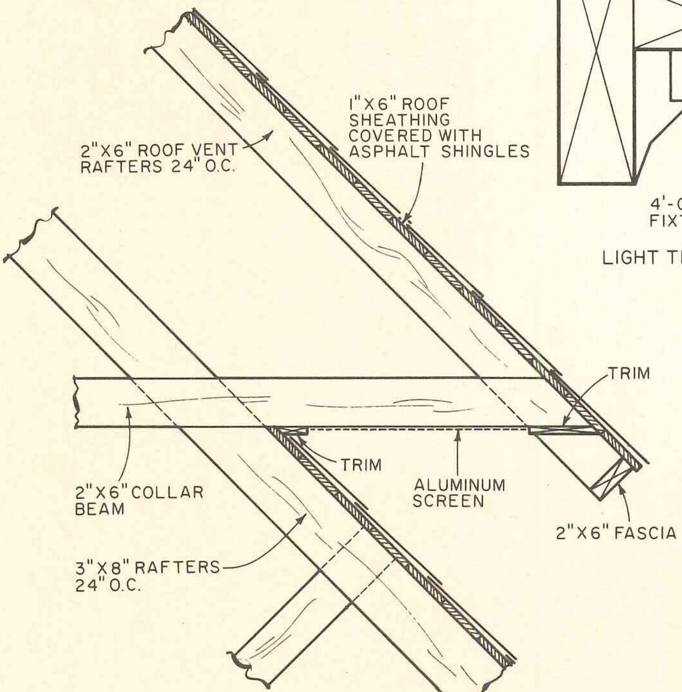




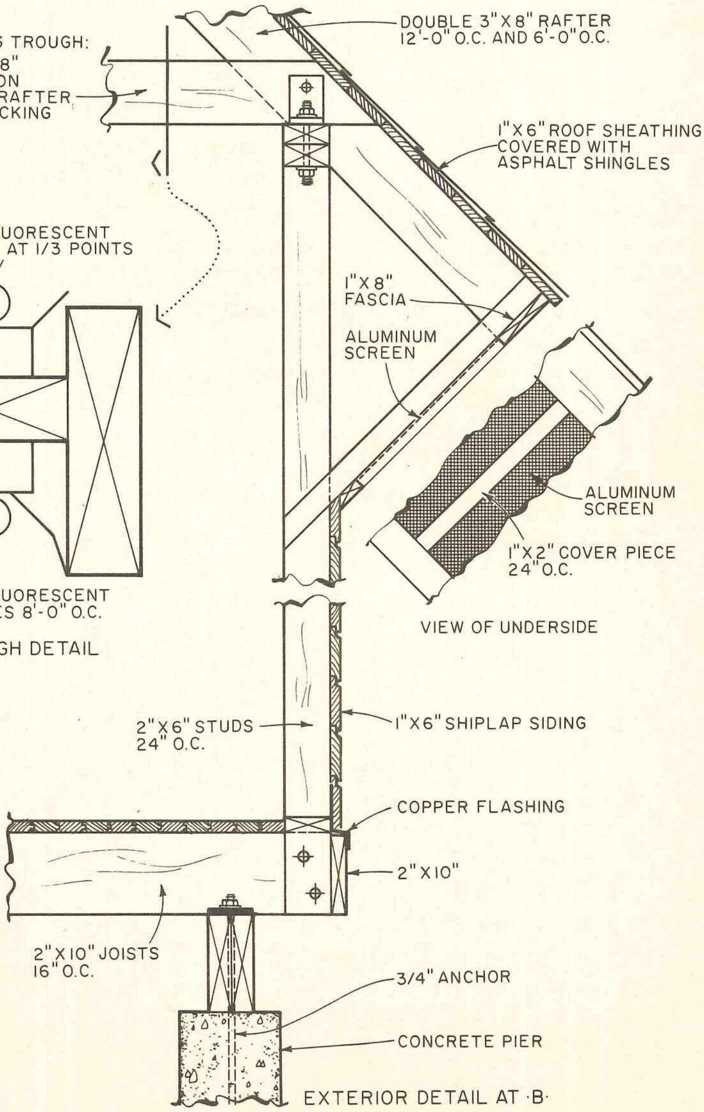
PARTIAL ELEVATION-SECTION



LIGHT TROUGH DETAIL



EXTERIOR DETAIL AT ·A·



EXTERIOR DETAIL AT ·B·

Architect: David E. Guise

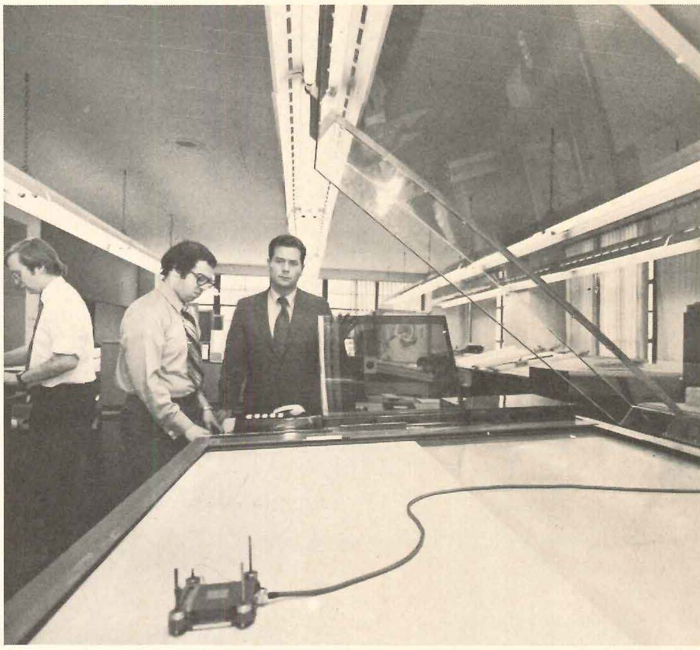
Designer's utopia?

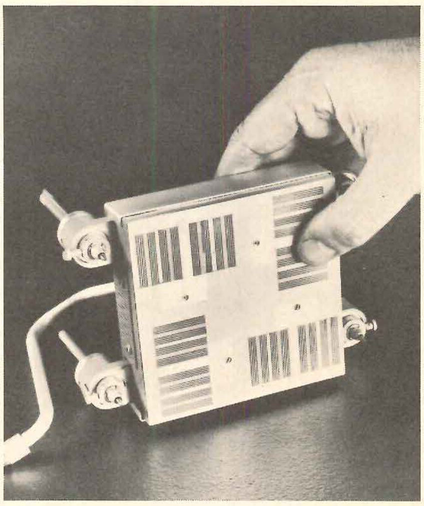
Several interior design firms are using computer programs to collate and store the growing amounts of information necessary for space planning, and to produce working drawings, specifications, cost estimates and purchase orders

"It's not the nature of design," states Larry Lerner, "to pick one from column A and one from column B. We're going to let the designer use this machine the same way he uses his pencil, line by line, curve by curve." Lerner of Saphier, Lerner & Schindler (SLS) has been involved with computers for the last eight years, exploring the ways a computer could make design and production more efficient. Lerner's first contact with a plotting computer was while doing a job for NASA where a plotter was used for drawing weather patterns. The use of a drafting computer seemed a logical way to eliminate the tedious repetitiveness of working drawings, insure their accuracy and deal with the increasing shortage of draftsmen.

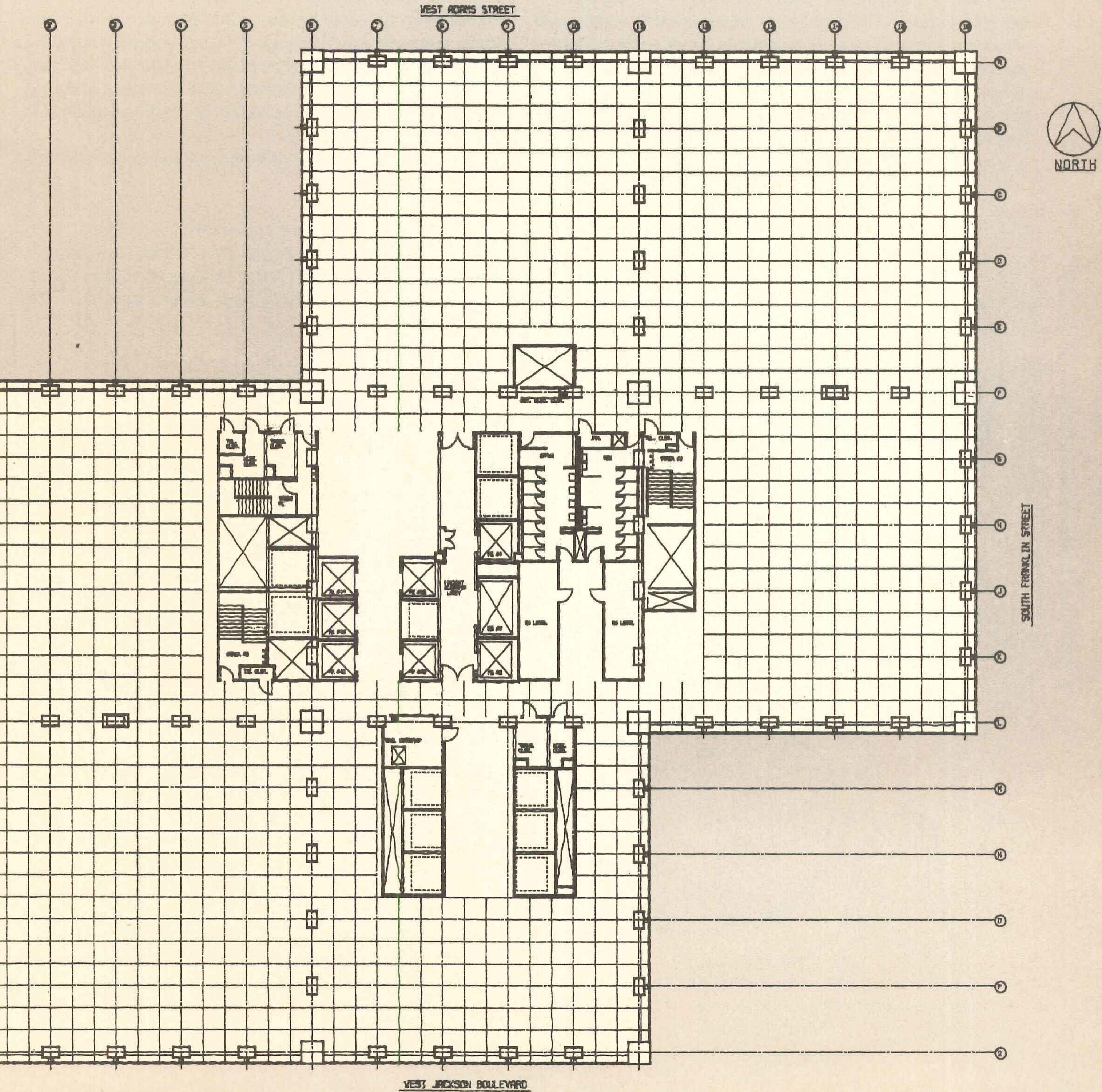
For Lerner it was necessary to look beyond the immediate problem of dealing with the objections and fears of the draftsmen who would need to be retrained to use a computer instead of a pencil, and of investing time, energy and money in developing programs with little return on the investment until the programs were worked out. The programmers initially hired by SLS were incapable of producing a software program for architectural drafting. Lerner finally hired an architectural graduate who had a knowledge of both languages. Three years later, with most of the program worked out, and the personnel retrained, the computer is showing its potential. Drawn and stored in three weeks time were 109 floors of an office building.

The cost of buying and maintaining such equipment was prohibitive even for a large firm like SLS and in 1966 the firm joined Litton Industries which could provide the financial security for SLS to purchase the equipment. The equipment purchased was a Xynetics 1000 automated drafting system. With some initial hesitation as to whether or not the drafting machine could perform in the way SLS hoped, it was decided to invest only in the output equipment. A temporary input system—an X-Y axis from which a drawing can be coded—was invented by Lerner. A continually expanding symbol book contains various fixtures and frequently used configurations of furniture, walls, doors, etc. that are stored in the comput-





The Xynetics 1000 computer (above) in operation at the New York offices of SLS. The drafting arm with four drawing points moves by electrical impulse through a magnetic field. The drawing (opposite) done by the computer is reproduced at the same size as the original.


WEST ADAMS STREET
NORTH
SOUTH FRANKLIN STREET
WEST JACKSON BOULEVARD

er's data bank. Any item to be drawn is located by its coordinates, the code for the object or configuration is given at the scale it is to be drawn. For repetitive fixtures—like lighting grids—it is necessary to give only one location point, the symbol code, the on-center spacing, and the total number of fixtures. Cards are keypunched and the machine draws out the given information.

The drafting arm is a square box 4" x 4" with four pen points. The arm floats on an air cushion above the paper, eliminating friction, allowing high speeds and acceleration. Movement of the arm is by electrical impulse through two magnetic fields, one in the drafting arm, the other the drafting table. Since there are no mechanical parts in the movement of the arm, there is an accuracy of 0.005 in.

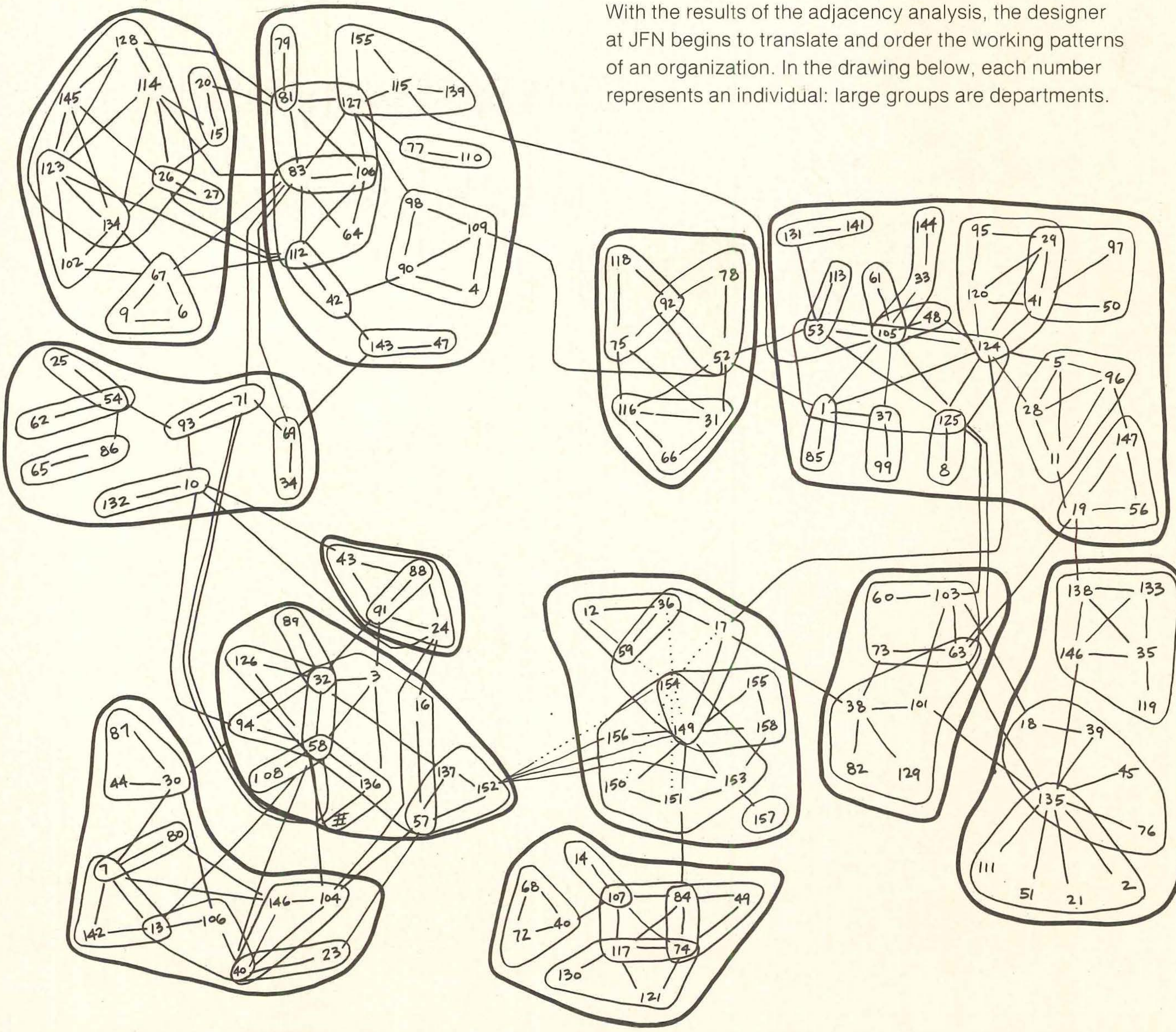
Now that the output has proven satisfactory for SLS, the next piece of equipment to be acquired will be an electronic digitizer for input. The digitizer, an electronic grid screen over which the drawing is laid, will eliminate the necessity of hand written manual translation of the drawing. By touching a coordinate point with the light pen and then a symbol, the information is stored directly in the data bank, eliminating the whole keypunch operation.

In addition to using the computer to draft, SLS has a number of other programs that are routinely used for space planning. Traffic studies, which include the communication of people and the flow of paper and information, are used to decide the adjacency of departments. Given the necessary sq ft required for departments and the sq ft of each floor, the computer will lay out the required areas, keeping track of the leftover square footage. An optimization program—a method of showing any number of space planning alternatives—is now in the developmental stages. Lerner does not feel that this program is sophisticated enough to be a useful tool yet. People can still do better than the machine.

Programming for the individual

Drafting computers are one tool for eliminating repetitive, time-consuming work in the design process. The growing size of offices, the increasing complexity of the organization and the specialization of work has increased the amount of information necessary to the designer. It is no longer possible for a designer to keep track of, or order, all of the requirements which affect the design. The most rapid and efficient means of collecting, storing and manipulating this information is by computer.

Flow of information and communication are two aspects of



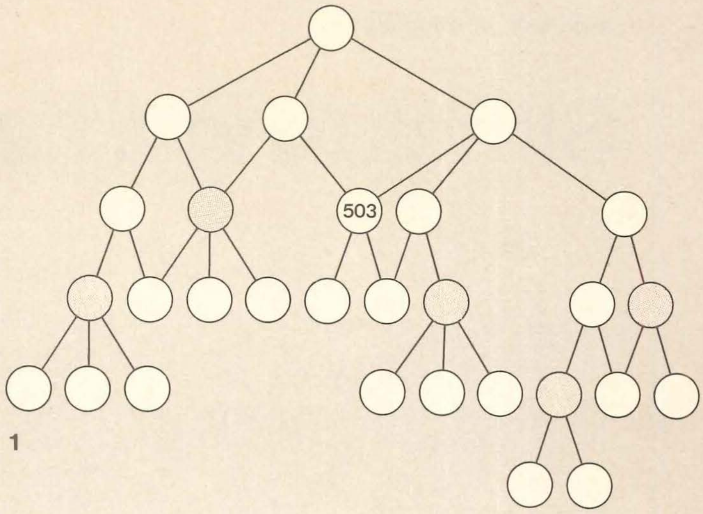
With the results of the adjacency analysis, the designer at JFN begins to translate and order the working patterns of an organization. In the drawing below, each number represents an individual: large groups are departments.

computer programs used by JFN and Herman Miller, Inc. JFN, a space planning firm in New York City, has on-line terminal access to the IIT 360 system. The three programs currently in use are a workplace evaluation, an inventory file and traffic (adjacency) studies. The workplace evaluation involves a questionnaire structured to allow different types of questions depending on the client's requirements. Its objective is to determine what the work of each individual is and the spatial and equipment requirements for doing it. The information is summarized by the computer for each individual, and can be printed out in any number of ways—by individual, by organizational level or by departments. The inventory file at the beginning of a job is a summation of the client's existing equipment—where it is, what it is, manufacturer, color, material, cost, etc.

As the job progresses, it is decided what equipment is to be kept and the file is updated. New items to be purchased are added with the same descriptive information and from this updated file purchase orders are written. Summations of inventory can also be called out in the same ways as the workplace program. The third aspect of JFN's computer use is the adjacency study used to help establish spatial organization. A questionnaire given to each employee asks for a list of those people with whom communication takes place, whether this person directs your work or you direct his, the frequency of contact, and its relative importance. The computer first prints a listing for each individual, then subsets (groups) and sets (departments). What eventually emerges is a schematic of the working organization which is often different from the apparent bureaucratic hierarchy.

The Decision Resource Service (DRS) of Herman Miller, Inc. offers two of the same programs as JFN—communication and equipment analysis—to managerial consultants, architects and organizations. One peculiarity which has turned up in the communications programs of both firms is the non-communication of individuals who should be communicating; an advertising sales manager and the vice president of sales is one example. Most organizations are receptive to learning about this kind of lapse; some are not. The interior designer's role, once limited to working within the client's program, has now expanded to writing the program based on an evaluation of the client's needs. The communication and workplace programs are two tools, but both, done at one point in time, become static representations. JFN wants to eventually eliminate itself as designer and teach management to use the analysis as a tool to re-evaluate the organization every six months to a year. DRS, which already offers its services to management, feels that at the cost of $15 per person, it would be reasonable to run a re-evaluation every year.

For Larry Lerner the ultimate utopia for the designer is the cathode ray tube. With this device, the designer, using a light pen, draws a perspective of what the space will look like, including color, texture, furniture, hardware and fixtures. The computer, with a data bank of necessary information, recognizes the images that are drawn. From that point the computer does working drawings, purchase orders and cost estimates. But then, someone will have to spend several years or more putting all the information into the data bank, so he can then push a button and get it all back. [SLR]



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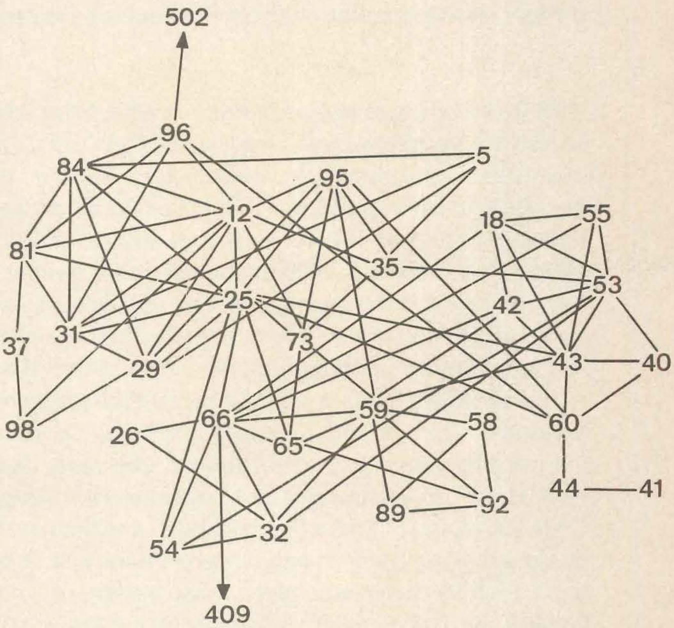
The DRS drawings represent 1) the inter-departmental structure, 2) the internal organization of one of the departments, and 3) the small work groups in a department.



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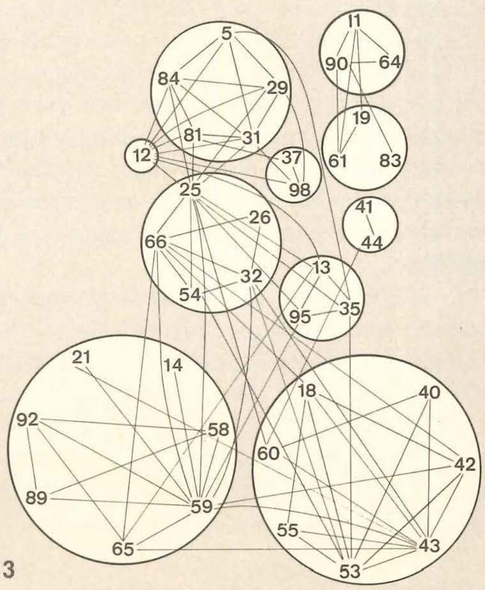


3

Structuring a new vision

Training students to solve universal problems rather than to learn a preset pattern of design solutions is the goal at Buffalo, where systems analysis has replaced old paradigms

If life in recent years has done nothing else, it has introduced society to the critical need for an expanded vision. Old paradigms (example, pattern, model—the term has old meanings but newly expanded usage) in education, art, law, psychology and a host of other disciplines, are being challenged. Conservation and ecology, with their demand for a wider vision, have finally become respectable. The search for solutions to social and behavioral problems reveals the need for aid from sources formerly preoccupied with narrow fields of practice.

The strongest challenge to the current paradigm of architectural education (and, therefore, practice) has been mounted by the joint efforts of John P. Eberhard, dean of the new School of Architecture and Environmental Design of the State University of New York at Buffalo, and Michael Brill, chairman of the Department of Architectural and Urban Systems. Eberhard says architects, as we traditionally have known them, will become obsolete if their method of practice remains unchanged. He does not make the statement lightly, but believes that a natural progression of historical events justifies such a pronouncement.

Two early forces, Eberhard says, upset the very core of the architectural establishment. The first was the revolution of the Bauhaus which, he thinks, was more important in its destruction of the historical basis of rules of design than it was in providing a well ordered substitute. After it, the architect could no longer bask in the comfort of historical precedent; his education could no longer be that of the obedient disciple sitting at the feet of a master, not if the master stressed the value of individual creativity and encouraged the exploration of new directions.

The other force can be traced back to the large-scale organization of scientific inquiry that resulted in the production of the atomic bomb. It formalized research and development and proved that it was possible to organize the processes of invention to attain a specific result. This new insight precipitated a profound shift of attitude about modes of thought that applied to all processes of invention and discovery. From that time clients gained a new appreciation of the validity of hard facts, and were less willing to look to the intuitions of ego-oriented form givers as the determinants of building needs.

A third force has recently emerged, Eberhard believes, in the body of a new generation of students who are seriously challenging the established methods of architectural education. Many of them see a world whose institutions and systems no longer respond to what they see as the appropriate needs. They see a world of environmental decay whose disease seems to spread unchecked. They question the justness of a society that has become incapable of curing its ills, and realize the education they have traditionally been offered cannot equip them to meet the challenge of building a better world. They demand, sometimes without having a clear idea of exactly what they want, an education of social relevance. Architecture students today know that the study of designing buildings, in itself, cannot prepare them to cope with the growing problems of environmental decay, that a much broader vision must be incorporated into their training.

The AIA became aware that the educational programs being offered in most architectural schools provided inadequate preparation for professionals to wrestle with these problems. It commissioned, and published in 1967, *A Study of Education for Environmental Design* by Robert L. Geddes and Bernard P. Spring of Princeton University. The "Princeton Report," as it has become known, was not well received by the profession because it proposed a broad program for the training of professionals without defining them as future "architects." The report established 216 tasks appropriate to the total task of environmental design. Because no single school could train professionals in all these essential tasks, the problem of organizing a school under the guidelines set forth in the report became one of where to place emphasis. The School of Architecture and Environmental Design at Buffalo has made a choice of emphases, and it has begun operation within a phased program of development.

To understand how Eberhard proposes to meet this challenge, he suggests looking at the following least used definitions of several terms in the *Random House Dictionary of the English Language:* architect . . . (3) the deviser, maker or creator of anything: "the architects of the constitution"; architecture . . . (3) the action of process of building; construction; education . . . (3) a degree, level, or kind of schooling: "a university education"; system . . . (3) an ordered

Drawings: George Fricke

and comprehensive assembly of facts, principles, doctrines, or the like, in a particular field of knowledge or thought: "a system of philosophy"; technology . . . (4) the sum of the ways in which social groups provide themselves with the material objects of their civilization. The first-listed definition of architecture is "the profession of designing buildings, open areas, communities, and other artificial constructions and environments, usually with some regard to aesthetic effect." Eberhard feels that this definition accurately depicts the direction of architectural education over the past 50 or 60 years. The third or fourth definitions are the ones with which he prefers to describe a new direction. They represent the thrust of his school, especially the graduate program.

Continuing education

In general terms, the School of Architecture and Environmental Design at Buffalo is made up of three main programs. Continuing education is the first, taught through the Millard Fillmore College, which has been made an extension of SUNY at Buffalo. This course is the nearest to conventional architectural education. The program, under director Richard K. Chalmers, draws students from diverse backgrounds. It includes, among others, those who, having chosen to go directly from community colleges to work in architectural firms, now wish either to continue their training or to work toward a B. Arch. None of the programs at Buffalo is oriented to the goals usually associated with architectural education. Architectural registration is not the end to be achieved, although the student may choose programs recognizing that as his goal. A broader vision is encouraged through exposure to the undergraduate and graduate programs.

Undergraduate

Ibrahim Jammal, chairman of the Undergraduate Program in Environmental Design, has developed a course outline for that curriculum. It *is* a new paradigm. Employing components of economics, behavioral sciences, political sciences, sociology, technology and other fields, the interdisciplinary nature of this schedule is unlike any previous pattern. Emphasis is, again, on providing students with basic skills with which they develop an ability to carry out the systematic solutions for problems (see chart, next page).

Graduate

Both of the preceding programs, however, get strong impetus from work being done at the graduate level, under the direction of Michael Brill. The graduate program, as might be expected, is entirely unique. The student in graduate level work is referred to as a Research Associate, a term more descriptive of his activities. Unlike usual graduate students pursuing designs of theoretical buildings or communities, the associates work on actual projects through research-based organizations. The original, most established group is called BOSTI (Buffalo Organization for Social and Technological Innovation, Inc.). BOSTI and its alternatives are non-profit corporations and, in effect, *are* the graduate school. Conceived as a practicum in which interdisciplinary teams experience the actual pressures of problem solving for a real client, BOSTI selects projects under the following criteria:

1. The project must clearly demonstrate the interrelatedness of systems problems, thus representing an educational opportunity for all the staff.
2. The project should offer the opportunity to contribute significantly to the real-world resolution of a sociotechnical problem rather than be limited to a paper study.
3. The project should lend itself to relating technical concerns to the satisfaction of human needs.

During the first 18 months, BOSTI has had 35 projects with such diverse titles as "Land Evaluation Analysis for Lease Negotiation" (for the Seneca Nation of Indians), "Study to Improve Performance of Teacher Education Facilities" (for the U.S. Office of Education, HEW) and "User Requirements Analysis for Operation Breakthrough Projects" (for Boise-Cascade Corp.).

According to Terry Collison, BOSTI's general manager, BOSTI is not only self-supporting, but pays salaries to the staff, making outside work by the student, often a divisive force, unnecessary. This feature also makes the most of the teaching staff, since their teaching and working duties are one and the same. Much of the course credit for work done at the graduate level is given for this actual project experience, with other courses making up the balance.

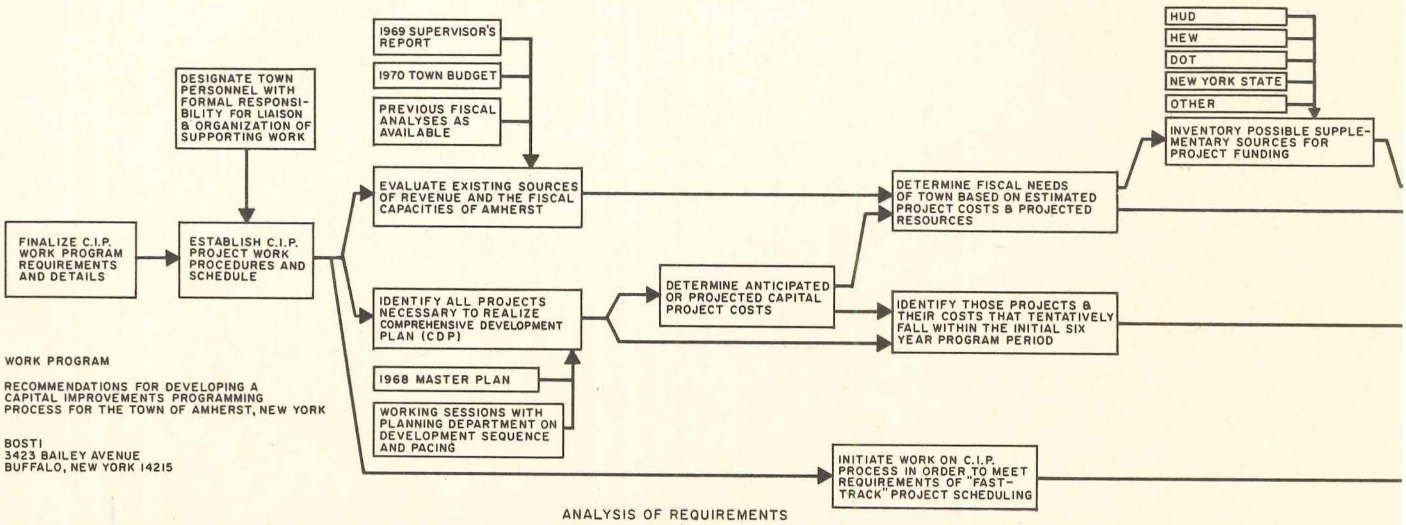
Undergraduate curriculum, School of Architecture and Environmental Design

Fall semester	Spring semester
General courses and prerequisites Intro. to environmental design (III)	General courses and prerequisites Intro. to environmental design (112)
Environmental perspectives Graphics & communication Qualitative and quantitative analysis (I) Elective	Environmental structure (proximate/communal/regional) Qualitative and quantitative analysis (II) Elective Elective
Proximate environment (studies/problems/reading) Environmental lab (I) — with 3-week problems/orientation Reading Elective Elective	Communal Environment (studies/problems/reading) Environmental lab (II) — with 3-week problem orientation Reading Elective Elective
Regional environment (studies/problems/reading) Reading Environmental lab (III) — with 3-week problem orientation Elective Elective	Environmental dynamics and change proximate/communal/ regional Theories of intervention Environmental lab (IV) — A semester-long problem combining proximate, communal and regional concepts Elective

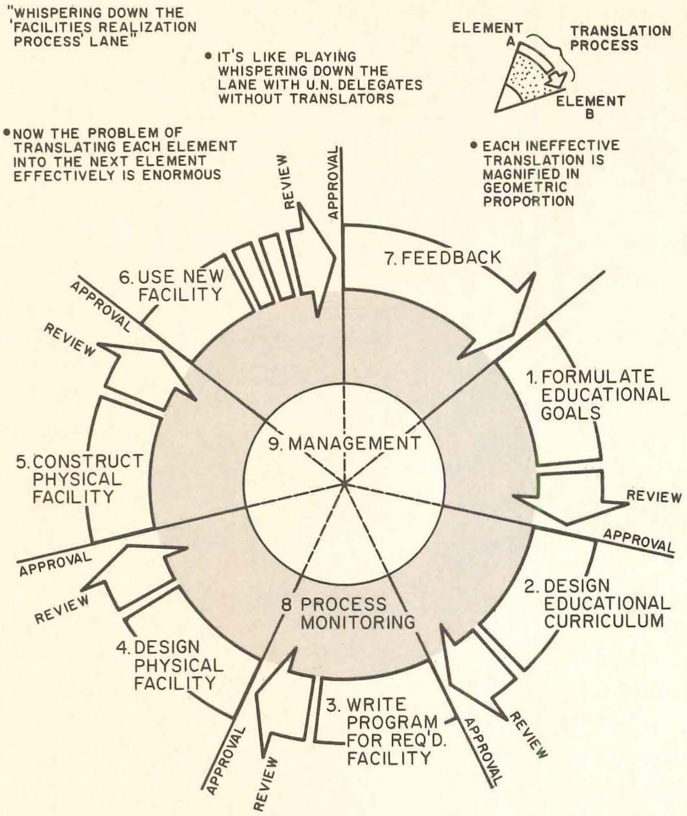
An alternative, not a substitute

Methods of arriving at the concise statement of the problem are some of the tools to be provided for the new profession. Closely related are the evaluation techniques for measuring alternative solutions, testing them for their appropriateness to the problem. The fact that BOSTI is performing a real function for real clients makes invaluable feedback possible; BOSTI's thrust makes it imperative. The whole approach to a design solution is seen as a circular, rather than a linear, path.

Questions, fears and outright rejection are to be expected to greet the Buffalo effort. After all, it is proposing to change totally a pattern of education with which the majority of prac-



ANALYSIS OF REQUIREMENTS



In a study to improve performance of teacher education facilities for the U.S. Office of Education, BOSTI first described the overall process by which facilities are realized; they found severe breaks between the nine elements of the process, and recommended five possible strategies for each element: improve the quality of work, change nature of work, improve translation process between elements, change the nature of information requirements between elements, and establish new combinations of these strategies.

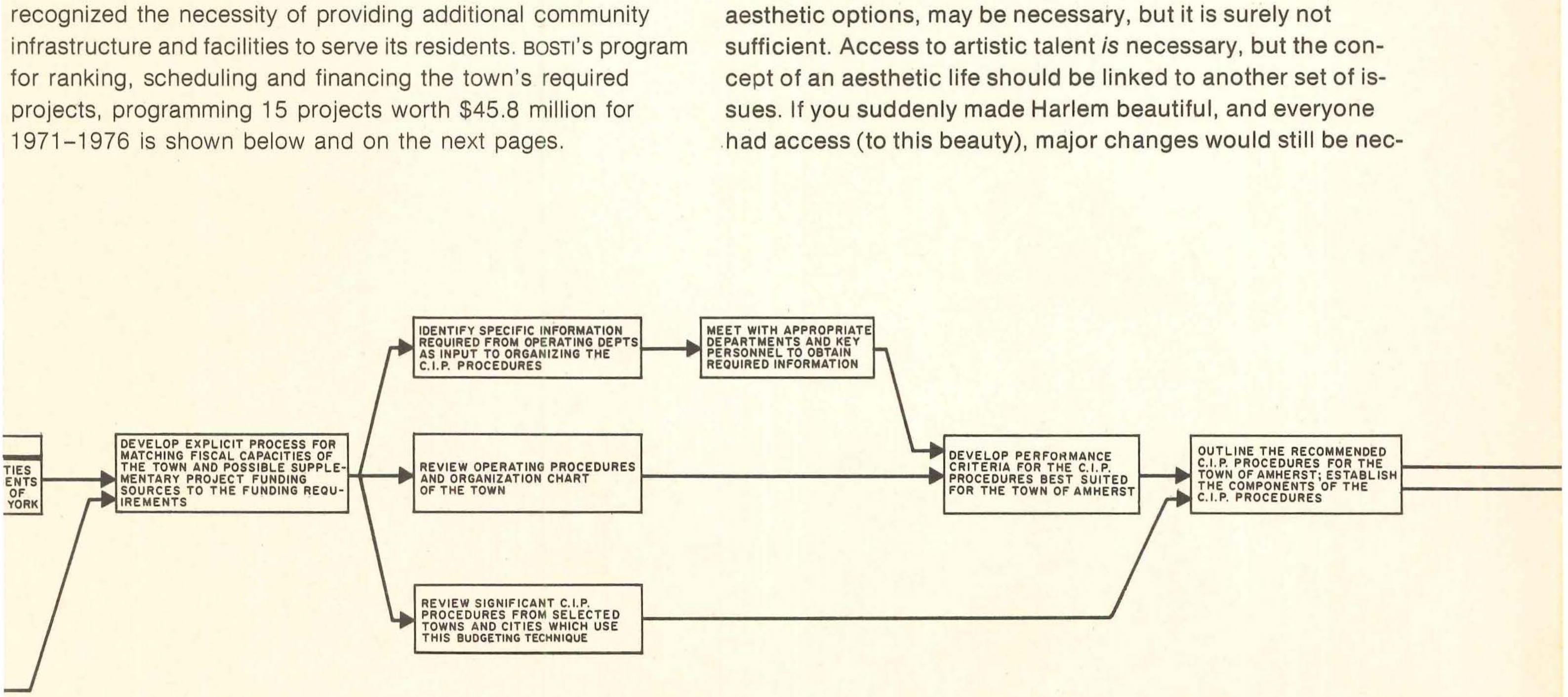
A six-year capital improvements programming process was developed for the town of Amherst, New York, part of the metropolitan Buffalo area. Site of a new 40,000 student campus and a proposed New Town for 25,000, Amherst recently recognized the necessity of providing additional community infrastructure and facilities to serve its residents. BOSTI's program for ranking, scheduling and financing the town's required projects, programming 15 projects worth $45.8 million for 1971–1976 is shown below and on the next pages.

ticing architects have learned to cope, or at least co-exist. Although he has always thought of himself as a generalist, an architect is now confronted with a disconcerting array of issues. Most architectural education cannot completely prepare an architect, even for present, everyday practice. There is just too much ground to cover. The approach at Buffalo, then, is Eberhard's proposed alternative—not substitute, necessarily, but alternative.

Development of proficiency in the basic skill categories clearly involves crossing disciplinary lines in ways quite foreign to conventional architectural education. To questions about whether the training of architects as now conceived should continue, Eberhard answers, "yes, but in decreasing numbers." Foreseeing a general change in the fields concerned with environmental design, he sees much more need in the future to provide tools for solving interdisciplinary problems. The student must first learn to define, or "get handles," on these problems before he can deal with them.

Under the best present circumstances, architects design a building that, in their estimation, meets client needs. The preconception that each client's needs can be met by a new building, however, is also being questioned. Systems analysis forbids that conclusion until such time as it becomes *the* solution, having been contrasted with all other alternatives. Some typical alternatives might be that the client needs to rethink the use of his present facilities or to restructure a hopelessly antiquated organizational plan. Within today's architectural paradigm, such optional modes of action are very seldom even considered. Eberhard, and Michael Brill who is chairman of the Department at the School of Architecture and Environmental Design, suggest that architects have too long been trained to think of themselves as the only source available to interpret client needs.

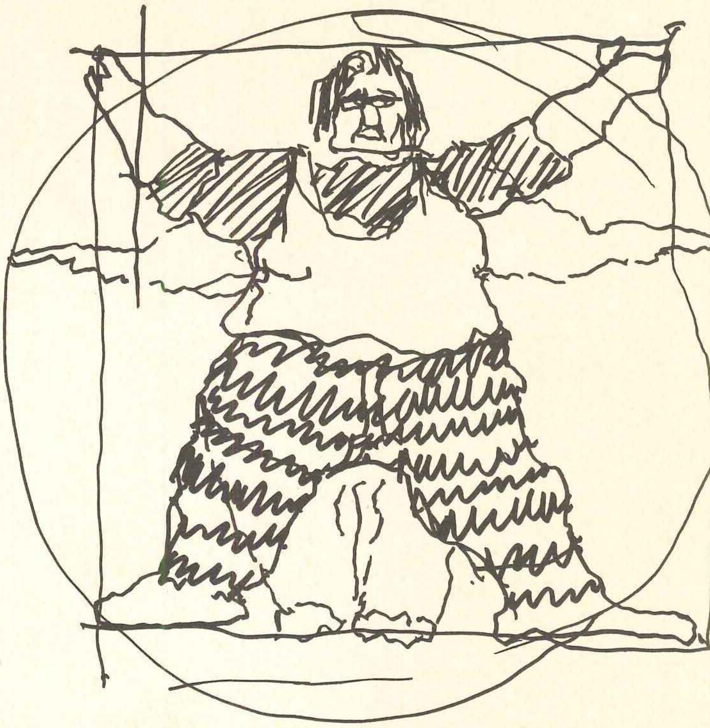
Brill, in answer to questions about the place of aesthetics within the new paradigm, suggests that to return to the age of the craftsman might be a wonderful dream were it not for the fact that craftsmanship cannot be made available to most of the people who need it, particularly the poor. "Artistic activity, the capacity to elaborate the self, to present life enhancing aesthetic options, may be necessary, but it is surely not sufficient. Access to artistic talent *is* necessary, but the concept of an aesthetic life should be linked to another set of issues. If you suddenly made Harlem beautiful, and everyone had access (to this beauty), major changes would still be nec-

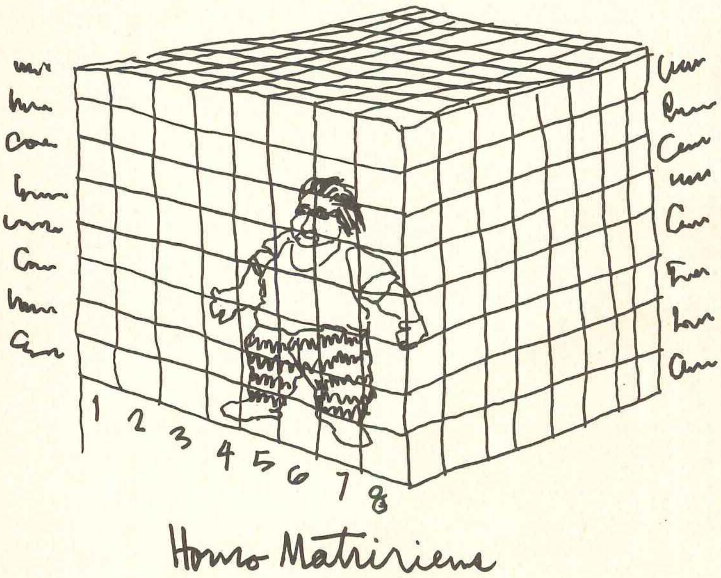


CAPITAL IMPROVEMENTS

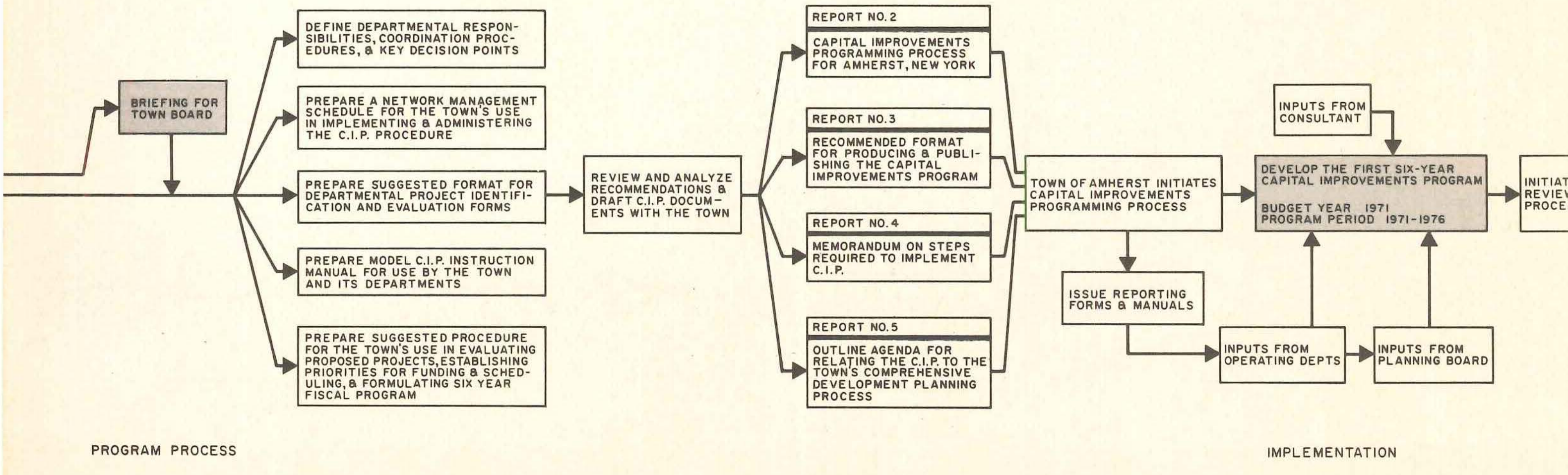
essary for people to feel that they related to it, that they'd come a long way."

Aesthetics are not precluded by systems analysis, but would presumably show up as one of the inputs resulting from a more thorough understanding of the client's needs. In whatever form that client defines such a term, it would enter the programming. Drawing the definition of aesthetics, and a summation of where it fits into the scheme of things in Buffalo are best accomplished by this comment from John Eberhard: "You have an interesting question in what is meant by aesthetics. Some time ago we researched the question of aesthetics with a student and came to the philosopher Schleiermacher who defined it as 'the proper relationship of artistic activity to a scheme of ethics.' Now, that obviously raises some more questions. What do you mean by a scheme of ethics, and what do you mean by a proper relationship? We decided that a proper relationship, which we got from another set of philosophers, was a natural result of an internalization of a set of values, not something superimposed. An example would be of a corporation or profession that properly related artistic activity to its scheme of ethics, that is, the relationship would not be something on paper that everyone saluted but no one really paid any attention to, it would be something that was internalized by the individuals through the organization and grew out of their felt needs. So what is the scheme of ethics, then? That is a much tougher thing. It seems that in a democracy in the United States at this point in time it would include the notion of equal opportunity, that all men have at least the right as Americans to have access to a number of things. If the relationship of artistic activity to a scheme of ethics says that every American should have an opportunity to benefit from those whose design skills can be utilized in the resolution of the built environment, then not only does it mean that it is an internal result (which I would think the new paradigm would be closer to than the old one), but that the scheme of things of the total design process of the nation cannot preclude access by people to that artistic activity. It absolutely is precluded now because there are not enough people by the present process, there are not enough architects even if they have the skills. The nature of how design skills are paid for requires a considerable investment of money, and the nature of what architects, of the old paradigm at least, think important for that investment to produce precludes equal access. We easily borrow the model from deToqueville in his book on democracy in America about making watches. He said that when only a few people had watches in their pockets they were beautifully crafted, handmade, very expensive objects. When they became mass-produced





Drawings: Paul Laseau



Core Knowledge-BOSTI, Building Systems Design Program

Subjects (by relationship to problem-solving process)

	Subject	desired level, all Research Assistants: pre-project	end 1st yr.	end 2nd yr.
concepts	concept of systems	2	3	4
	performance concept	2	3	4
	user needs concept	2	3	4
	new paradigm concept	1	1	1
	concept of feedback/feedforward	1	3	4
	definition of technology	1	1	1
	concept of ecology	0	1	2
skills	systems analysis	2	3	4-5
	operations research		2	2
	symbolic logic	0	1	2
	cost-benefit analysis	0	2	3
	PERT/CPM (related to project planning & budgeting)	1	3	3-4
	graphic systems analysis tools	1	3	3-4
	information systems & search methods	1	3	3-4
	uses & interpretation of statistics	1	2	3
	survey research techniques	1	3	4
	questionnaire design	1	2	3
	computer uses	0	2	2
	computer programming	0	2	2
	Hermes techniques (analysis)	0	1	2
	research design and methods	0	2-3	4
skills	design processes	2	2	3-4
	design of structural subsystems	option for specialization		
	design of panel subsystems	option for specialization		
	design of mechanical subsystems	option for specialization		
	design of field-assembly systems	option for specialization		
	design of plant-assembly systems	option for specialization		
	Hermes techniques (invention)	0	1	1
	reading arch'l plans & programs	0	2	2
information	market approaches	0	2	3
	economics (beyond budgeting & accounting)		2	2
	traditional bldg. industry (unions, laws, codes, inst.)	1	2	2-3
	developing industrialized building industry	1	2-3	4
	building systems & Components	1	2-3	3-4
	structural subsystems	1	2-3	3-4
	panel subsystems	1	2-3	3-4
	mechanical subsystems	1	2-3	3-4
	field-assembly systems	1	2-3	3-4
	plant-assembly systems	1	2-3	3-4
	materials & construction	0	1-2	2
	history (or survey) of environmental technology (transport, commun, etc.)	0	2	3-4
	history of architectural theories & forms	0	0-2	2
	history of the city	0	2	2
	history of planning (city, social, env. etc.)	0	2	3
	pattern language	0	0-1	1
	computerized design	0	0-1	1
	design theories	0	1-2	2

Subjects (by relationship to problem-solving process)

		Subject	desired level, all Research Assistants: pre-project	end 1st yr.	end 2nd yr.
steps III & IV developing test methods; testing	concepts	parametric and non-parametric measurement	1	2	3
		concept of hard & soft measurement	1	2	3
		concept of simulation	1	2-3	4
		concept of cost-benefit analysis	1	2-3	3-4
	skills	simulation methods:	1	2	2
		gaming		3	3
		other non-mathematical models		3	3
		computerized simulation		0-2	2
		physical modeling & testing		0-1	1-2
		forecasting methods	1	2	3
	information	industrial testing	0		1
		government standards (testing requirements, safety standards etc.)	0		2
		proxemics	0	1	1
		human factors engineering	0	1-2	2
		gestalt psychology & its underlying experimental methods	0	0-2	2
step V implementation		accounting	0	1-2	2-3
		proposal writing	0	3	4
		contract writing	0	2	2-3
		teamwork	1	3	4
		use of consultants	1	3	4
		client relationships	1	3	3-4
		problem recognition		3	4
		graphics communication	0	3	3
		information transfer		3	3-4
		presentation skills	0	2	2
		report writing	0	2	2
		report production	0	2	2

Explanation of Levels

1 *Acquaintance:* know it exists (& what it is; be aware of approximate relationship to field.

2 *Familiarity:* know jargon; know how to use consultants; understand its capabilities & limitations.

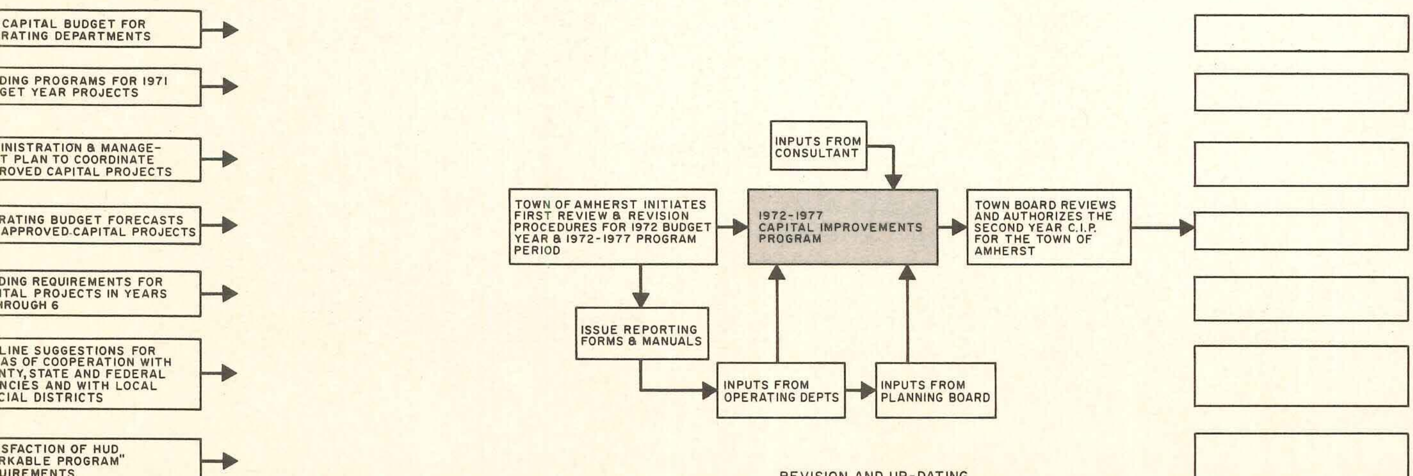
3 *Proficiency:* be skilled in use under supervision, OR be informed as to principles, processes &/or state-of-the-art.

4 *Mastery:* be skillful in use without supervision, OR have expert knowledge of principles, processes &/or state-of-the-art.

5 *Expertise:* have extraordinary skill & knowledge including demonstrated capacity to innovate.

they were not as well crafted and not as elegantly made, but everyone had one in his pocket. If a watch has some utility, and the only way you can get a watch is to buy the product of a craftsman, if you have to invest $2000, and if those craftsmen preclude the possibility of everyone having a watch simply by maintaining the level of involvement of their task, that's not a proper relationship of an artistic activity to a scheme of ethics, and therefore it is not aesthetically satisfactory."

BOSTI and the School of Architecture and Environmental Design at Buffalo have begun, offering an alternative in the training of environmental professionals. The school exists to attempt to fill the need for that broader vision of the interrelated aspects of the built environment. It challenges old meanings, then accepts its own challenge. [DM/JM]



Reinhold Publishing Corporation's

P/A annual design awards program for projects not yet built

Progressive Architecture announces its nineteenth annual Design Awards Program. Awards will be made to U.S. and Canadian architects, urban planners and their clients for projects now in the design stage to be built in 1972 in the United States and Canada. Any building, group of buildings or urban planning project, will be eligible.

Purpose of the Design Awards Program is to give recognition to good design in the period of design development, rather than after completion, in order to encourage the designers and owners of the projects so honored.

First design award, awards, and citations may be given by the jury listed below to the best projects chosen on the basis of site use and development, choice of structural system and materials and methods of construction, solution of the client's program, and overall design excellence. **Jury** will be composed of the following architects, planners and engineers: **Richard Bender,** Principal of a Consulting Practice in Architecture, Engineering and Building Technology, Professor of Architecture and Director of the Architecture Experiment Laboratory, College of Environmental Design, University of California at Berkeley; **Charles A. Blessing,** Architect, Professional Community Planner, Civil Engineer, Director of City Planning, Detroit City Plan Commission, Adjunct Professor, Department of Urban Planning, Wayne State University, Graduate School; **Earl R. Flansburgh,** President, Earl R. Flansburgh and Associates, Inc., Cambridge, Mass.; **M. Paul Friedberg,** Partner-in-charge of Design and Planning, M. Paul Friedberg & Associates, Landscape Architecture and Urban Design, Professor and Director of Urban Landscape Program at City College, New York; **Ian L. McHarg,** Partner, Wallace, McHarg, Roberts and Todd, Architects/Landscape Architects/City and Regional Planners, Philadelphia, Professor and Chairman, Department of Landscape Architecture and Regional Planning, Graduate School of Fine Arts, University of Pennsylvania; **John C. Parkin,** Partner, John C. Parkin, Architects, Engineers, Planners, Toronto; **Moshe Safdie,** Architect, Moshe Safdie Architect, Montreal, Charlotte Shepherd Davenport Professor of Architecture, Faculties of Design and Planning, School of Art and Architecture, Yale University, New Haven; **Louis Sauer,** Principal, Louis Sauer Associates, Architects, Philadelphia.

Judgment will take place in Stamford, Conn., during September 1971. Winners of Awards and Citations will be notified (confidentially) immediately after the judgment.

Announcement of the winning projects will be made at a presentation in the home town (if practicable) of the recipient of the First Design Award. Winning projects will be featured in January 1972 P/A. As in the past, P/A will arrange coverage of winning projects in news media, particularly in those localities of the Award and Citation winners.

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Submissions do not require filling an application blank. For each project you submit, simply send:

1 On a 5″ x 8″ card, type the client's name, location, and proper name of project; name and address of the architect; and identify all items included in the submission.
2 Brief explanation of the program and your solution.
3 Description of materials and construction methods used, and the reasons for their use.
4 Site plans; basic building plans; pertinent sections and details.
5 Perspective or model photographs.
6 A statement that: (a) the project is now in the design stage and that construction is anticipated in 1972; and (b) that submission of a project for judgment gives **Progressive Architecture** first rights in the architectural field to publish both the project and the finished building if it receives an Award or Citation.

It is preferred that you submit 8″ x 10″ prints, photostats or photographs bound in a folder. Original drawings, actual models, or mounted exhibit panels will not be accepted and no material is to exceed 11″ x 17″ in size. Each project is to be submitted under separate cover. Anonymity is not required.

Deadline for mailing is August 31, 1971. Address entries to Awards Editor,

Progressive Architecture
600 Summer St., Stamford, Conn. 06904.

P/A will guard and return all submitted material.

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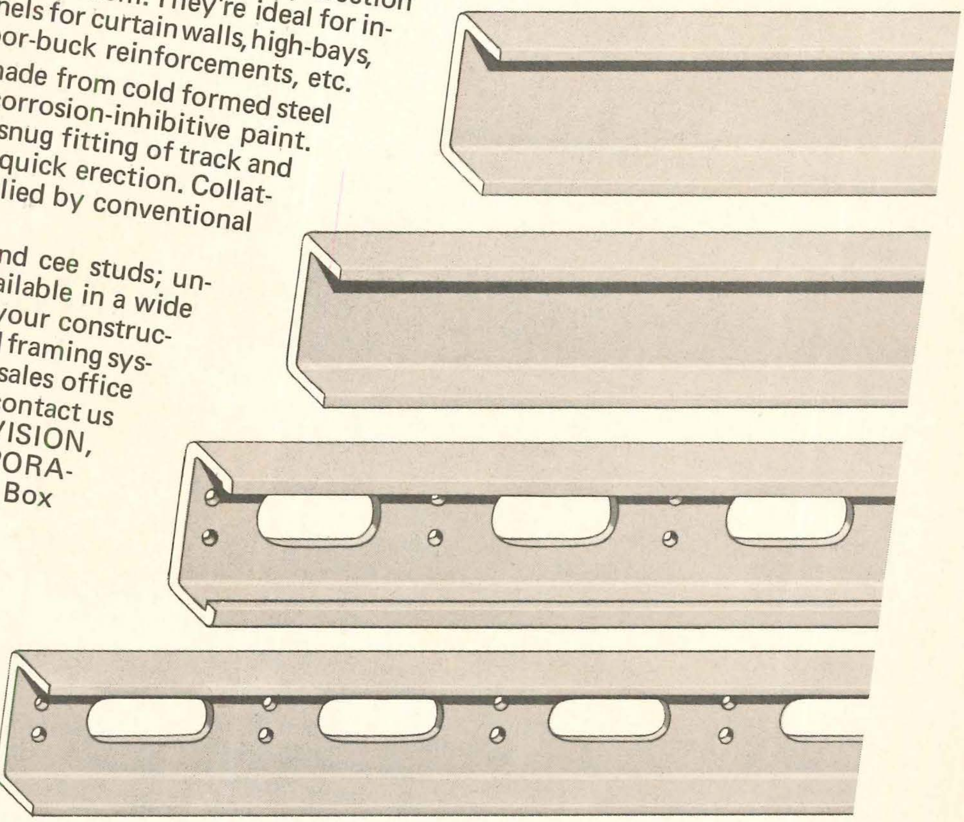

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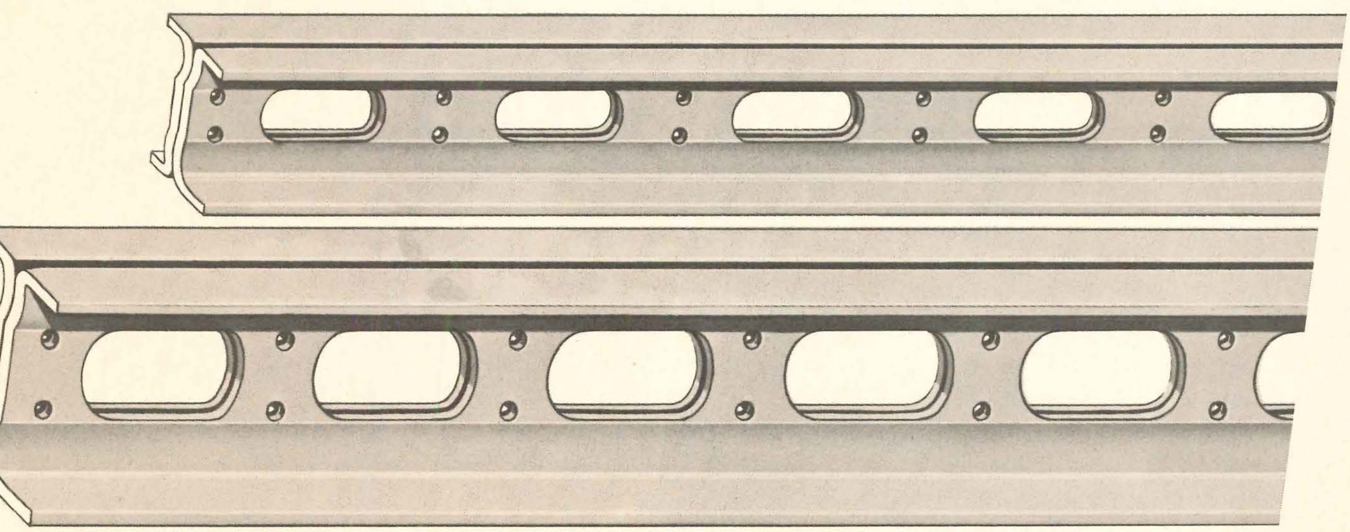

Specifications clinic

Liquid membrane waterproofing

Harold J. Rosen, PE, FCSI

In order to assess the many new waterproofing products flooding the market for plaza and terrace area use, the industry must develop a reference standard

In recent years a new concept in waterproofing has evolved designed primarily for terrace and plaza areas over occupied spaces. It consists of a liquid applied elastomeric coating containing essentially a rubberized bitumen using polysulfides or polyurethanes in combination with asphalt or coal tar pitch. Some manufacturers are also using reclaimed rubber mixed with asphalt or tar.

Theoretically, the system is designed so that any water that penetrates does not move laterally underneath the membrane. In practice, a leak would therefore occur at the point of puncture since the system is designed to assure complete mechanical adhesion to the substrate. Remedial action would be simplified since the leak could be pinpointed; it would not be necessary to remove large segments of paving, insulation and waterproofing as is presently required for repairs with built-up membranes or with elastomeric sheet systems using neoprene, butyl, polyvinyl chloride or EPDM. In these systems water entering through a rupture can move beneath the system to some distant point, which defies pinpointing the actual rupture.

Unfortunately, this new concept has been beset by problems, largely due to the development of a host of products, manufactured by dozens of formulators without any guidelines or standards that the specifier can use to analyze, evaluate and select a liquid membrane system. At a recent workshop session sponsored by BRI in conjunction with Committee C24 or ASTM, it was disclosed that there are some 80 products that purport to be liquid membrane systems. Each manufacturer claims to formulate a superior system and the specifier finds it difficult to assess the products in comparison with each other.

There is no industry standard or specification that would establish a minimum requirement the specifier can use in either assessing the material or in specifying it. Each manufacturer describes his product in different terms. Each uses differing ASTM test criteria to describe certain physical characteristics of his product. Each recommends differing mil thicknesses to be used in the product's application. Each recommends differing conditions with respect to the substrate and to the application of finished paving.

If the specifier described the material of one manufacturer, he would exclude others, since the formulation can be an elastomer containing polysulfide or polyurethane and the bitumen can be either asphalt or coal tar. If the specifier described the wet mil or dry mil thickness he would find that there were variations from product to product. If he attempted to prepare a performance specification, based upon the performance data developed through the testing of the materials of several manufacturers, he would find very little correlation among them and would find it most difficult to write a performance specification.

It is quite apparent that a reference standard should be developed, either by the manufacturers, by ASTM, or by the federal government through a federal specification that will reduce the existing confusion. In addition, the industry should police itself through some minimum association rules that would eliminate the fly-by-night vendors and others who make unsubstantiated extravagant claims for their products.

What are some of the criteria that should become part of a reference standard? The reference standard should establish an adhesion in peel test for both wet and dry surfaces. This would be a measure of the mechanical bond of waterproofing to the substrate. A minimum vapor barrier transmission value should be established. Another important criterion would be ability to span a crack in the substrate of up to ⅛ in. Virtually all concrete structures develop hairline or minute cracks and the liquid membrane system should possess elastomeric qualities that would elongate up to ⅛ in. without failure. Another physical characteristic is the ability of the system to heal itself. During the construction process after membranes are installed, they are subjected to the abuse of succeeding construction trades engaged in decking over the membrane.

Punctures are sometimes induced as a result and a good membrane should have the capability of autogenous healing. Another criterion would involve changes in the elastomeric qualities due to the aging process. Heat aging, and exposure to alternate wetting and drying, should be investigated to determine whether elongation, adhesion and ability to heal are affected by this aging process. Recommendations should also be made with respect to flashing details, application techniques to insure mil thickness, and protection courses to be used above the membrane.

The sealant industry was required to go through this same process to achieve a measure of respectability. It's time for the manufacturers of liquid membrane systems to pool their efforts to determine criteria and develop a much needed reference standard.

Author: Harold Rosen is Chief Specifications Writer of Skidmore, Owings & Merrill, New York City.

Designs on Intelligence

The Architecture Machine *by Nicholas Negroponte. Cambridge: MIT Press, 1970. 153 pp., illus. $5.95 (paperback).*

Reviewed by Murray Milne. The reviewer is Associate Professor of Architecture at UCLA.

The Architecture Machine does not exist and most assuredly never will. However, a superb little book about The Machine does exist. The book is skillfully written, elegantly designed and presents a case that is compelling and enlightening. Like most utopian tracts, this one must be taken more on faith than on fact. But visions of a utopian future, however unattainable, still have the power to guide and direct the course of present events. Be forewarned, the ideas in this little book will change the practice of architecture.

Negroponte has dedicated his book, "To the first machine that can appreciate the gesture," and this precisely captures the essence of his thesis. The book begins with a quick review of some of the more interesting developments in man-machine communication, computer graphics and design methodology. It then turns to the business at hand—computer-aided design.

Negroponte is suggesting that we could build an Architecture Machine that is capable of understanding metaphors, recognizing goals and detecting changes in context. It should be able to go out into the environment to collect certain specific pieces of information, or to sift through great piles of data and sort out certain kinds of things, or to work along beside the architect and keep track of the decisions he has made and be able to hand him any piece of information he needs. Perhaps if the Architecture Machine knew the architect intimately, it could hand him a piece of information an instant before he needed it.

Interestingly enough, a few pieces of The Machine already exist. They were designed and built by Negroponte and Leon Grosser and their students. Some of these devices exhibit a kind of adaptive or "learning" behavior, and most of the at least at first, seem to generate variety an interesting and surprising way. GROW is a computer program that controls the distribution of solids and voids arrayed a flat plane. Each new element that is added to the array affects all of the loca tions in its immediate vicinity by modify the probability that they will in turn bec either solid or void. As this procedure is repeated over and over, the resulting pa terns seem to exhibit properties which semble certain natural growth processe

LEARN is a computer program designe to observe and imitate a designer's personal mannerisms. First it is "shown" a series of solutions to the problem of arranging solids and voids in three-dimen sional space, then it is instructed to gen ate a new solution based on the informa tion it has learned about the probability that any particular location was occupie by a solid or a void. Its first attempt appears to be a fair approximation of the "mannerisms" contained in the initial solutions (massing, number of element amount of coverage, etc.). However, be cause it operates purely statistically, its [continued on page 108]

This advertisement has no headline. It is merely a factual statement, but one that we believe is of vital import to every architect and engineer.

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TCS has no equal among standard architectural metals in resistance to atmospheric corrosion.

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It's a fact the giants of the pneumatic control business have many more service installers than Barber-Colman. That's *quantity*.

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It's a fact that big jobs—with unusual control and air distribution problems—can confound the giants. For example, interfacing pneumatic, electric, and solid-state controls and then making them work in a tough air-delivery situation can have some people talking to themselves in no time.

It's also a fact that Barber-Colman is thriving on big jobs the giants won't take. The main reason is we're the only control manufacturer that builds pneumatic, electric, hydraulic, and solid-state systems . . . plus our own complete line of air distribution products. Which means our people think and work in terms of the total environmental system, rather than independent functions. Things that have to work together get designed together so that the tough jobs—and the easy ones—go in faster, with fewer problems.

Today, a lot of manufacturers will give you any type of control system you need for your job—as long as it's pneumatic. It's also a fact that Barber-Colman gives you the best in pneumatics—and all the other types of control systems, too. And a comparative analysis of job records proves it—we *do* install more types and sizes of environmental control jobs than either of the larger environmental control manufacturers.

If you would rather select than settle on your next control job, get a bid from Barber-Colman. We give you more than control. Your Barber-Colman field office has all the facts about our total capability—including pneumatics. Or, if you prefer, write to Mr. Peter Van Dae, Director of Marketing.

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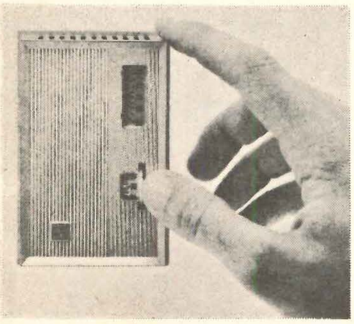

Fact: nobody knows more about pneumatic controls than Barber-Colman.

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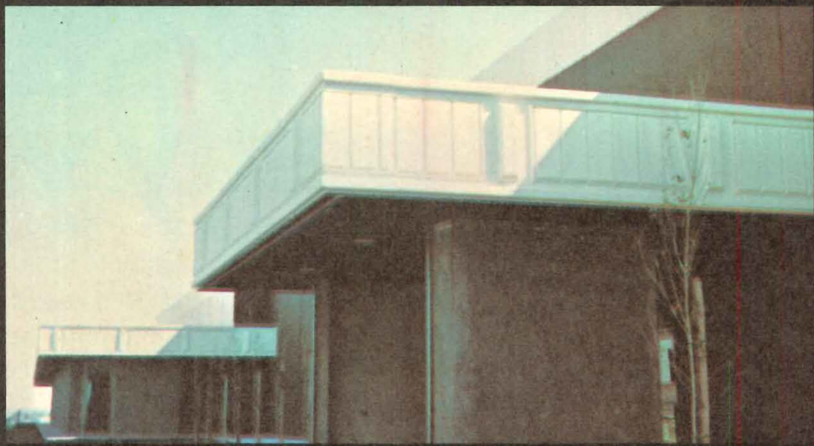
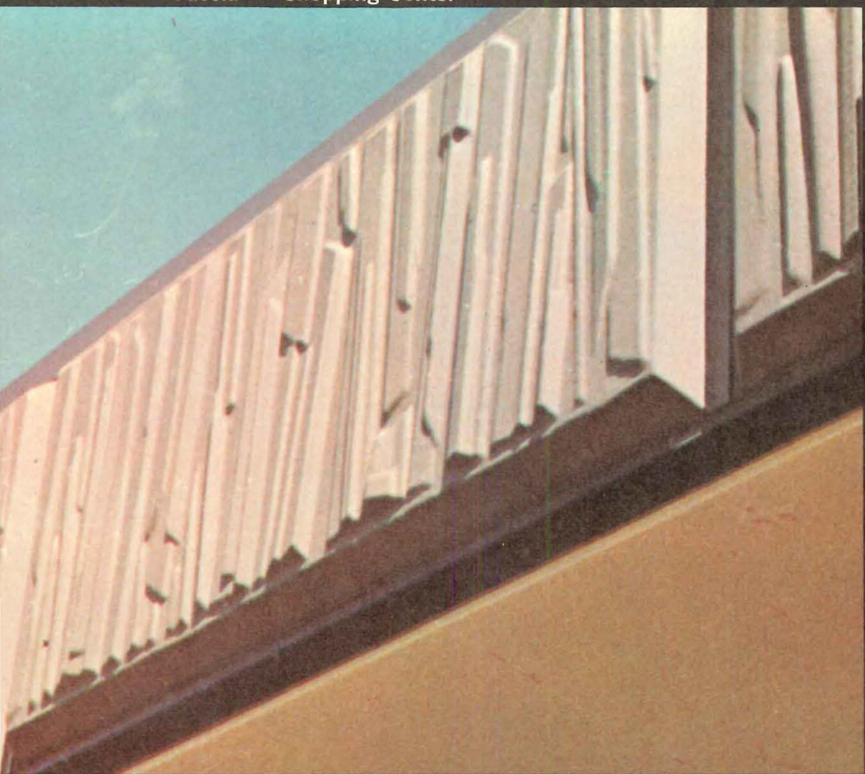
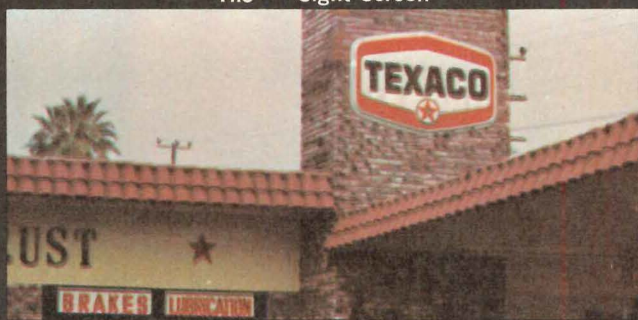
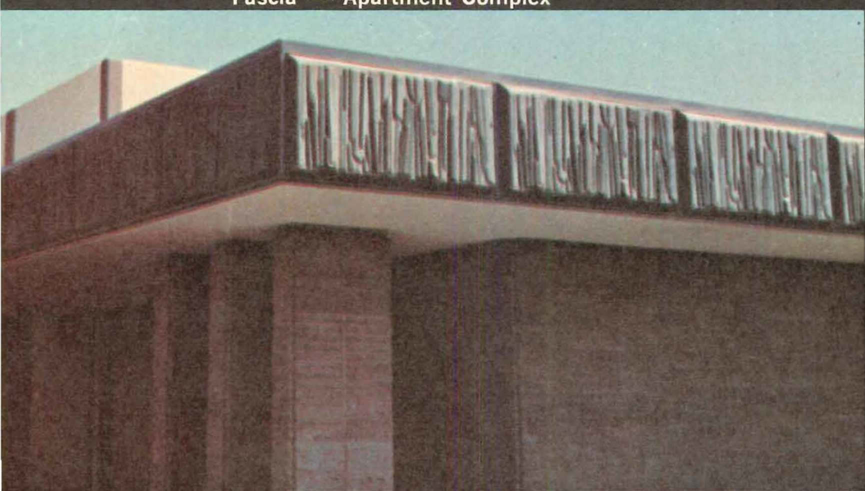

Fascia — Sony Corp.

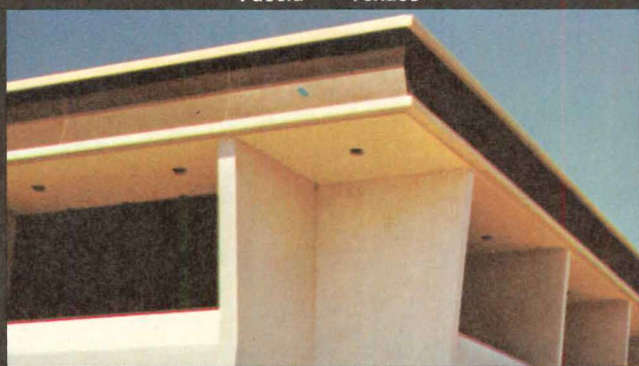

Fascia — Apartment Complex


Tile — Sight Screen



Fascia — Texaco


Fascia — Industrial Complex


Fascia — Ampex Computer Division

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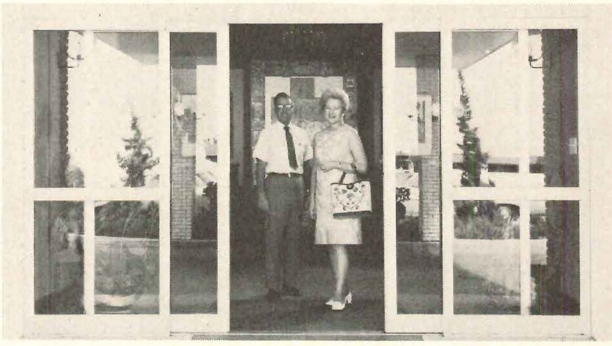

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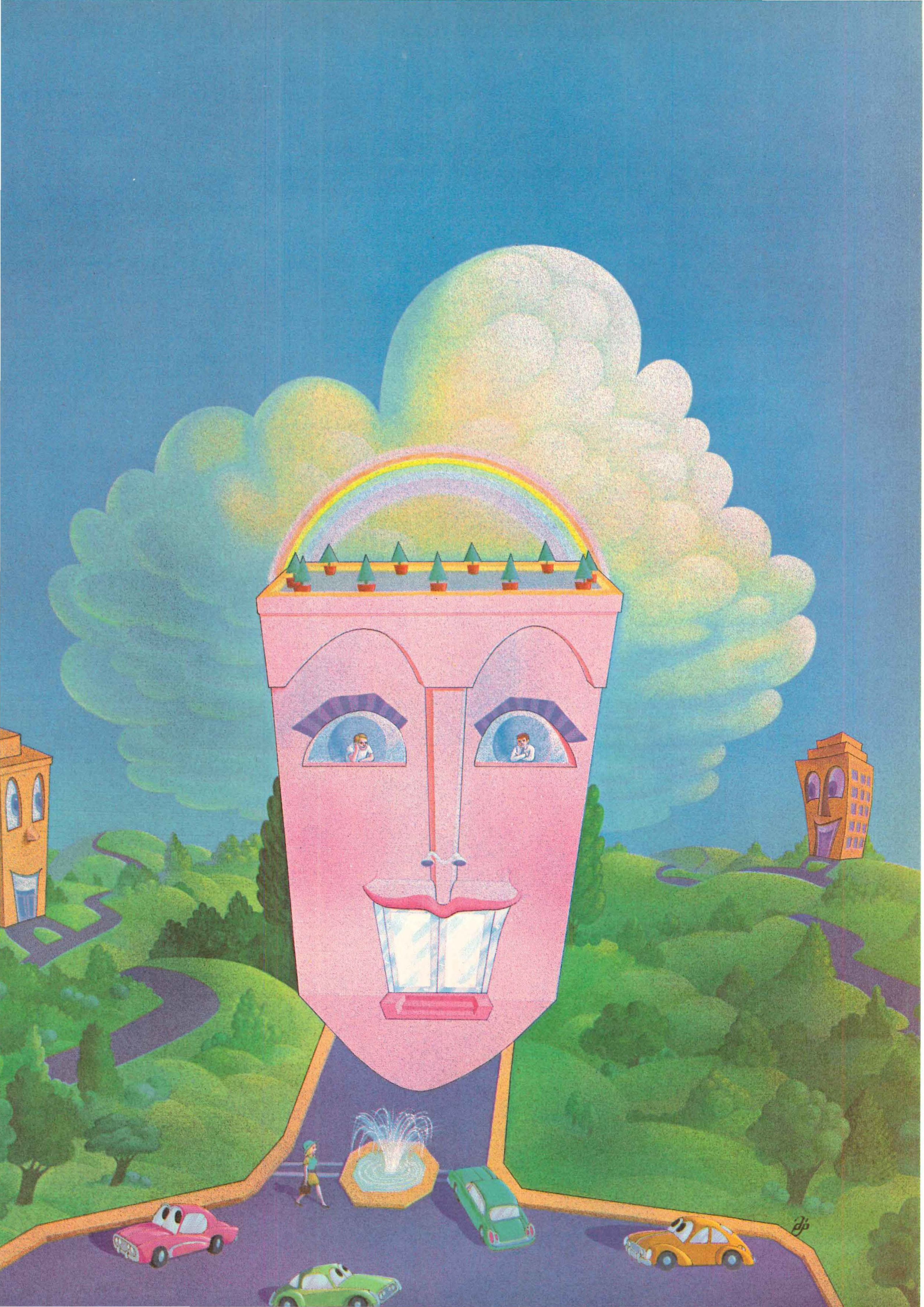


Books continued from page 98

performance on successive trials appears to degenerate into almost completely random distributions of solids and voids.

GROPE consists of a light-sensing unit mounted on a battery-powered toy tractor which can crawl around over a map and sense the number of light-dark edges which pass under its "eye." The probability that it will make a turn is a function of the number of edges it sees, which means that it spends most of its time groping around in areas with the greatest complexity, or the greatest "interest" in Negroponte's terms.

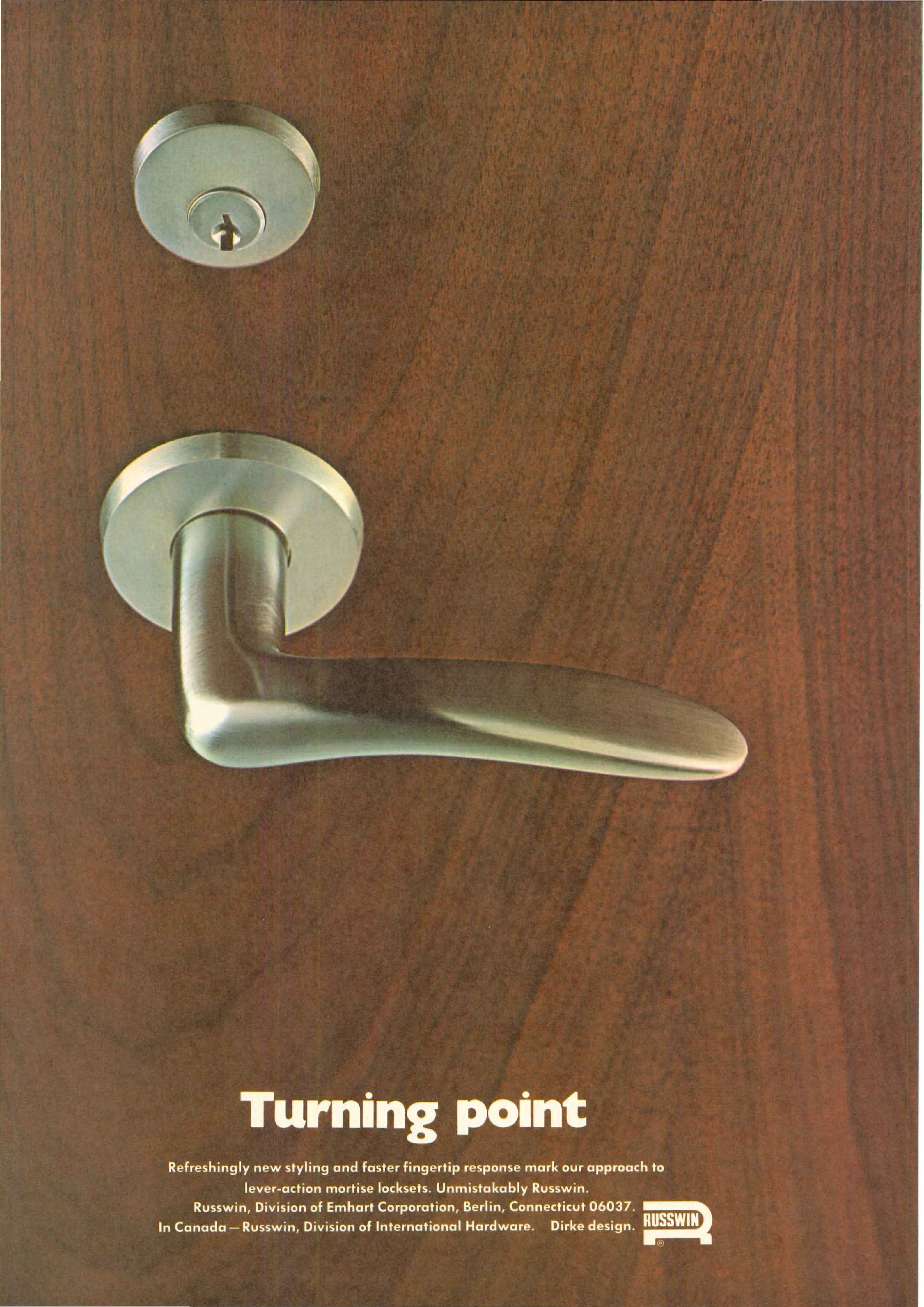
Negroponte also describes a machine called SEEK which plays with baby's blocks. It uses a TV camera to sense their location and a mechanical hand to move them around, all under computer control. One of the most amusing machines is STUPID, which will carry on long conversations with anyone patient enough to keep typing responses into its keyboard. It generates its responses on the basis of the preceding statement plus a few word strings randomly selected from its memory of earli conversations. The non-sequitors it pro duces are tantalizingly close to being meaningful, given the redundancy of th English language.

Just to avoid possible confusion, it should be noted that Negroponte has n bered the chapters of his book in binar perhaps so that any computers who ha pen to pick it up might feel more comfortable. Chapter 101 (or 5 for you old-fashioned decimal types) performs a po mortem on URBAN5, a computer-graphic interactive "urban design partner," whi is to date the most sophisticated and si nificant demonstration of the feasibility computer-aided design. This system ha been abandoned, because it was unab to evolve in response to the designer's needs, and in fact could only perform a repertoire of very specific functions wh were imposed by its originators. It was condemned for relying "completely an all times on the good judgment of the h man designer," but if this is a flaw, it is which no system can escape. In spite o shortcomings, URBAN5 was a valuable a important first step: the lessons learne from it will influence the design of coun less systems yet to come.

It should be pointed out that every o the systems that Negroponte describes LEARN, GROWTH, GROPE, SEEK, STUPID and URBAN5—has a built-in random number generator which adds a certain amoun variety and surprise value to the output There is nothing unethical about rando number generators. In fact, they are absolutely essential. However, the surpris they produce must not be confused wit insight or innate "intelligence" on the p of the system; they are purely a statistic phenomenon.

In none of the parts of The Architect Machine that Negroponte describes is the existence of random number gener ators made explicit. It might be argued this is fair enough since the book is intended only to illustrate a few basic prin ciples for a general audience. However the danger in this is that the reader is le with the impression that these various s tems are capable of performing with fa more sophistication than is the case.

In setting up a working partnership b tween an architect and a computer, on the most important considerations is de ciding which functions to assign to the man, and which to assign to the machi It is this seemingly benign issue which proves to be the most controversial.
[continued on page 116]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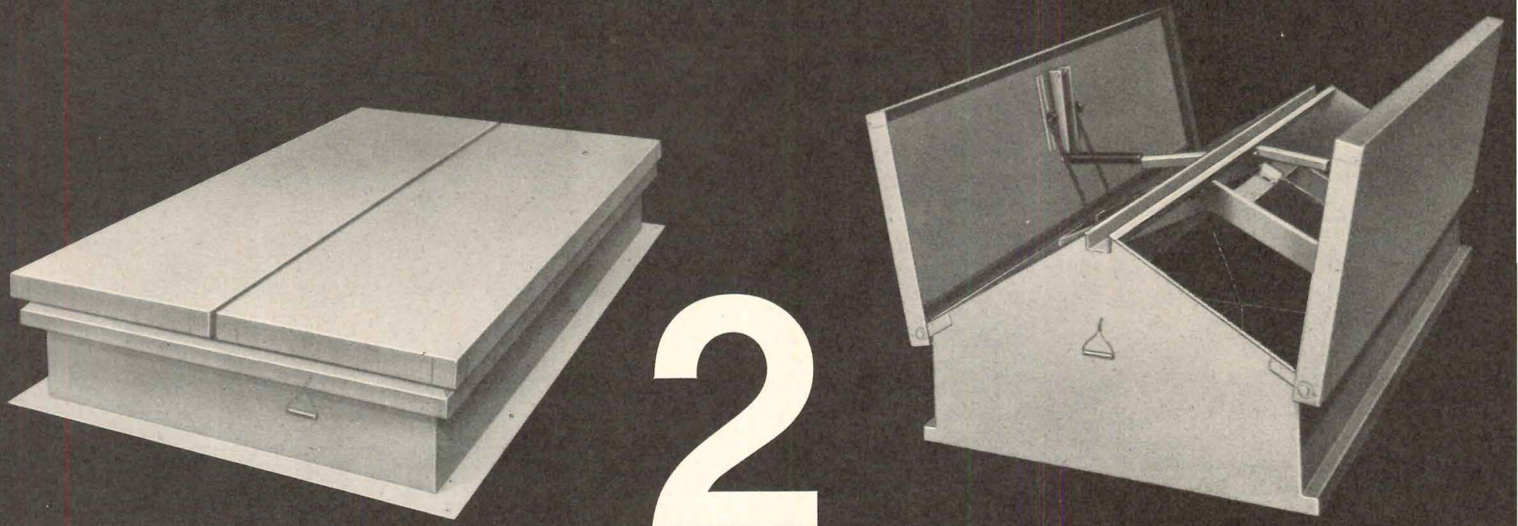

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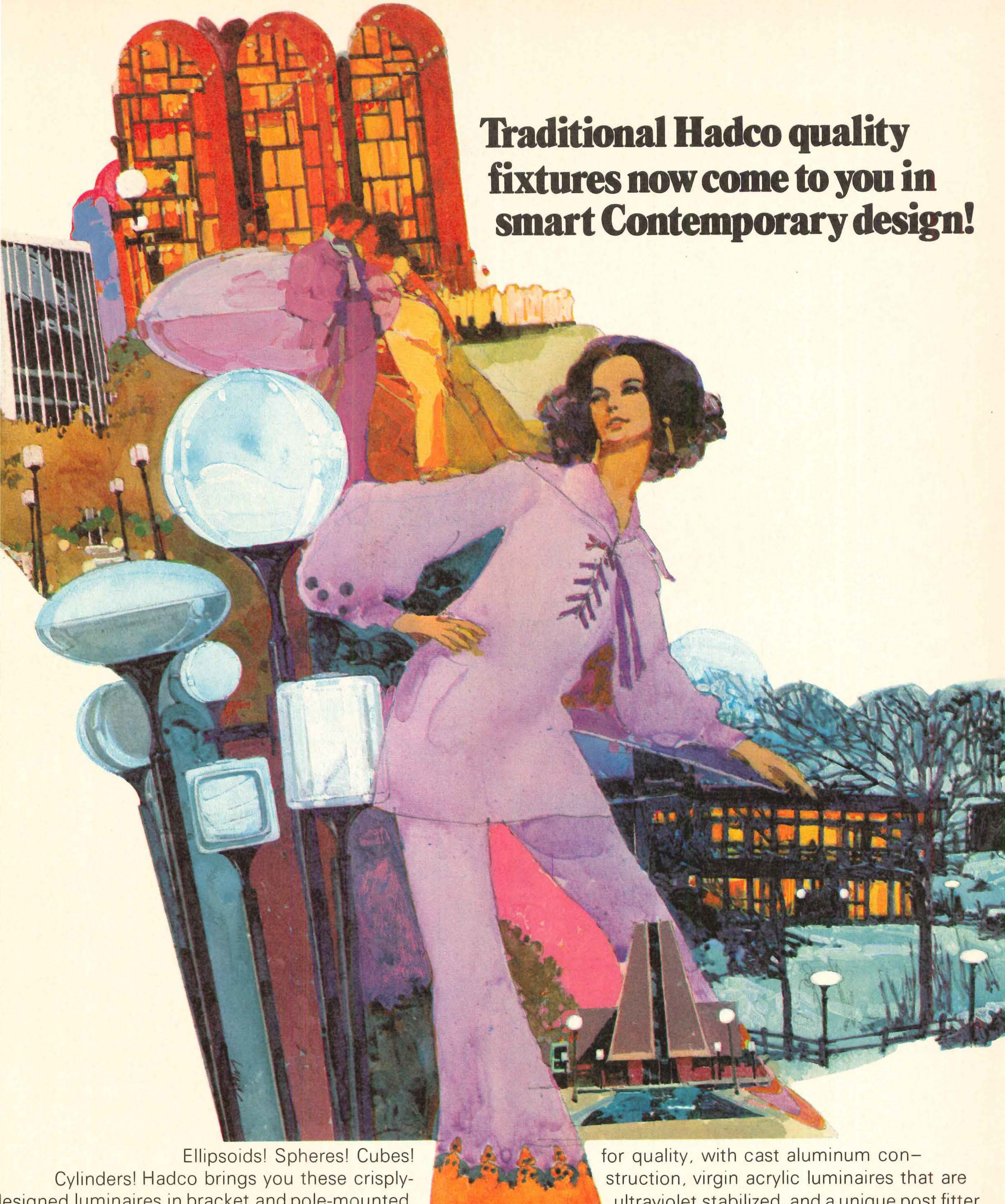

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Books continued from page 108

There are at least three different philosophies that are operative in the area of computer-aided design. The first might be characterized as the simple deterministic approach. If the problem has only one answer, there is no need for discussion. All one can do is input the criteria and wait for the result. In this approach the computer is doing most of the work. The user must trust the program and understand its limits. The earliest work in engineering and operations research falls in this category.

Unfortunately, the architect usually is confronted with problems which have no specific procedure or algorithm for arriving at a solution. Such situations call for a second philosophy of computer-aided design. This approach relies on the intimate cooperation between man and machine, and might be characterized as interactive or conversational. The architect must not only be able to input the criteria, but he must be able to select and modify the processes used to reach a solution or display the alternatives. Because no single answer is forthcoming, he must be prepared to make the necessary decisions on the basis of his judgment, past experience, intuition or whatever heuristic techniques he can summon. In this situation, the computer can offer a valuable assist, but only up to a certain point, beyond which the architect must worry the problem through to a solution by himself.

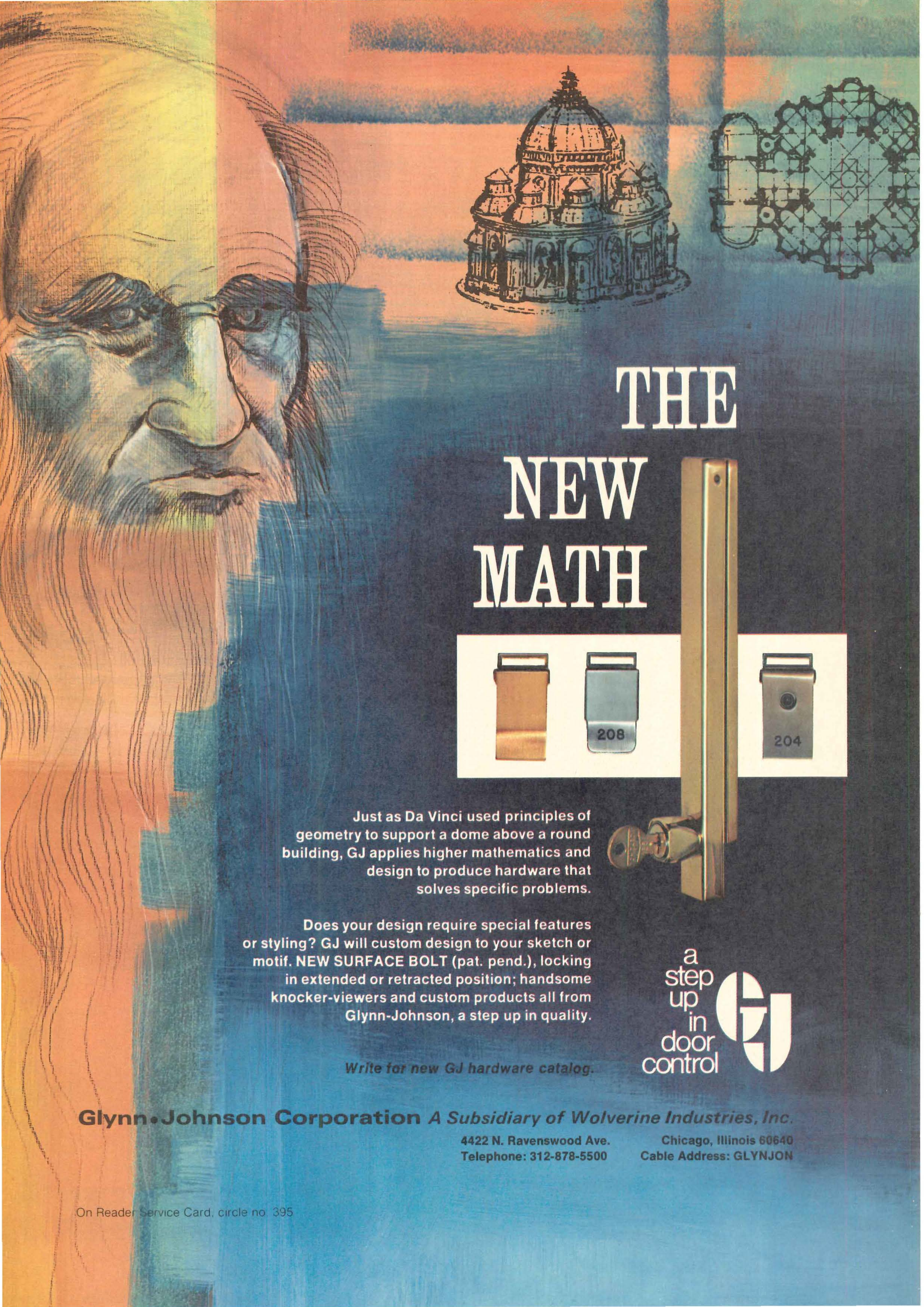
The third approach is the one Negroponte now envisions. It holds that an "intelligent" machine can be induced to "learn" and that it eventually will be able to make those difficult or impossible judgments better than the human. The field of Artificial Intelligence has already shown some impressive results. With a certain degree of success, computers can play chess, read bank checks, prove geometry theorems and play ping pong. But before a computer can perform the function called "design," it must acquire the ability to derive "meaning." Although this is a tremendously exciting possibility, there is little evidence to give credence to this hope.

Machine intelligence is the issue. Before a truly synergistic partnership can exist between a machine and an architect, the machine must exhibit at least some of the attributes of human intelligence. The onl ternative, of course, is to force the hum to think like the machine, and we all kn where that leads.

One of the ways humans think is by g ering many kinds of information from th environment, interpreting this informati on the basis of previous experience an thus deriving new meaning. This proce sometimes called learning. All this seen straightforward enough and so, Negroponte would argue, it should not be too difficult to build a machine which could the same thing. Not much hardware wo be required: a set of receptors sensitive various types of energy (light, sound, h etc.), a reasonably large memory and a simple comparator circuits for detectin differences. In the beginning, such a sy tem would probably exhibit fairly crude amoeba-like performance, but given enough time and a little luck, it could evolve, becoming progressively better.

But now we see the flaw; who deci which is "better" and which is "wors How does such a system acquire its values, its ethics? Every system has a g or ethic which has been imposed upo

[continued on page 120]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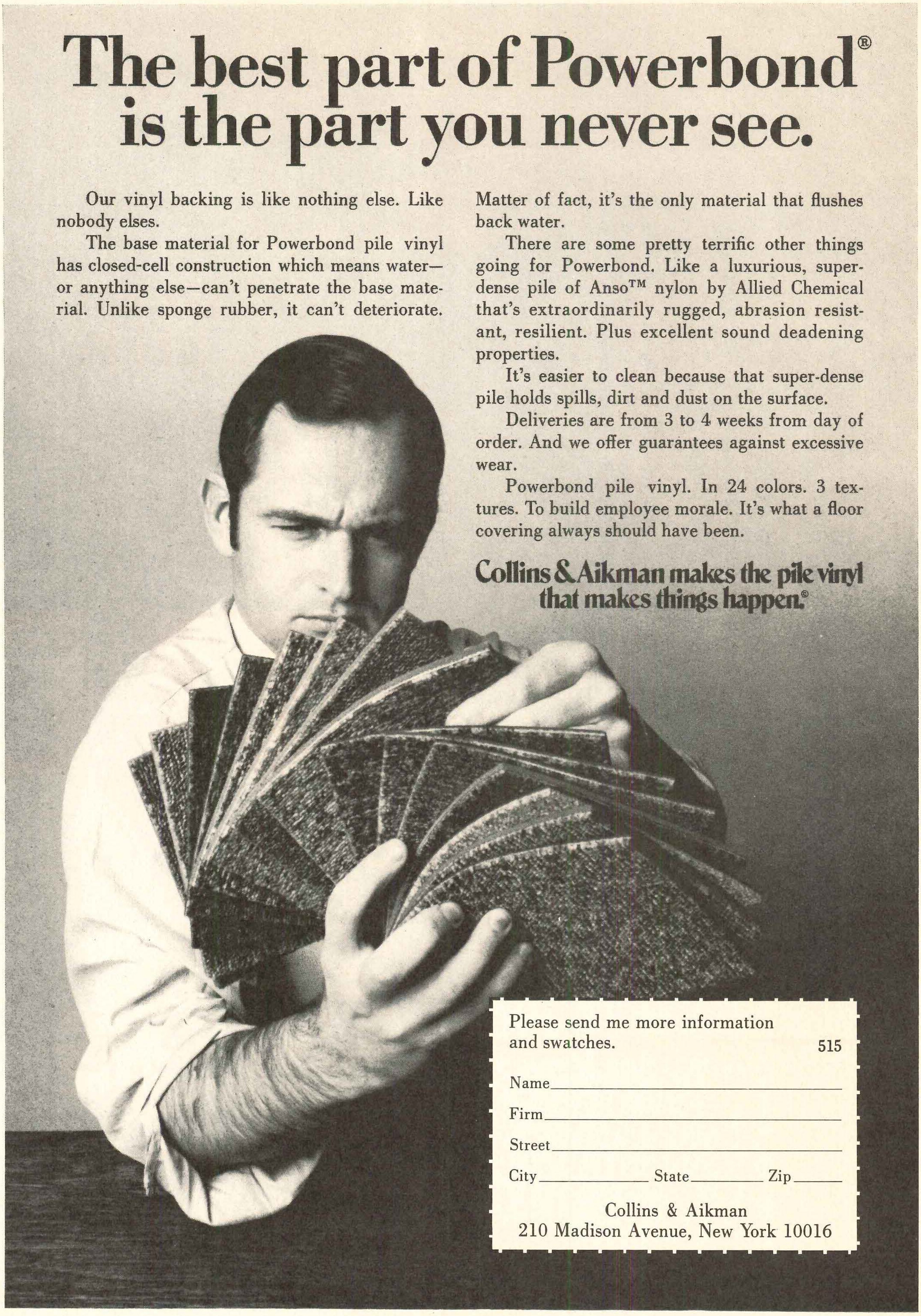

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Books continued from page 116

and which the system is completely i capable of challenging, modifying or e comprehending.

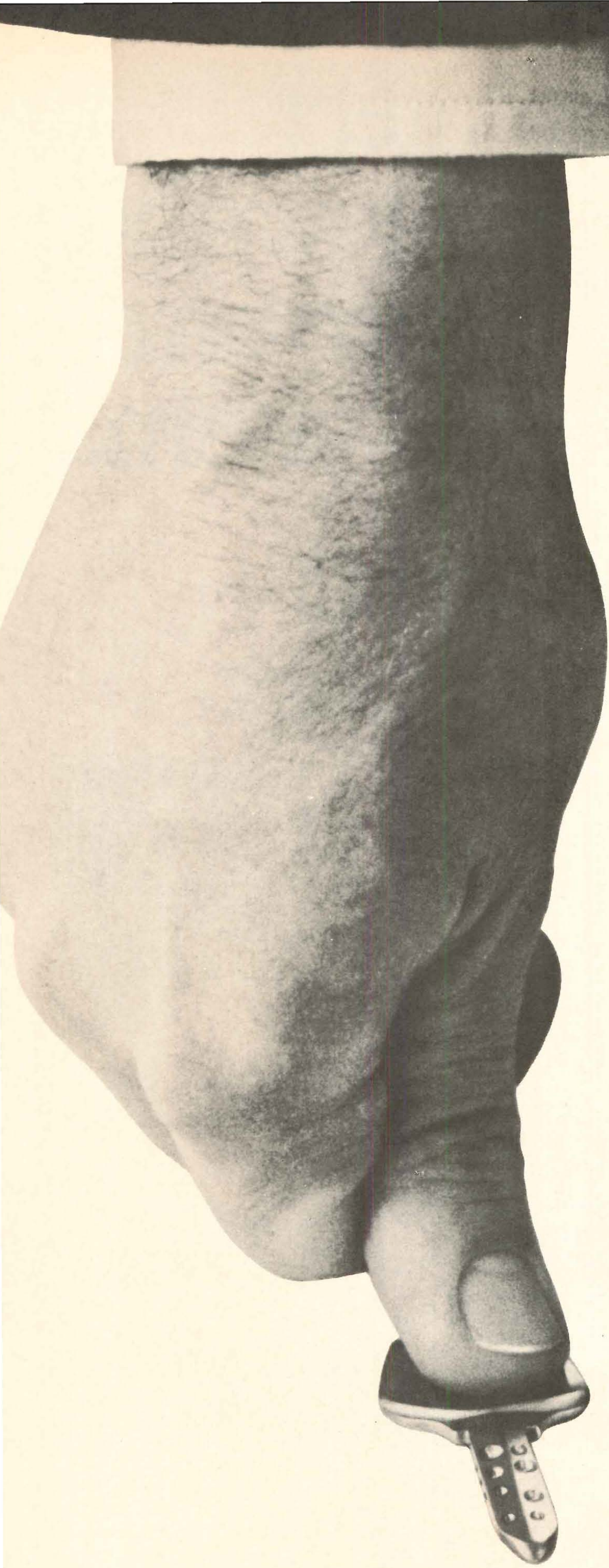
It is true that we can design machin which do, in fact, exhibit a limited kind of "intelligent" performance. That is, i system can modify its present activitie the basis of the outcomes of its previo activities, and if the system has the ab to remember the processes it has use then the system should be able to rec sively devise more efficient strategies achieve a particular goal. These are k as self-organizing or adaptive system But once again, the "goal" of the syst must be imposed by an intelligence w exists completely outside the system.

Negroponte asserts that his Archite Machine will be ethical, but he ducks question of how it will acquire its ethic have a simple answer for Negroponte architect must impose his ethics on th machine. He can attempt to do this di by telling The Machine what is "good" what is "bad," or he can do it indirect selecting the purpose which the syste shall fulfill. This means, of course, tha respect to the ethical criterion, The M chine can be no better and no worse the architect.

Negroponte has not been particula clear about the assumptions he has b into The Architecture Machine and th purpose he intends it to fill. But wheth explicity or implicity, a set of goals h fact been imposed on it. The Architec Machine is ethical because it has bee given Negroponte's ethics.

This is exactly the issue which caus the most apprehension among people fear the prospect of machines perforn more and more of the architect's func The thought of giving some of the hu tasks over to The Machine worries pe who enjoy performing these tasks, or feel these tasks are their best means earning a living, or who use these tas a means of avoiding doing something difficult.

But this, I think, makes clear the rea portance of this book. Negroponte is to show us how we can begin to build chines that are more sophisticated in capabilities, thereby relieving the arc of many of the mechanistic tasks whic is now obliged to perform. This does mean that the architect is any less imp tant, only that he is now free to worry more important things.



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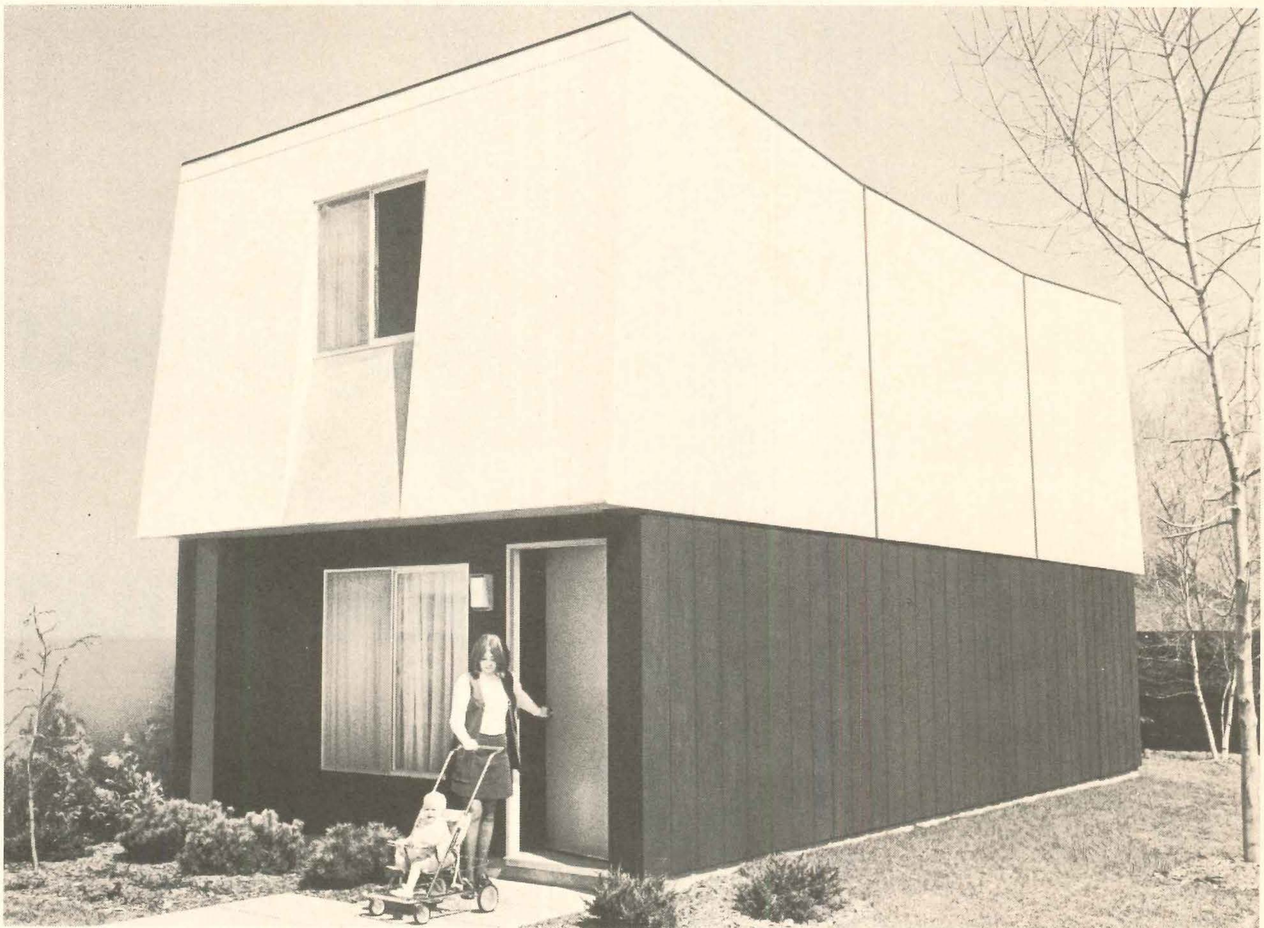

Architects: Roger Allen Associates, Inc.
Grand Rapids, Michigan

Manufactured by: Modular Methods, Inc.
Ernie King, A.I.A., Pres.

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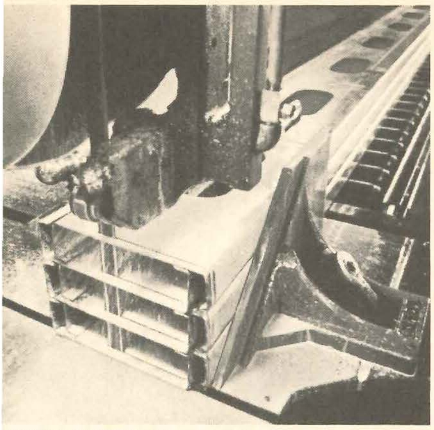

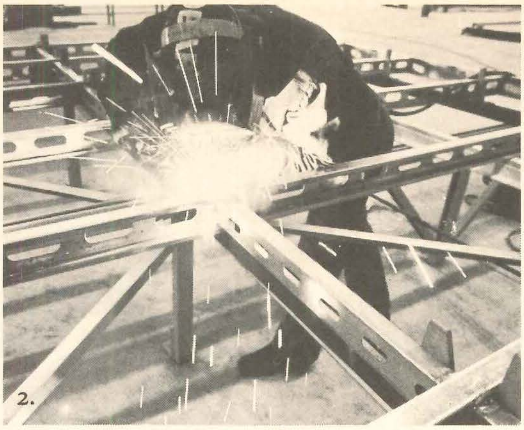

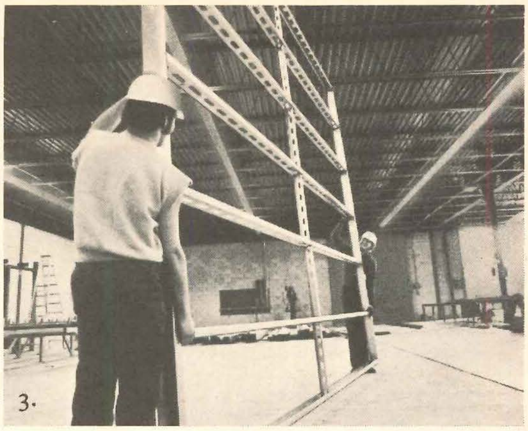

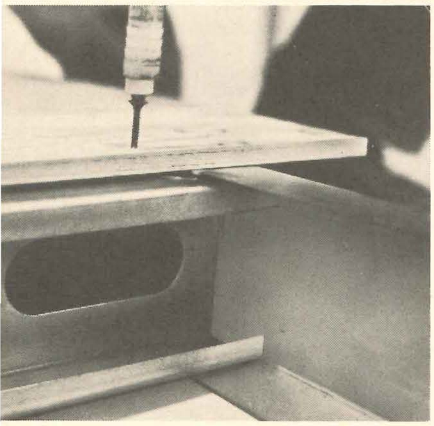

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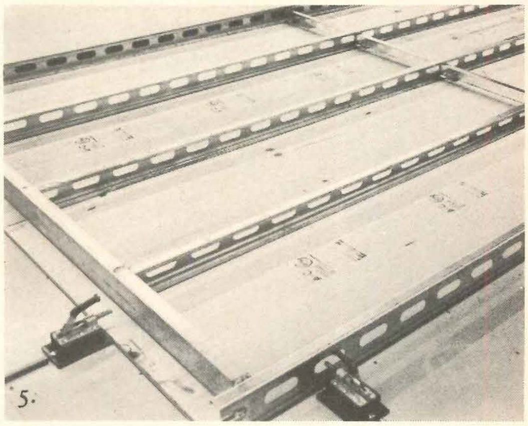

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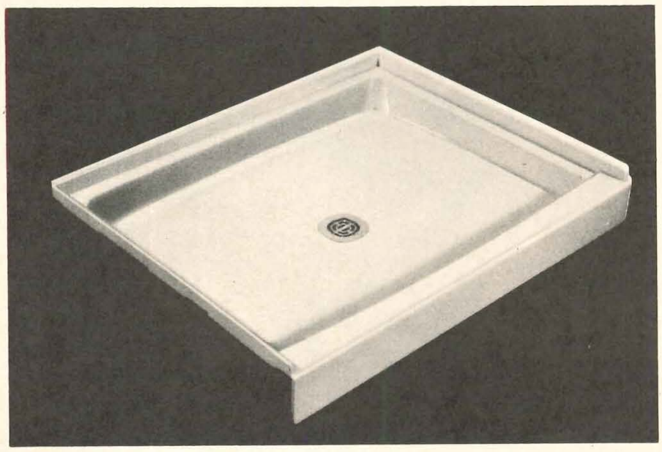

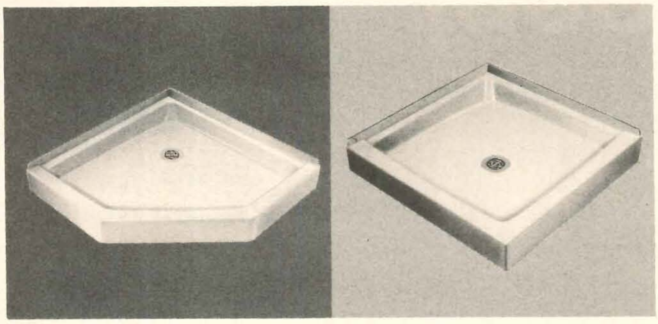

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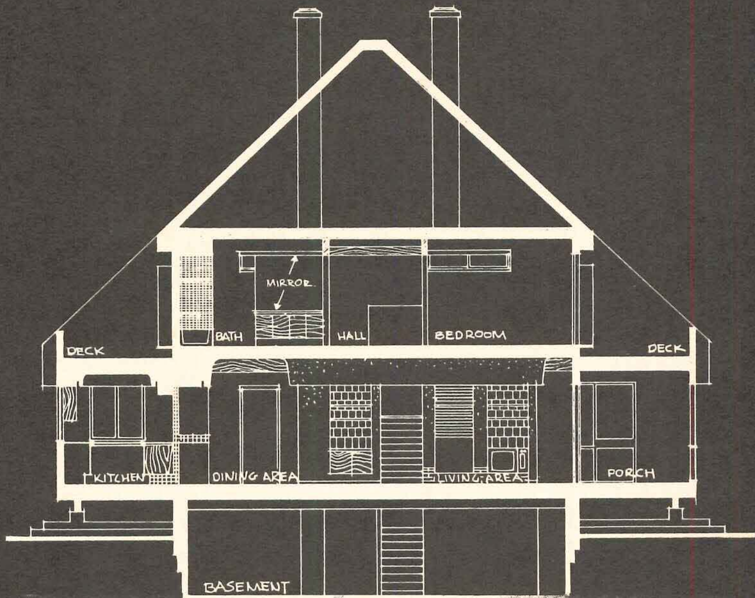

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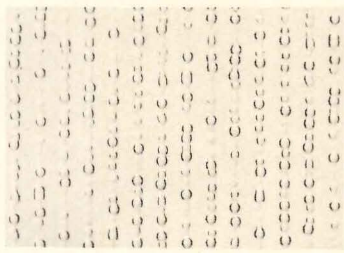

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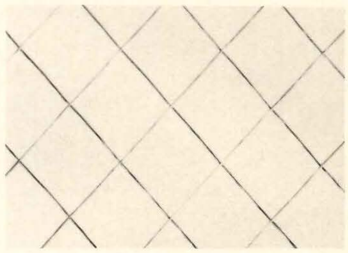

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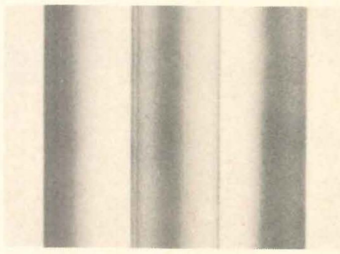

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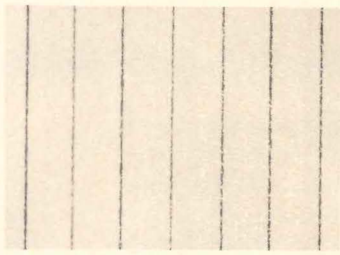

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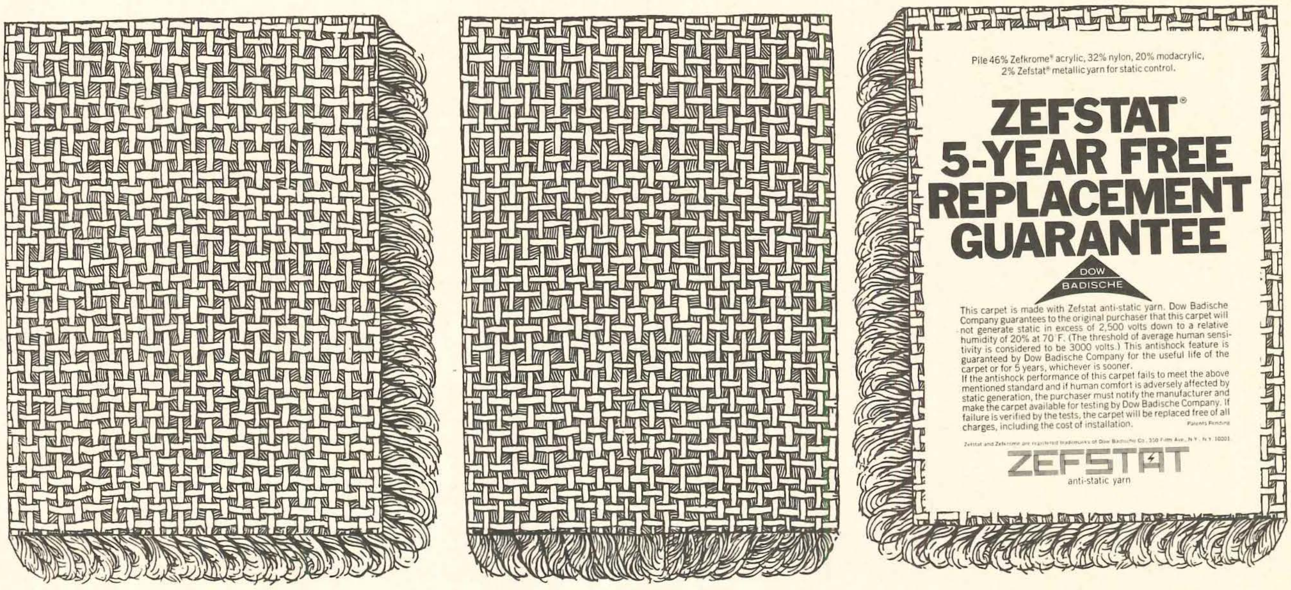

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Architect: Florida registration, AIA, NCARB certificate, 38, family, interested in relocation to Fort Lauderdale-Miami area, to take over coordination of production in firm (partnership potential), and free principal's time for other functions. Wide diversified experience, including FHA procedures. Resume on request. Reply to Box # 1361-257, *Progressive Architecture.*

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Architect: Registered in Illinois; 18 years own practice, consisting of medium size projects —educational, religious, industrial, institutional, commercial, municipal; past experience mostly in office production and field supervision, but have had extensive experience in all phases of architectural practice. Reply to Box # 1361-258, *Progressive Architecture.*

Architect: With twenty years varied experience in architecture and construction, NCARB and registration in five states desires employment in Florida industry, construction, education, architecture or government agency. Area code 513-224-0751 or Box # 1361-259, *Progressive Architecture.*

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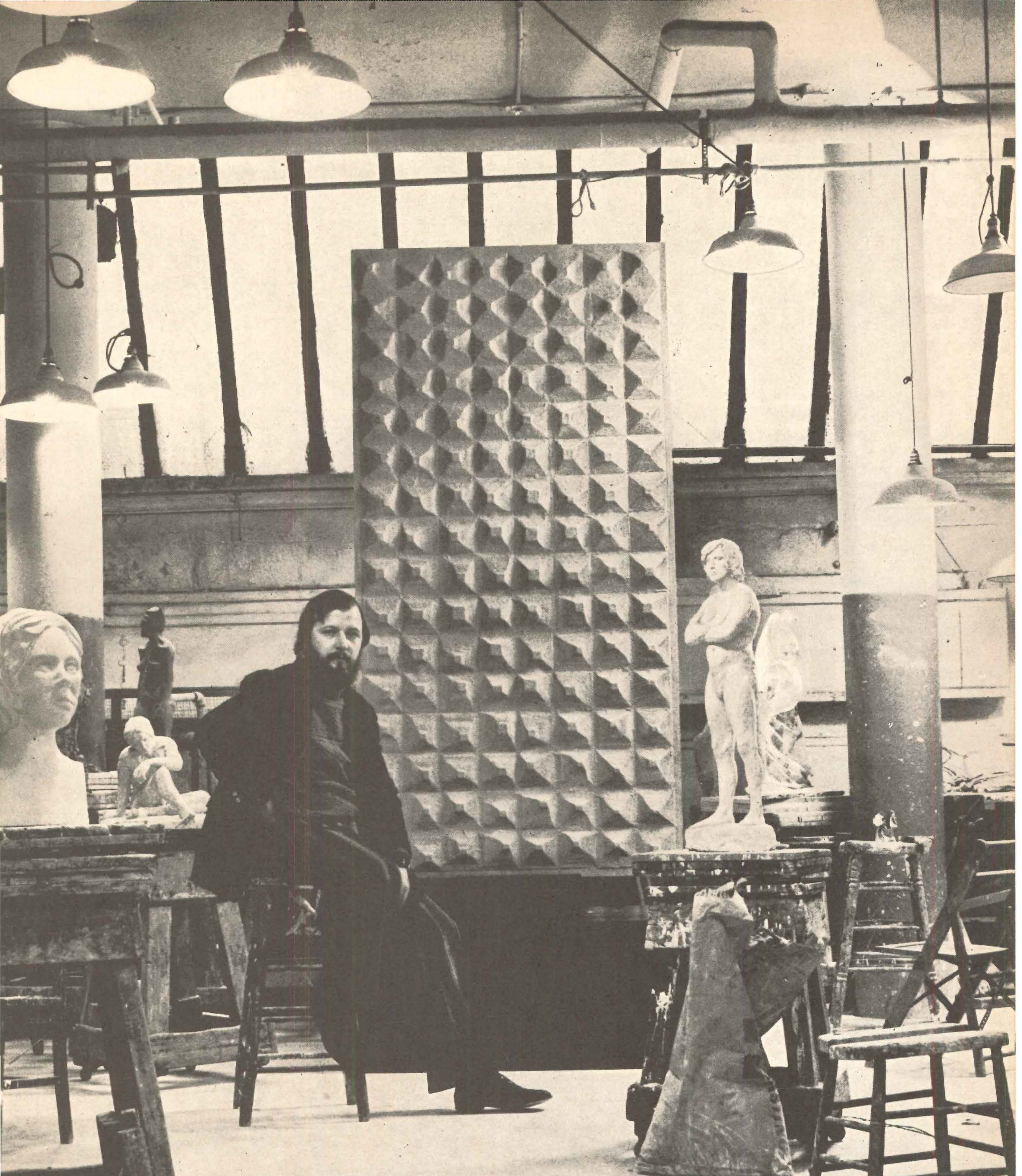

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